

**Essential components of training for ensuring
confident and effective medical practice in remote
settings**

by

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Abstract

Introduction: Remote and rural populations are at higher risk of diseases and mortality compared to urban populations (Royal College of Physicians, 2019) (Department for Environment Food & Rural affairs, 2022). Evidence suggests less efficacy and confidence among health providers in remote and rural regions despite dedicated training programs. This study aimed to identify the essential components of training required to prepare healthcare professionals for confident and effective medical practice in remote and rural settings using the following objectives:

- a. To understand the views of the experts across the world on the essential features required in training healthcare professionals working and about to work in remote and rural settings.
- b. To arrive at the consensus position for core training components to ensure confident and effective practice.

Methodology: An email-based 3 round Delphi methodology was used.

Round 1 had open ended questions on the most frequently used knowledge, skills and resources used in a Remote and Rural Healthcare set up.

Round 2 had themes generated from round 1 and agreement rating was sought.

Round 3 summarised findings from round 2 and asked for re-rating of the themes that did not reach consensus earlier. Quantitative triangulation was employed to support the consensus process, using mean agreement scores, % agreement levels, standard deviation and Inter Quartile range to assess convergence and variability.

Results: Round 1 resulted in 65 themes under the headings knowledge topics, useful skills and useful things in a course on remote and rural health/medical practice. Through iterative refinement and expert feedback, the themes were reduced to 58 in Round 2 and finalized to 41 in Round 3, representing strong consensus.

Conclusions: This research contributes to the limited body of literature on remote health education and demonstrates the value of combining qualitative thematic analysis with quantitative validation in Delphi studies.

Recommendations include integrating the consensus themes into training curricula, conducting regional validation studies, and promoting global collaboration in remote health education.

*Dedicated to
My lovely pets,
my husband (Sukesh),
Parents (Shiva Prasad &
Manjula),
my brother Narasimha
& revered teachers.*

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List of Abbreviations

AAFP: American Academy of Family Physicians
ACRRM: Australian College of Rural and Remote Medicine
AMED: Allied and Complementary Medicine Database
AMREF: African Medical and Research Foundation
BEME: Best Evidence in Medical Education
BMJ: British Medical Journal
CALs: Comprehensive Advanced Life Support
CARE Course: Comprehensive Approach to Rural Emergencies
CBE: Community-Based Education
CINAHL: Cumulative Index to Nursing and Allied Health Literature
CME: Continuing Medical Education
COBES: Community-Based Experience and Services
CPD: Continuing Professional Development
CPP: Community Participation Program
CRANaplus: Council of Remote Area Nurses of Australia
ECG: Electrocardiogram
EDCare: Emergency Department Care
EML: Essential Medicines List
ENT: Ear, Nose, and Throat
ERIC: Education Resources Information Center
EmONC: Emergency Obstetric and Newborn Care
FDA: Food and Drug Administration
GP: General Practitioner
HA: Health Assistant
HMIC: Health Management Information Consortium
IQR: Interquartile Range
LMIC: Low- and Middle-Income Countries
MBBS: Bachelor of Medicine, Bachelor of Surgery
MERSQI: Medical Education Research Study Quality Instrument
MOA: Memorandum of Agreement
NCD: Non-Communicable Diseases

NCRRM: National Centre for Remote and Rural Medicine
NGO: Non-Governmental Organization
NSW: New South Wales
PA: Physician Assistant
PBL: Problem-Based Learning
PD: Professional Development
PG: Postgraduate
PGDip/Cert: Postgraduate Diploma/Certificate
PHCW: Primary Health Care Worker
POCUS: Point-of-Care Ultrasound
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
R1/R2/R3: Round 1/ 2/ 3
RACGP: Royal Australian College of General Practitioners
RAG: Red-Amber-Green (rating system)
RFDS: Royal Flying Doctor Service
RHP: Rural Health Practitioner
RRH: Rural and Remote Health
Rx: Treatment
SCCT: Social Cognitive Careers Theory
SD: Standard Deviation
TBL: Team-Based Learning
UG: Undergraduate
UN: United Nations
UNICEF: United Nations International Children's Emergency Fund
USA: United States of America
WHO: World Health Organization
WONCA: World Organization of National Colleges, Academies and Academic Associations of General Practitioners/Family Physicians

Introduction

Introduction

"Rural health" refers to the health of people living in rural areas, which are generally located farther from healthcare facilities compared to urban areas (FDA Office of minority health and health equity, 2023). Remote health encompasses an amplification of the challenges seen in rural healthcare, including more isolated populations, dispersed and smaller communities, and higher proportions of indigenous and distinct cultural minority groups engaging in unique economic activities (Wakerman et al., 2017). People in these areas often face fewer employment opportunities, lower literacy rates and educational attainment, higher rates of tobacco and alcohol use, distinct cultural norms, and unique dietary habits. These populations primarily consist of older adults, people with disabilities, infants and children, veterans, individuals without health insurance, the unemployed, and those living in poverty (Department for Environment Food & Rural affairs, 2022).

Remote and rural populations are at higher risk of diseases and mortality compared to urban populations. In the developed world, the prevalent diseases in rural and remote regions are often lifestyle-related, such as non-communicable diseases (NCDs) and mental health issues. In contrast, in the developing world, health issues are predominantly driven by poverty-related healthcare decisions, women and child health challenges, communicable diseases, and rising risk factors for NCDs, alongside natural or environmental hazards. However, a common factor across all countries, regardless of their level of development, is the limited access to care in remote and rural areas. This is due to fewer health centres and medical facilities, as well as a shortage of skilled doctors and other healthcare providers (Royal College of Physicians, 2019) (Department for Environment Food & Rural affairs, 2022). The World Health Organisation (WHO) has advised countries to adopt broad strategies—namely educational interventions, regulatory interventions, financial incentives, and personal and professional support—to address these challenges and move towards Universal Health Coverage (World Health Organisation, 2020).

Review of Literature

Review of Literature

As of 2015, approximately 55% of the global rural population was neither protected by legislation nor affiliated with a health insurance scheme, with this figure rising to 83% in Africa and 56% in the Asia-Pacific region (Xenia Scheil-Adlung, 2015). The global shortage of skilled health workers is particularly acute in rural areas, accounting for 7 million out of a total deficit of 10.3 million health workers. This indicates that rural regions experience significantly greater health worker shortages than urban areas. Consequently, more than 50% of the global rural population lacks access to effective healthcare, compared to 24% of the urban population. In Africa, up to 77% of the population lacks access to healthcare due to the absence of essential health workers, followed by 75% in the Asia-Pacific region (excluding India and China).

Many factors influence the retention of health workers in rural areas. These factors can be at the individual level, such as gender, family situation, and age, and at the community level, such as difficult living and working conditions, recognition and participation, opportunities for career advancement, stimulating and challenging tasks, promotion prospects, and co-worker recognition (Ag Ahmed et al., 2020) (Manda Kenneth et al., 2023). To address this issue, countries have adopted four broad strategies recommended by the WHO: educational interventions, regulatory interventions, financial incentives, and personal and professional support for sustainability (World Health Organisation, 2020). Educational interventions include initiatives like the 'rural pipeline' (targeted recruitment and selection of students from rural areas), extended exposure to rural training during basic medical education, and postgraduate Continuing Professional Development (CPD) fellowships for doctors in remote areas, all of which have significantly improved retention (World Health Organisation, 2020) (Russell et al., 2021).

Systematic Review

Introduction

In our preliminary search, we found few studies that investigated training programs related to remote and rural health care, and these were mainly found from Australia and Canada. Systematic reviews on such training programs are very scarce. Manabu Saito et al (2022) reviewed the evaluation of post graduate rural medical training programs. Carole Reeve et al (2020) have tried to explore the purpose of these programs, the strategies implemented, and the outcomes observed. Continuing educational programs for remote and rural health providers were investigated by Wu et al. (2023). Raymond Guilbault RW and Vinson JA (2017) emphasised that medical students trained in underserved areas are more likely to be retained and provide primary care services to these populations. Through this study, we aim to contribute to the 'educational interventions' strategy proposed by the WHO.

In our overview of training programs around the world, we observed that the training programs varied across countries and continents. In Asia and Africa, training programs were conducted by their respective governments in collaboration with international organizations such as the WHO and United Nations International Children's Emergency Fund (UNICEF). Additionally, a significant amount of voluntary work by Non-Governmental Organisations (NGOs) from Europe and the USA has been observed in these regions. In Asia, most of the training occurred through university undergraduate, postgraduate, and residency programs, while in Africa, the training was more disease specific. In contrast, developed countries have well-established rural placement programs integrated into undergraduate and postgraduate curricula at some universities, aimed at retaining skilled healthcare workers in rural areas.

Though multiple studies have analysed the training programs incorporated in various medical schools, only a handful of systematic reviews exist that look at the perspectives of trainees on the training programs influencing their career choice to become rural health care practitioners. Hence, there is a lack of comprehensive data in remote and rural medical and health care. There were no reviews focused on the training components and modalities and their influence on the outcome or perspectives of the trainees and their efficiency on rural health care practice.

With our systematic review, we aimed

1. To get an overview of training programs present across the globe by understanding:

- a. the types of training programs and components present for health care professionals placed in or on the topic of rural and remote settings,
- b. the effectiveness of these programs in terms of Kirkpatrick hierarchy's outcomes.

Methodology:

Search Strategy:

An electronic search of the data bases (Academic search complete, AMED, British Education Index, CINAHL Ultimate, Education abstracts, educational administration abstracts, ERIC, Medline, Embase, Journals@Ovid and HMIC) on search platforms Ovid, Ebsco, PubMed and Scopus were conducted. The search was piloted with 15 terms initially to check for appropriateness of the search strategy which led to addition of further terms. A standardised search strategy was used with 25 search terms and their Boolean combinations. The final search was performed on June 20, 2023 with standardised search strategy using 25 search terms as follows: ("Training* Programs*" OR "Learning* Programs*" OR "Education* Programs*" OR "Courses*" OR "Classes*" OR "Curriculum*") AND ("Components*" OR "Contents*" OR "Modules*" OR "Course work*" OR "Subjects*" OR "Topics*") AND ("Remote medical care" OR "Rural medical care" OR "Remote healthcare" OR "Rural healthcare") AND ("Effectiveness*" OR "Efficacy*" OR "Efficiency*" OR "Impact*" OR "Effects*" OR "Outcomes*" OR "Results*" OR "Performance*" OR "Productivity*"). The full search strategy is provided in Supplementary Appendix 1. Papers identified through reference lists were also included. Auto deduplication was done in Medline and RefWorks.

Inclusion criteria:

- All the studies published in the form of original research, commentaries, editorials, project reports, short reports etc, that described or looked for education programs related to remote and rural healthcare provision, if there is an original contribution, were included.

Exclusion criteria:

- Studies where objectives focused on training methodology or technology used but not knowledge or skill outcome, mode of training delivery alone, trainings related to specific subjects or areas such as surgery, qualitative research, etc were excluded.
- All the articles that were reviews, discussions, viewpoints, opinions, cross-sectional surveys or book chapters were not included in the study.

- Studies where participants were not medical or paramedical students or health professionals were also excluded.

Steps followed to include the studies for review is shown in the Prisma flowchart (Page et al., 2021) in the figure 1.

Data extraction:

Data extraction form was prepared based on BEME Guidance (Hammick, Dornan & Steinert, 2010).

Data extracted included

- Article identification details such as title, authors, journal name, article type, year of publication and length of publication.
- Context (study setting, geographical location, study subjects: number and type)
- Details on educational intervention such as training type, method of training, duration, training components and effectiveness.
- Risk of bias in study methodology and
- Risk of bias in study reporting.

Data were entered into the latest version of Microsoft excel file followed by analysis and presentation.

Quality assessment:

A visual RAG (red, amber, green) ranking system was used to assess the risk of reporting for five areas: underpinning bias, resource bias, setting bias, educational bias and content bias. Articles were categorised as high quality with low risk of bias (green), unclear quality and risk or moderate risk (Amber) and low quality or high risk (red) (Table 1) (Gordon et al., 2020)

Table 1: Visual ranking system for Risk of Bias reporting

Bias source	High quality	Unclear quality	Low Quality
Underpinning bias (U)	Clear and relevant description of theoretical models or conceptual frameworks that underpin the development	Some limited discussion of underpinning, with minimal interpretation in the context of the study	No mention of underpinning
Resource bias (R)	Clear description of the cost / time /resources needed for the development	Some limited description of resources	No mention of resources
Setting bias (S)	Clear details of the educational context and learner characteristics of the study	Some description, but not significant as to support dissemination	No details of learner characteristics or setting
Educational bias (E)	Clear description of relevant educational methods employed to support delivery	Some educational methods mentioned but limited detail as to how applied	No details of educational methods
Content bias (C)	Provision of detailed materials (or details of access)	Some elements of materials presented or summary information	No educational content presented

To assess the quality of study methodology, Medical Education Research Quality Instrument (MERSQI) was used (Cook, Reed, 2015). Scores were given to various items such as study design, sampling, type of data, validity evidence for the evaluation instrument scores, data analysis and outcomes. Frequencies of scores for each item was measured.

Synthesis of evidence: A descriptive synthesis of the included studies was done from the extracted data. A visual summary of data was provided as required. The narrative summary described type of articles, timing of publication, setting, location of the intervention, the type and number of participants, type of program (undergraduate/postgraduate/ Professional development), educational materials and outcomes. Outcomes were summarised in accordance with Kirkpatrick’s model of evaluation. Summary of risk of bias of the study methodologies and reporting was provided.

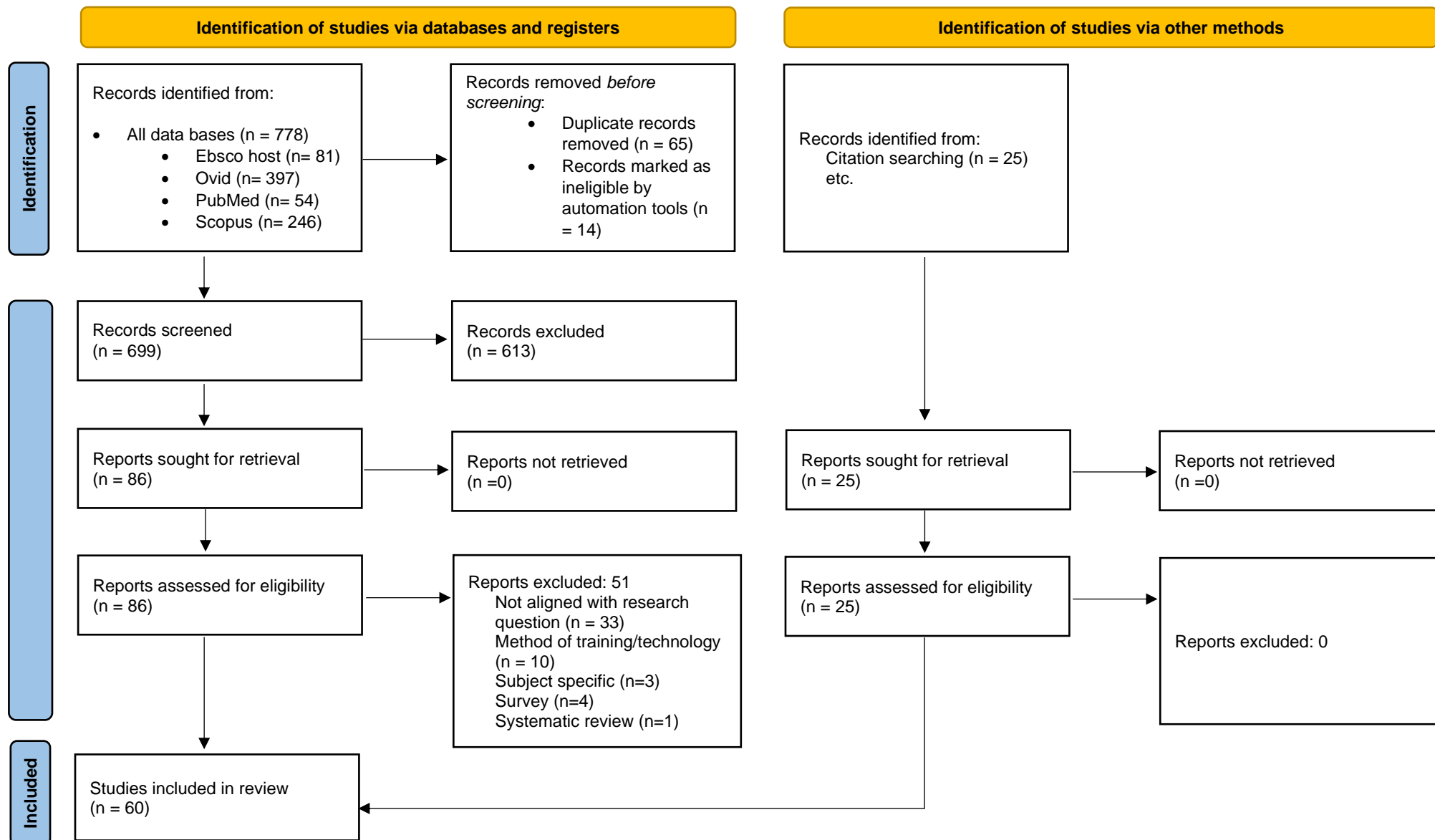


Figure 1 PRISMA flow diagram for a new systematic review of studies

Results:

A total of 778 articles were identified through database searching. After deduplication and removal of ineligible articles 699 remained. These were screened by title and abstract and 613 articles were excluded leaving 86 studies that were identified for full text screening. Following this, 51 of 86 were excluded as per the exclusion criteria for the review. Hence, 35 were included in the review. There were 25 articles added through citation searching leading to a total of 60 articles included in the final analysis (Figure 1).

Geographic origin of studies, year of publication

The majority of the studies were from North America (43%), followed by Oceania (30%), Asia (11.7%), Africa (10%) and Europe (5%) (Figure 2). Figure 3 shows that the first study on training in remote and rural medicine was reported in 1995 (Erkel, Nivens & Kennedy, 1995), it was an interprofessional training in North America. The number of studies published showed a gradually increasing trend up to 2009 followed by fluctuations in the subsequent years. The highest number of studies were reported in the year 2012 (n=6).

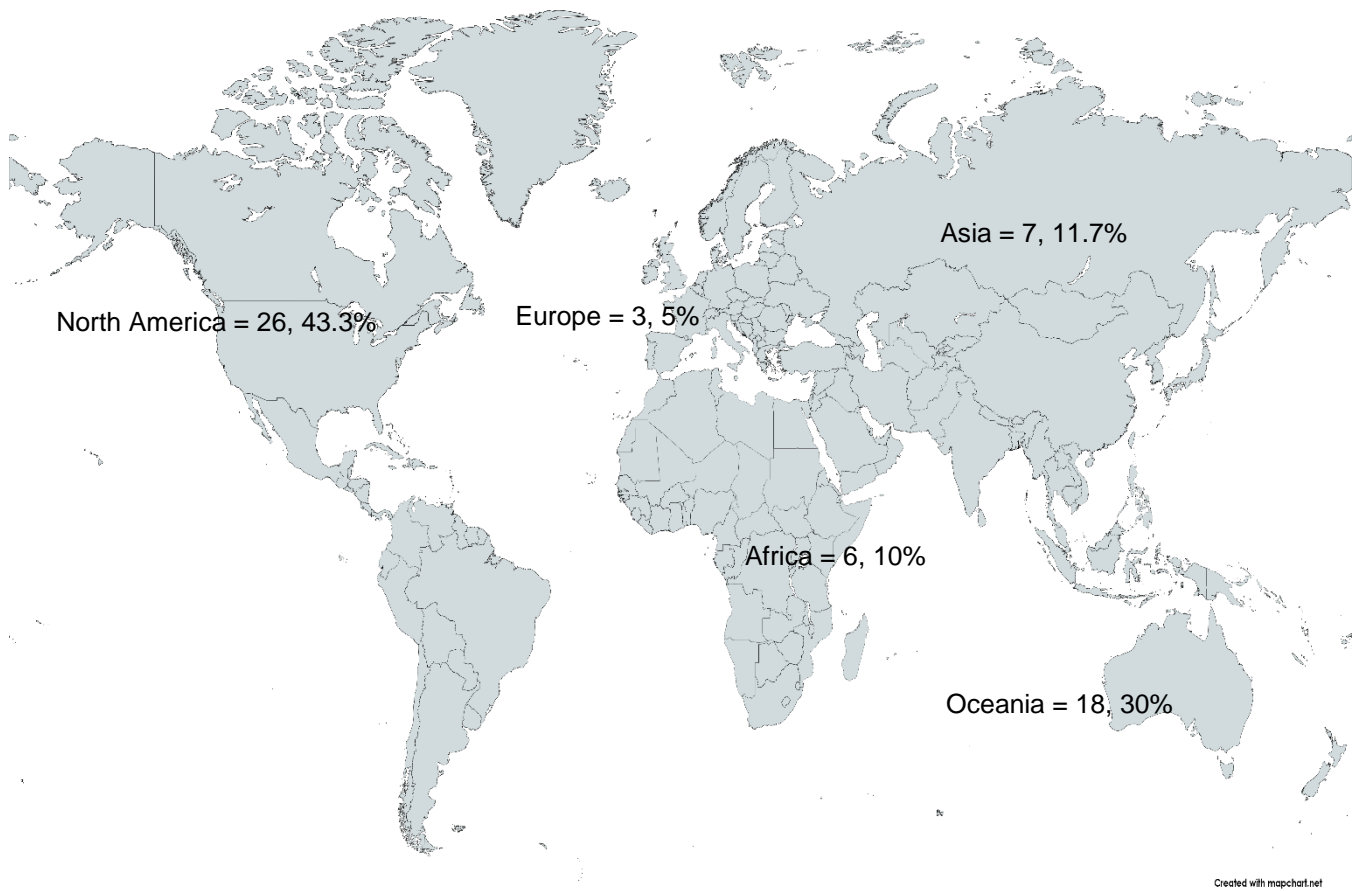


Figure 2: Distribution of the studies on remote and rural medicine and healthcare

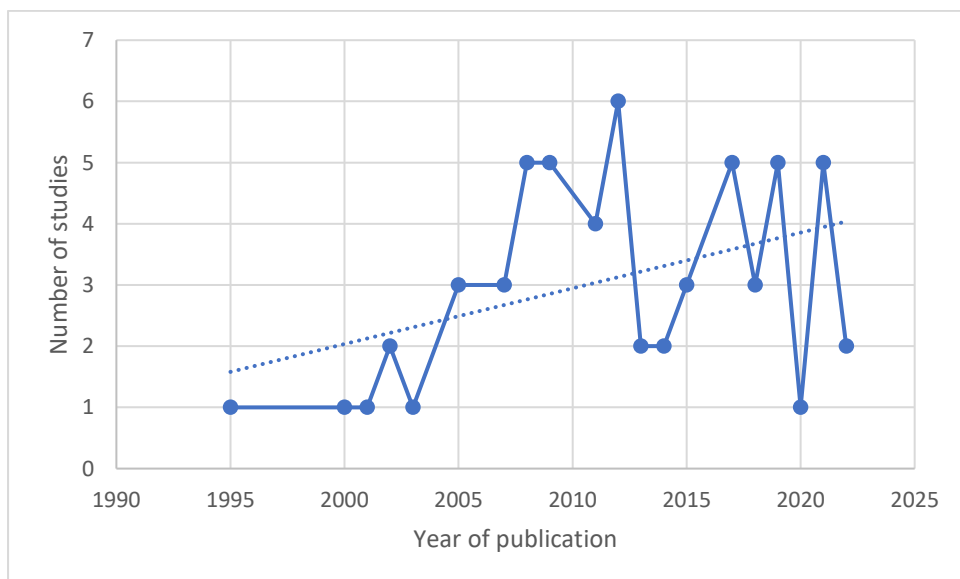


Figure 3: Number of studies published across the years

Level of programs, disciplines and participants

Broadly, the programs were conducted at the levels of undergraduate(UG) (n=38, 63.3%), foundation years (n=1, 1.7%), post-graduate (PG) level (n=6, 10%), PG diploma/Certificate courses (n=1, 1.7%), PG Vocational training (n=1, 1.7%) and Continuing Medical Education (CME)/ Professional Development (PD) (n=13, 21.7%) (Figure 4).

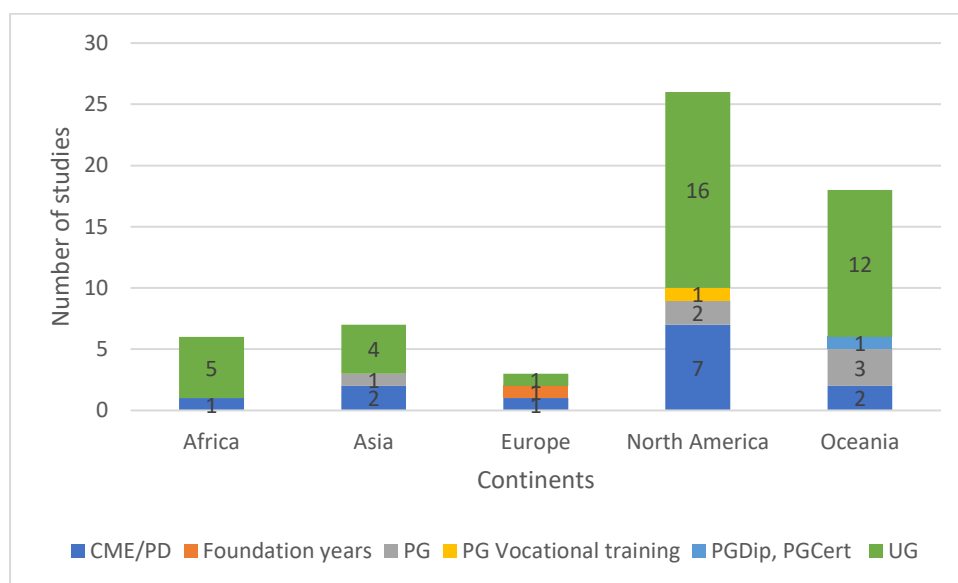


Figure 4: Distribution of studies according to the levels of training programs across continents

The programs were conducted in the disciplines of medicine, interprofessional and allied health professionals. Among allied health professionals, the study subjects varied from health workers to students/ professionals from dental, social work, clinical associate, occupational therapy and pharmacy disciplines (Figure 5).

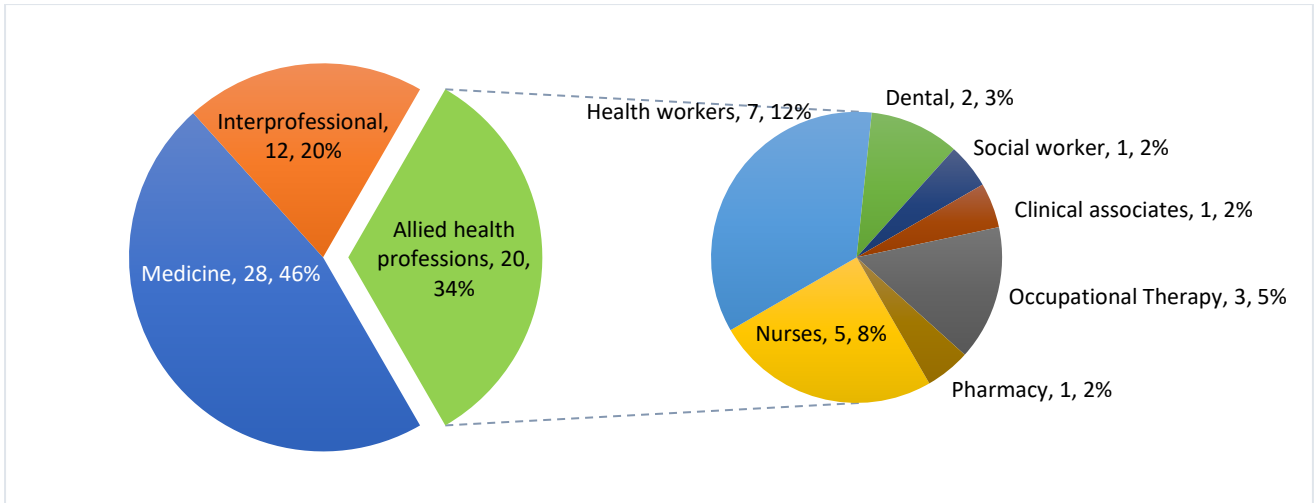


Figure 5: Classification of studies based on discipline of study subjects

The sample sizes of the studies ranged between 3 (Kenny et al.) and two thousand eight hundred and twenty-three (MacDowell Martin, Glasser Micheal & Hunsaker Matthew, 2013) (Figure 6). There were 26 studies with sample size less than hundred. 9 studies had sample size between hundred and one and one hundred ninety-nine and 18 studies had sample size above two hundred. 7 studies did not mention about the sample size (Blattner et al., 2017) (Hammick, Dornan & Steinert, 2010) (Pedersen, Kathy M. P. A. S., P.A.C. et al., 2015) (Thomson, P., 2021) (Mayne, Glascoff, 2002) (Clark et al., 2015) (Keahey, 2008).

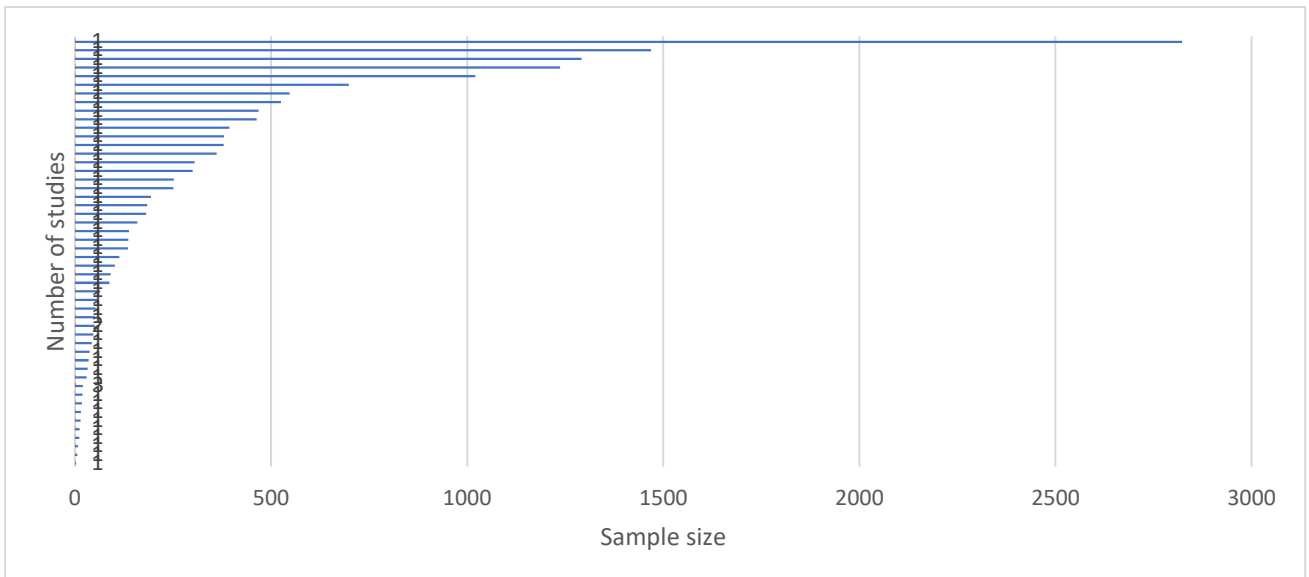


Figure 6: Number of participants in the studies

Study designs, type and length of articles

There were 16 qualitative and 8 quantitative study designs. Cohort design was used in 3 studies, one study each had Randomised Controlled trial and chart review design respectively. Sixteen studies were descriptive, 13 had mixed methods and two studies were program evaluations. 45 studies were published as original research on trainings. One study each were published under the sections- review, short report, research report, policy report, brief report, opinion, focus, feature article, curriculum and conference proceedings in various journals. Studies which focused on curriculum design were published as commentaries (n=2) and project reports(n=3) (Figure 7). Original research articles were in about 4 to 20 pages, commentaries were in 6 pages length, reports were published between 2 and 12 pages.

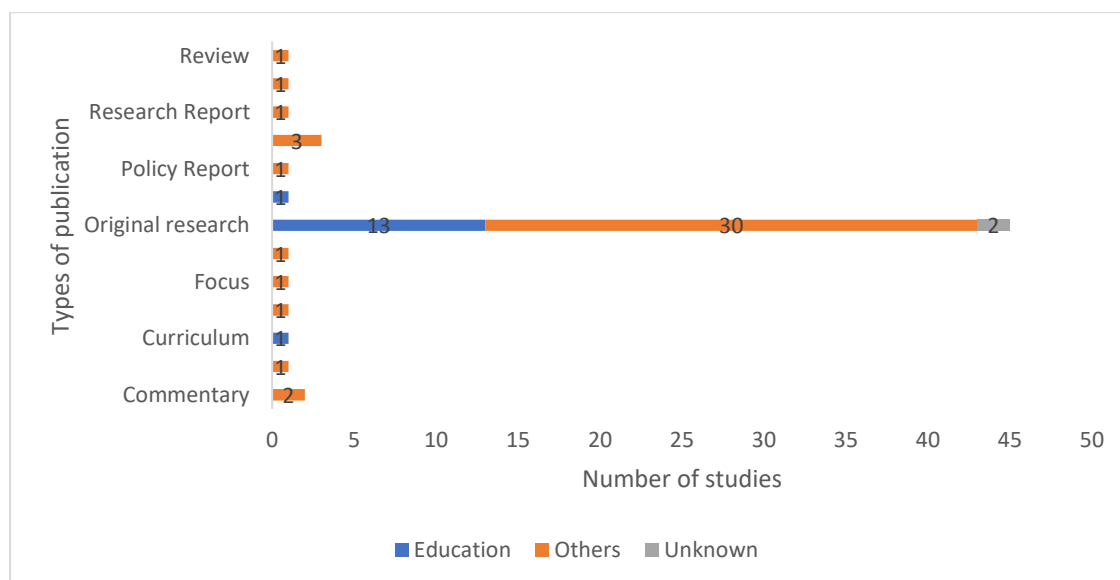


Figure 7: Number of studies as per the types of publications and journals

Journal types

A quarter of the 60 studies were published in education related journals such as BMC medical education (n=3), Education for Health (n=1), Education for Primary Care (n=1), Journal of Medical Education and Curricular Development (n=1), Journal of Nursing Education (n=1), Medical Education (n=2), Medical Teacher(n=1), Nurse Educator(n=1), Teaching and learning in Medicine (n=2) and The Journal of Physician Assistant Education (n=2). For two articles (Geller et al., 2002) (Salvatori, Penny S. Dip P. &O. T. M. H. Sc, Berry, Sue C. Dip P. T. M. C. E. & Eva, 2007) published in the journal named "Learning in health and social care", the journal details could not be found in their

website. About 72% of the studies were published in non-education related journals namely, Remote and rural health (n=9), South African family practice (n=3), Academic medicine (n=3), Canadian Journal of Rural Medicine (n=2), Journal for Nurses in staff development (n=2), The Australian Journal of Rural health (n=2) and one article was published in African journal of primary healthcare and family medicine, American journal of health-system pharmacists, Australian Journal of Rural Health, Australian Nursing and Midwifery Journal, European Journal of Dentistry, Faculty Dental Journal, Indian Journal of Community Medicine, International nursing review, Journal of Agromedicine, Journal of Allied Health, Journal of clinical nursing, Journal of interprofessional care, Journal of medical Internet research, Journal of Multidisciplinary Healthcare, Journal of Primary Health Care, Journal of Rural Health, Nursing Inquiry, Prehospital emergency care, Social work in healthcare, The American Journal of Occupational Therapy, The journal of medical investigation and The Journal of Rural health each (Figure 8).

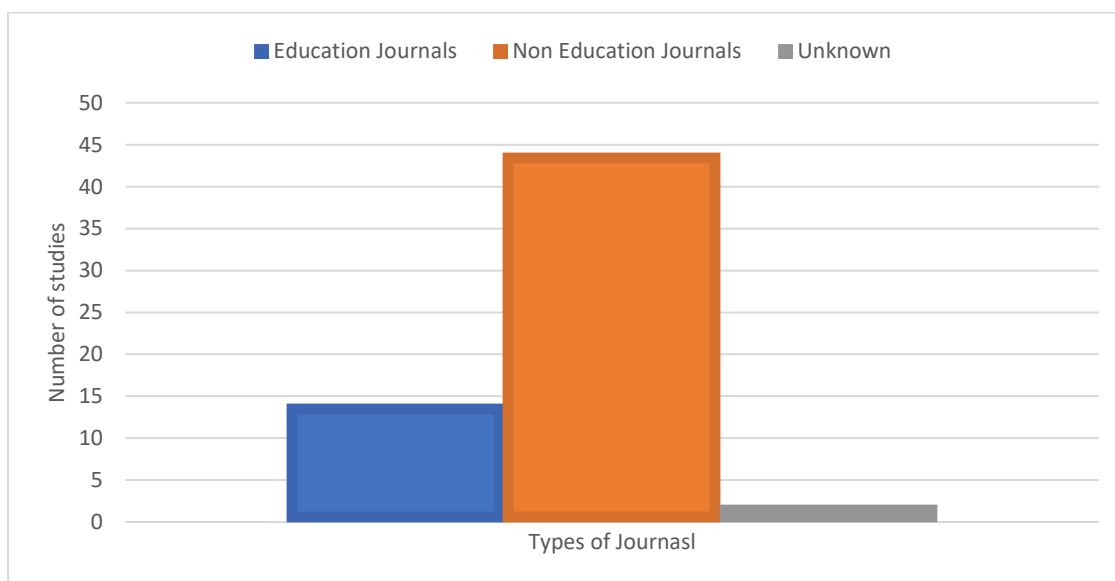


Figure 8: Classification of studies as per the type of journals

Sites of development and implementation of training programs

The majority of programs (n=48, 80%) were developed in universities and implemented at a community level. One study was conducted at provincial level in Canada. It was a CME/PD program where GPs and medical office assistants were trained. One study each were conducted at country level (CME/PD) and Health centre/university level (UG Program). The rest of the studies were conducted at health

centres (n=5) and hospitals (n=3) and were mostly CME/PDs (3 were in health centres and 2 in hospitals) (Figure 9).

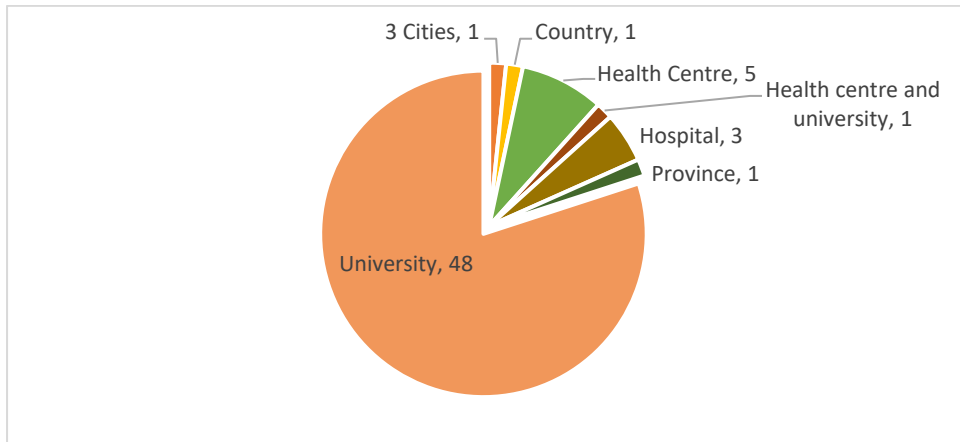


Figure 9: Distribution of educational program development and implementation sites

Duration of trainings, mode of delivery and instruction methods

Duration of the programs were not specified/ nor clear in 10 studies. The duration varied widely from 2 hours to 5 years based on the program type (Figure 10).

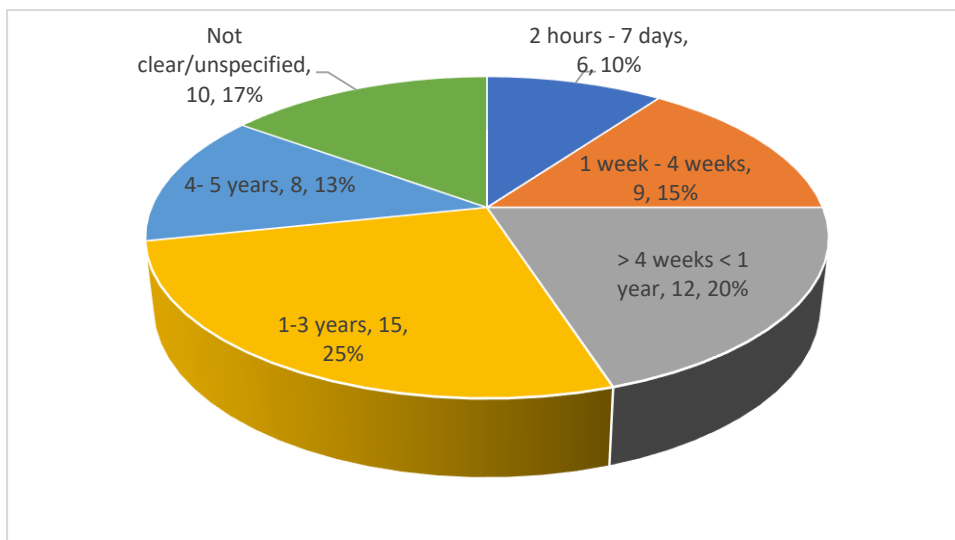


Figure 10: Duration of training programs

The majority of the programs delivered in-person trainings (n=41, 68.3%) followed by blended approach of distance and in-person training (n=11, 18.3%). The program delivery method was not mentioned in five studies (Figure 11).

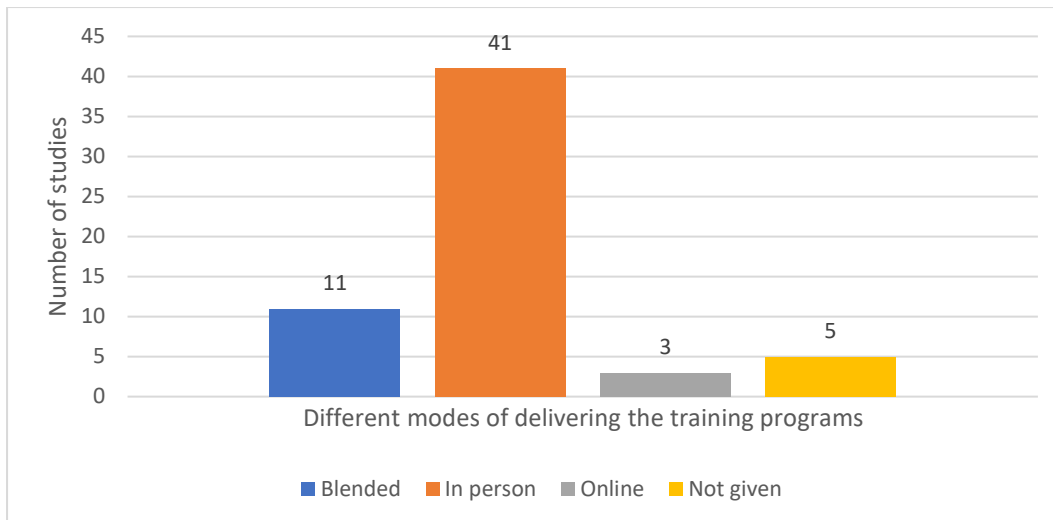


Figure 11: Distribution of studies as per the modes of training programs

Methods of instruction included traditional methods such as didactic lectures, presentations, assignments. Many programs also adopted sophisticated learning mechanisms such as discussions, procedural skills, work integrated learning/ experiential learning/ service learning, small group learning, team-based learning, problem-based learning, preceptorship/mentorship and community-based education and services (COBES).

Theoretical underpinnings mentioned.

‘Theory’, in this study, broadly includes any established theories, frameworks, principles, models, concepts and approaches used or considered while developing the training program. There were 21 studies that mentioned the underpinning concepts for the development of respective training programs. They have used theories such as community-based education (Clinical and medical), complexity theory, Social cognitive careers theory, social foundations of medicine, principles of primary healthcare, integrations of context of care with selected healthcare delivery models, hypothetico-deductive reasoning, chronic care model, Benner’s theory/framework, concept-based curriculum approach, Ericsson’s theory of expertise, Kern’s six-step model and Principles of adult learning by Knowles. The studies often cited instructional approaches (e.g., Team Based Learning, Problem Based Learning), although did not include any explicit description of underpinning theory. Sometimes more than one theory and approach were applied and adopted.

While not all studies used the term 'Kirkpatrick's outcomes,' 57 studies (95%) reported them.

Quality assessment/risk of bias

Risk of bias in study reporting

The risk of reporting bias was evaluated using the RAG tool for all the studies (Gordon et al., 2020). Reporting quality was low to average across studies and correlated with both the length and type of articles. About ten (17%) studies were of high-quality (green) regarding theoretical underpinning with majority (n=38, 63%) rated as poor (red). Only three studies out of 60 were determined as having low risk of bias in 4 domains. The domains identified at highest risk of bias were resource and underpinning with 51 (85%) and 38 (63%) studies not reporting (i.e. red), respectively. Setting, education and content were more often found to be at lower risk of bias (i.e., green) with 51 (85%), 44 (73%) and 36 (60%) respectively (Figure 12).

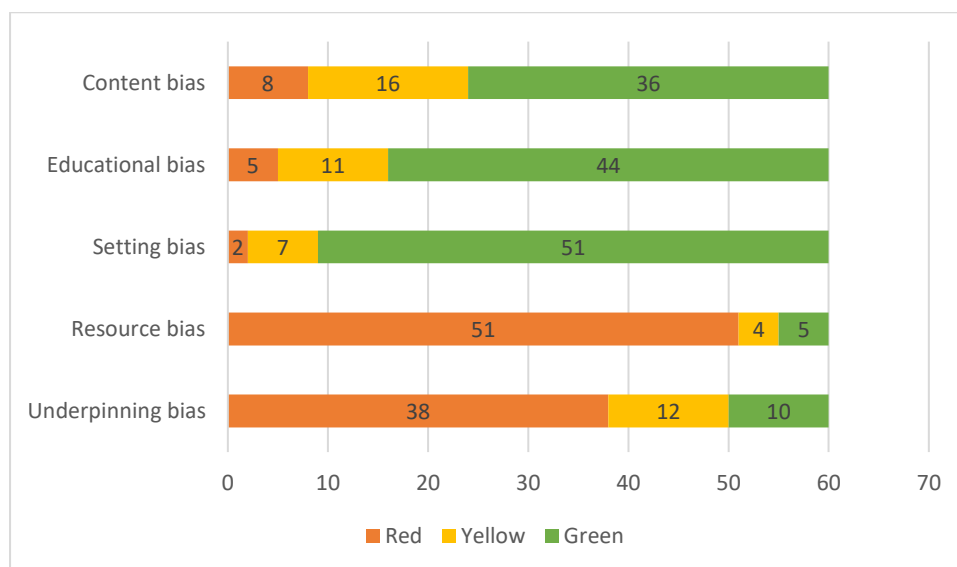


Figure 12: Risk of bias of reporting medical education studies

The reports focussed principally on educational design and delivery, rather than thoroughly assessing the outcomes of educational interventions or development. The detailed reporting bias of each study is given in the table 2.

Table 2 : Risk of Bias in reporting the study

Educational studies focused on Medicine							
Study no.	Authors, year of publication [Ref]	Title of the study	Underpinning Bias	Resource Bias	Setting Bias	Educational Bias	Content Bias
1	(Tani et al., 2005)	Evaluation of primary care practice in the university of Tokushima	Red	Red	Green	Green	Yellow
2	(Newbury Jonathan et al., 2005)	Development of 'rural week' for medical students: impact and quality report	Red	Red	Green	Green	Green
3	(Dowell Anthony, Crampton Peter & Parkin Chris, 2001)	The first sunrise: an experience of cultural immersion and community health needs assessment by undergraduate medical students in New Zealand	Yellow	Yellow	Green	Green	Yellow
4	(Ross, Cameron & Greenwood, 2019)	A Qualitative Investigation of the Experiences of Students and Preceptors Taking Part in Remote and Rural Community Experiential Placements During Early Medical Training	Red	Red	Green	Green	Green
5	(Thompson et al., 2017)	Views from the field: Medical student experiences and perceptions of interprofessional learning and collaboration in rural settings	Green	Red	Green	Green	Yellow
6	(Diab, Mcneill & Ross, 2014)	Review of final-year medical students' rural attachment at district hospitals in KwaZulu-Natal: student perspectives	Yellow	Red	Green	Green	Green
7	(Naidu, Claudia S. et al., 2012)	An evaluation of University of Cape Town medical students' community placements in South Africa	Yellow	Red	Green	Green	Green
8	(Navinan, Mitrakrishnan Rayno, Wijyaratne & Rajapakse, 2011)	Final-Year Medical Students' Perceptions Regarding the Curriculum in Public Health	Yellow	Red	Green	Green	Green
9	(Amalba et al., 2019)	Trainees' preferences regarding choice of place of work after completing medical training in traditional or problem-based learning/community-based education and service curricula: a study in Ghanaian medical schools	Green	Red	Green	Green	Green

10	(Holst, Normann & Herrmann, 2015)	Strengthening training in rural practice in Germany: new approach for undergraduate medical curriculum towards sustaining rural health care						
11	(MacDowell, Glasser & Hunsaker, 2013)	A decade of rural physician workforce outcomes for the Rockford Rural Medical Education Program, University of Illinois						
12	(Quinn et al., 2011)	Influencing Residency Choice and Practice Location Through a Longitudinal Rural Pipeline Program						
13	(Naidu, C. S., Irlam, 2014)	Evaluating the rural health placements of the Rural Support Network at the Faculty of Health Sciences, University of Cape Town						
14	(Lee et al., 2011)	Initial evaluation of rural programs at the Australian National University: understanding the effects of rural programs on intentions for rural and remote medical practice						
15	(Worley et al., 2000)	The Parallel Rural Community Curriculum: an integrated clinical curriculum based in rural general practice						
16	(Eley, Baker, 2009)	The Value of a Rural Medicine Rotation on Encouraging Students Toward a Rural Career: Clear Benefits From the RUSC Program						
17	(Glasser et al., 2008b)	A Comprehensive Medical Education Program Response to Rural Primary Care Needs						
18	(Waslowski, Paton, Freymond, Patel, Brownrigg, Olesovsky & Nyhof-Young, 2021)	Evaluation of a pilot rural mentorship programme for and by pre-clerkship medical students						
19	(Yahata Shinsuke et al., 2020)	Long-term impact of undergraduate community-based clinical training on community healthcare practice in Japan: a cross-sectional study						
20	(Eley Diann et al., 2008)	Developing a Rural Workforce Through Medical Education:Lessons From Down Under						

21	(Rourke et al., 2017)	From pipelines to pathways : the memorial experience in educating doctors for rural generalist practice					
22	(J Cleland et al., 2012)	Attracting healthcare professionals to remote and rural medicine: Learning from doctors in training in the north of Scotland					
23	(Blattner et al., 2017)	A targeted rural postgraduate education programme – linking rural doctors across New Zealand and into the Pacific					
24	(Heng, Pong, Chan et al., 2007)	Graduates of northern Ontario family medicine residency programs practise where they train					
25	(Blattner Katharina et al., 2022)	New Zealand postgraduate medical training by distance for Pacific Island country-based general practitioners: a qualitative study					
26	(Rourke James et al., 2018)	Does rural generalist focused medical school and family medicine training make a difference? Memorial university of Newfoundland outcomes					
27	(VanRooyen, Michael J. et al., 2009)	Training military medics as civilian prehospital care providers in southern sudan					
28	(MacCarthy et al., 2012)	Improving primary care in British Columbia, Canada: evaluation of a peer-to-peer continuing education program for family physicians					
Interprofessional educational studies							
Study no.	Authors, year of publication [Ref]	Title of the study	Underpinning Bias	Resource Bias	Setting Bias	Educational Bias	Content Bias
29	(Opina-Tan, 2013)	A pilot implementation of interprofessional education in a community-academe partnership in the Philippines					
30	(Fertman, Carl I. et al., 2005)	Challenges of Preparing Allied health professionals for interdisciplinay practice in rural areas					
31	(Florence et al., 2007)	Rural Health Professions Education at East Tennessee State University: Survey of Graduates From the First Decade of the Community Partnership Program					

32	(Bolte, Bennett & Moore, 2012)	ENRICHing the rural clinical experience for undergraduate health science students: A short report on inter-professional education in Broken Hillajr					
33	(Erkel, Nivens & Kennedy, 1995)	Intensive Immersion of Nursing Students in Rural Interdisciplinary Care					
34	(Geller et al., 2002)	Interdisciplinary health professional education in rural New Mexico: a 10 year experience					
35	(Mayne, Glascoff, 2002)	Service Learning Preparing a Healthcare Workforce for the Next Century					
36	(Lennon-Dearing et al., 2008)	A Rural Community-Based Interdisciplinary Curriculum: A Social Work Perspective					
37	(Salvatori, Penny S. et al., 2007)	Implementation and evaluation of an interprofessional education initiative for students in the health professions					
38	(Lenthall et al., 2021)	Preparing nurses to work in remote health practice: Evaluation of a post-graduate program					
39	(Pedersen, Kathy et al., 2015)	Human Resources for Health: A Needs Assessment of the Nepal Health Assistant – A Physician Assistant Analogue?					
40	(Woltenberg, Leslie N. M. S. Ed et al., 2021)	Making a Case for Multimodal IPE: Developing a Competency-Based Interprofessional Curriculum for Health Professions Learners at Rural Campuses					
Educational studies of various allied health professions							
Study no.	Authors, year of publication [Ref]	Title of the study	Underpinning Bias	Resource Bias	Setting Bias	Educational Bias	Content Bias
41	(Wolfgang et al., 2019)	Immersive placement experiences promote rural intent in allied health students of urban and rural origin					
42	(Fitzpatrick et al., 2019)	Learning about Aboriginal health and wellbeing at the postgraduate level: novel application of the Growth and Empowerment Measure					

43	(Hill et al., 2018)	The road to registration: Aboriginal and Torres Strait Islander health practitioner training in north Queensland					
44	(Barker et al., 2021)	Evaluation of the Allied Health Rural Generalist Program 2017- 2019					
45	(Banks et al., 2011)	Flying Start NHS: easing the transition from student to registered health professional					
46	(Mehanni et al., 2019)	Transition to active learning in rural Nepal: an adaptable and scalable curriculum development model					
47	(Zhan, Zhang, Sun, Liu, Peng, Zhang & Yan, 2017)	Effects of Improving Primary Health Care Workers' Knowledge About Public Health Services in Rural China: A Comparative Study of Blended Learning and Pure E-Learning.					
48	(Kenny et al., 2004)	Why 4 years when 3 will do? Enhanced knowledge for rural nursing practice					
49	(Schuelke, Ellermeier, 2022)	Agricultural Safety and Health Curriculum: Preparing the Next Generation of Rural Nurses					
50	(Floyd Barbara O'Malley, Kretschmann Sue & Young Heather, 2005)	Facilitating Role Transition for New Graduate RNs in a Semi-Rural Healthcare Setting					
51	(Clark et al., 2015)	Strengthening healthcare delivery in Haiti through nursing continuing education					
52	(Keahey, 2008)	Against the Odds Orienting and Retaining Rural Nurses					
53	(Brockwell, Wielandt & Clark, 2009)	Four years after graduation: Occupational therapists' work destinations and perceptions of preparedness for practice					
54	(Brandt, 2014)	From Collaboration to Cause: Breaking Rural Poverty Cycles Through Educational Partnerships					
55	(Smallfield, Anderson, 2008)	Addressing Agricultural Issues in Health Care Education: An Occupational Therapy Curriculum					

		Program Description					
56	(Thomson, Peter, 2021)	Return to Oz: regional, rural, remote and relevant! by Peter Thomson What is the state of dental education in Australia?					
57	(Johnson, Blinkhorn, 2012)	Assessment of a dental rural teaching program					
58	(Baca et al., 2017)	A new health care profession in rural district hospitals: a case study of the introduction of Clinical Associates in Shongwe hospital					
59	(Scott, Mollie Ashe et al., 2017)	Creating a new rural pharmacy workforce: Development and implementation of the Rural Pharmacy Health Initiative					
60	(Cunningham, Vande Merwe, 2009)	Virtual grand rounds: a new educational approach in social work that benefits long-term care providers and patients in rural Idaho					

Risk of bias in study methodology

Methodological rigor was assessed using the medical education research study quality instrument, MERSQI (Cook, Reed, 2015) , which revealed lower scores across domains such as study design, institutions, type of data, validity for evaluation instrument and data analysis sophistication (Table 3). Since the MERSQI was applied to all study methodologies, not just experimental, quasi-experimental or observational studies, there were some gaps (i.e., not applicable (N/A)) in various domains of scoring. Additionally, brevity in reporting of some studies (e.g., commentaries, brief reports) limited description of some items and missing items received a score of 0. An analysis of the categories revealed several patterns in the data (Table 2). Single group cross-sectional study designs were the most common (n = 43, 71.6%). Fourteen (23.3%) utilized a nonrandomized two group design, two (3.3%) used a single group pre-post design, and one (1.7%) reported on a randomized control trial. Fifty-one studies (85%) sampled only one institution and six studies (10%) sampled more than two institutions. Sampling response rates were reported in 8 (13.3%), 30 (50%), and 5 (8.3%) studies with response rates of < 50%, 50%-74% and > 75% respectively. For one study (1.7%) a sampling response rate was deemed N/A. Sampling response rate was not reported in 16 studies (26.7%).

Type of data presented focused on assessment by study participants in 27 (45%) studies, whereas 20 (33.3%) studies presented objective data, and in thirteen (21.7%) it was not described. Validity evidence for study instrument was not described in 42 studies (70%) indicating the domain with high scope for future improvement on methodological assessment. Data analysis sophistication was low and mostly descriptive. Eighteen studies (30%) performed tests of statistical inference. Outcomes in 21 studies (35%) focused on knowledge and skills, whereas 13 (21.7%) studies noted changes in satisfaction, attitudes, perceptions, general facts and behaviours respectively. Patient/healthcare outcome was examined in 10 studies (16.6%).

Table 3: Risk of bias in medical education study methodologies

	MERSQI Item and options	MERSQI Score	n	%
1	Study design			
	Single group cross-sectional or single group post-test only	1	43	71.67
	Single group pre-test & post-test	1.5	2	3.33
	Nonrandomized, 2 groups	2	14	23.33
	Randomized controlled trial	3	1	1.67
2	Institutions studied			
	1	0.5	51	85.00
	2	1	3	5.00
	> 2	1.5	6	10.00
3	Response rate, %			
	Not applicable (NA)	NA	1	1.67
	Not reported	0	16	26.67
	< 50	0.5	8	13.33
	50-74	1	30	50.00
	> 75	1.5	5	8.33
4	Type of data			
	Not described (ND)	ND	13	21.67
	Assessment by participants	1	27	45.00
	Objective measurement	3	20	33.33
5	Validity evidence for evaluation instrument			
	NA	NA	3	5.00
	Not described	0	42	70.00
	Content	1	11	18.33
5	Validity evidence for evaluation instrument			
	Internal structure	2	2	3.33
	Relationships to other variables	3	2	3.33
6	Data analysis sophistication			
	ND	0	12	20.00
	Descriptive analysis only	1	30	50.00
	Beyond descriptive analysis	2	18	30.00
7	Appropriateness of data analysis:			
	No	0	12	20.00
	Appropriate for study design, type of data	1	48	80.00

	MERSQI Item and options	MERSQI Score	n	%
8	Outcomes			
	Satisfaction, attitudes, perceptions, opinions, general facts	1	13	21.67
	Knowledge, skills	1.5	21	35.00
	Behaviours	2	13	21.67
	Patient/health care outcome	3	10	16.67
	No outcome described	0	3	5.00

Training components and outcomes of the studies

Among the twenty-eight studies on training programs for medical students, 21 were at under-graduate level. Of these, seven UG level medical programs were from North America, followed by Oceania (n=6), Africa (n=4), Asia (n=3) and Europe (n=1). There was one study of foundation year post MBBS program from Europe and a PG Diploma/Cert course for medical students at Oceania. One PG program each at North America and Oceania, one PG vocational training program from North America and one study each on CME / PD trainings were reported at North America and Africa. Rourke J et al (2017) did not evaluate the program in their study. There was no notable impact from the training program in the study conducted by Shinsuke Yahata et al (2020).

Five studies attempted to evaluate all the levels of Kirkpatrick's hierarchy. Four studies investigated long term effects of the training exclusively and found that more than half of the participants were working or at least worked for major duration of their careers in the rural areas or areas nearer to their hometowns and preceptorship communities (Glasser et al., 2008) (Quinn et al., 2011b) (Heng, Pong, Chan, Benjamin T. B. M. P. A. et al., 2007) (Rourke et al., 2018). A study by Ross et al (2019) shows that the participants were mostly not preferring rural practice. Similar opinion was given in another study (Table 4).

Table 4: Details of educational studies focused in medicine

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
1	(Tani et al., 2005)	University	Asia	56	Students: Medicine	UG	2 hours - 7 days	Procedural skills	In person		Intensity for interest in community and remote area medicine increased by 12 and 19 points on Visual Analogue Scale (VAS) respectively after the practice. Understanding about community and remote area medicine increased by 23 and 18 points respectively after the training and the students who feel worthy to practice community and remote area medicine increased by 15 and 11 points respectively. Will to work increased by 14 points after training.
2	(Newbury Jonathan et al., 2005)	University	Oceania	300	Students: Medicine	UG	1 week - 4 weeks	Procedural skills, discussions, Problem based learning	In person		Informative Learning, understanding of rural medical placements and practice, cultural awareness issues, awareness on common local health problems, communication skills, teamwork

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
3	(Dowell Anthony, Crampton Peter & Parkin Chris, 2001)	University	Oceania	51	Students: Medicine	UG	1 week - 4 weeks	Procedural skills	In person	Community based medical education	Very valuable, Understood the Māori people and their way of life and health needs, their attitudes to life, Care about them and their health and concerns, rapport build up
4	(Ross, Cameron & Greenwood, 2019)	University	North America	20	Students: Medicine	UG	> 4 weeks < 1 year	Preceptors hip	In person		Great experience, joyful, got a lot better at communicating with patients, first clinical experience, wide range of clinical exposure, lot of learning on basics of medicine, Teamwork. But mostly not preferring rural practice
5	(Thompson et al., 2017)	University	North America	47	Students: Medicine	UG	1-3 years	Experiential learning	In person	Complexity theory	Role flexibility within rural interprofessional collaborations, understood existing gaps and challenges in the existing healthcare environment, unstructured interprofessional learning by face-to-face communication, Resilience was manifest in the actions of interprofessional team as

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
											the students believed that not all professionals may be qualified for certain roles
6	(Diab, Mcneill & Ross, 2014)	University	Africa	182	Students: Medicine	UG	1 week - 4 weeks	Team based learning	Blended	Community based medical education	Very important for gaining practical skills, learnt skills and refresh knowledge, know better referral systems, research methods, interprofessional collaborations/teamwork, exposed to different aspects of medicine, like resource management, Part of multidisciplinary team, updating the treatment protocols
7	(Naidu, Claudia S. et al., 2012)	University	Africa	64	Students: Medicine	UG	> 4 weeks < 1 year	Didactic lectures, procedural skills	In person	CBE	Awesome and self-reflecting and great learning experience, Confident in research and health promotion skills, interpretation skills
8	(Navinan, Mitrakrishnan Rayno, Wijayarathne & Rajapakse, 2011)	University	Asia	184	Students: Medicine	UG	4- 5 years	lectures, presentations, small group discussions, experiential learning	In person	CBE	Enjoyable, identifying significant health issues, research methodology and biostatistics, small group learning, working in teams, prepared and competent to work in the community

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
9	(Amalba et al., 2019)	University	Africa	525	Students: Medicine	UG	> 4 weeks < 1 year	PBL, COBES Vs Traditional methods	In person	CBE	Exposure to rural settings, understand the determinants of health in rural areas, broaden their knowledge base and clinical skills in less resource settings, Willing for rural practice provided better accommodation and schooling facilities
10	(Holst, Normann & Herrmann, 2015)	University	Europe	14	Students: Medicine	UG	2 hours - 7 days	Discussions , Procedural skills	In person		Better understanding on the rules and pathways of specialising in general practice and family medicine, gained more concrete insight and corrected their ideas about work and life as rural practitioners, insights into the financial implications of rural practice, Positive attitude for rural practice, reassessing the professional planning, empathic interviewing techniques

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
11	(Glasser et al.)	University	North America	2823	Students: Medicine	UG	4- 5 years	Preceptorship, assignments	In person		RMED graduates were 14.4 times more likely than non-RMED graduates to choose family medicine; 6.7 times more likely to choose a primary care practice specialty; 17.2 times more likely to be currently practicing in a rural location; and 12.8 times more likely to be currently practicing in a primary care shortage zip code. Analysis of current RMED graduates' practice locations indicates that 41.9% were within 90 miles of their fourth-year preceptorship community. Among RMED graduates practicing in Illinois, 62.1% and 73.3% were located within 60 and 90 miles, respectively, of their hometown.
12	(Quinn et al., 2011)	University	North America	1469	Students: Medicine	UG	1 week - 4 weeks	Procedural skills	In person		About 55.7% of the students chose primary care as specialty, 32.9% chose family medicine

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
13	(Naidu, C. S., Irlam, 2014)	University	Africa	50	Students: Medicine	UG	Not clear/unspecified	Procedural skills	In person		Both positive and negative experiences, knowing a little bit about everything" rather than limiting oneself to specialisation in one area of medicine
14	(Lee et al., 2011)	University	Oceania	88	Students: Medicine	UG	4- 5 years	Procedural skills	In person	Social foundations of medicine	Change in intent to practice in remote/rural areas was positive in 33% of students
15	(Worley et al., 2000)	University	Oceania	8	Students: Medicine	UG	1-3 years	Didactic lectures, procedural skills	Blended	Community based medical education	'more like working and getting up in the morning and going off to work', 'did not realise dealing with interpersonal conflicts would be so draining', PRCC students performed significantly better than their FMC peers in an examination prepared for the hospital-based experience, improved decision making in holistic manner, PRCC students' academic performance improved in comparison with that of their tertiary hospital peers' and in comparison to their own results in previous years.

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
16	(Eley, Baker, 2009)	University	Oceania	463	Students: Medicine	UG	> 4 weeks < 1 year	Procedural skills, preceptorship	In person	Service learning and active learning	Mean score for agreeing on overall satisfaction of the course was high; were confident in clinical ability, improved skills in patient management; Positive intention of pursuing a medical career in a remote or rural location before placement was in 35% of the students as compared to 76% at the end of the placement
17	(Glasser et al., 2008)	University	North America	159	Students: Medicine	UG	4- 5 years	Didactic lectures, preceptorship and procedural skills	In person		Students consistently rate their skill development as positive, with major gains made in the areas of understanding the primary care office structure, ancillary health care systems, the hospital care system, and the general community. The majority of the 159 RMED graduates (121, 76%) have entered primary care residencies: 99 (62%) family medicine, 8 (5%) general internal medicine, 8 (5%) medicine/pediatrics, and

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
											6 (4%) pediatrics. Of the 159 RMED Program graduates, 103 (65%) are currently in practice. Eighty-five (82.5%) of these 103 are in primary care practice—88 (85.4%) if obstetrics–gynaecology is included in the total. Further, 69 (67%) of these graduates have gone into primary care practice in towns of 20,000 people or fewer.
18	(Waslowski, Paton, Freymond, Patel, Brownrigg, Olesovsky & Nyhof-Young, 2021)	University	North America	18	Students: Medicine	UG	> 4 weeks < 1 year	Discussions	In person		Developed stronger understanding of rural family medicine careers and lifestyles, several students said the experience confirmed their pre-existing interest in rural family medicine.
19	(Yahata Shinsuke et al., 2020)	University	Asia	468	Medical doctors	UG	1 week - 4 weeks	Not given	Not given	Community based clinical training	There was no notable impact of undergraduate CBCT on current CH practice and rural retention. The experiences of home medical care and long-term care facilities may be

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
19	(Yahata Shinsuke et al., 2020)										associated with providing CH practice in the future.
20	(Eley Diann et al., 2008)	University	Oceania	305	Students: Medicine	UG	1-3 years	small group, procedural skills	In person		Majority of the students agreed or strongly agreed RCS encouraged interest in rural medicine, prepared for rural practice and developed confidence and new skills to manage patients in rural areas
21	(Rourke et al., 2017)	University	North America	698	Medical doctors and students	UG and PG vocational training	1-3 years	Didactic lectures, preceptorship and procedural skills	In person		
22	(J Cleland et al., 2012)	Hospital	Europe	20	Medical doctors	Foundation years	1-3 years	Procedural skills	In person	Social cognitive careers theory (SCCT)	Enjoyment of the place, but exhaustive, much more clinical and administrative experience, good teamwork, However, they Cannot take the risk of uncertainty in duty hours, change in the duty places across different remote areas with families
23	(Blattner et al., 2017)	University	Oceania	-	Medical doctors	PG	4-5 years	Didactic lectures	Blended		Great program, relevant, group discussions and

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
23	(Blattner et al., 2017)										knowledge exchange was great. Insight into rural context, right basics; helpful for making quick/safe decisions when in stressful situations, Great impact on the practice
24	(Heng, Pong, Chan et al., 2007)	University	North America	194	Medical doctors	PG	Not clear/unspecified	Not given	Not given	-	FMN graduates were more likely than NOFM graduates to be working in a rural area at both 1 and 2 years after graduation and NOFM graduates were more likely to be working in Northern Ontario at 2 years after graduation. FMN graduates were more likely to continue practising in rural areas and less likely to continue practising in northern Ontario, compared with NOFM graduates. Slightly over one-half of all person-years of medical practice took place in northern Ontario and two-thirds of all person-years of practice took place in

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
24	(Heng, Pong, Chan et al., 2007)										northern Ontario, in rural areas or both.
25	(Blattner Katharina et al., 2022)	University	Oceania	12	Medical doctors	PGDip, PGCert	> 4 weeks < 1 year	Discussions, Procedural skills	Blended		Very relevant, strengthening clinical knowledge and expertise, communication skills, professionalism; Practicing according to evidence, developing professional connections
26	(Rourke James et al., 2018)	University	North America	379	Medical doctors	PG Vocational training	2 years	Procedural skills, preceptorship	In person		Among 391 physicians practicing in Newfoundland and Labrador (NL), 257 (65.7%) were Memorial PG graduates and 247 (63.2%) were Memorial MD graduates. Of the 163 FM graduates, 148 (90.8%) were Memorial FM graduates and 118 (72.4%) were Memorial MD graduates. Of the 68 in rural practice, 51 (75.0%) were Memorial PG graduates and 31 (45.6%) were Memorial MD graduates. Of the 41 FM graduates in rural practice, 39 (95.1%) were Memorial FM

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
	(Rourke James et al., 2018)										graduates and 22 (53.7%) were Memorial MD graduates. At the national level, the percentages of all Memorial PGs practicing rurally 2 years after completion of PG training for all PG categories were significantly better than the national average. The percentage of rural FM-trained physicians were significantly higher for Memorial compared with the national level. When considering specialists who practice rurally, Memorial is the best performing medical school for all categories.
7	(VanRooyen, Michael J. et al., 2009)	Hospital	Africa	35	Medical doctors	CME/PD	2 hours - 7 days	didactic lectures, small group learning, procedural skills	In person		A mean improvement of 35.0% (p 0.0005) was seen between pre-test and post-test evaluation of skills. The greatest test score improvement was noted in haemorrhage, wound care, and head trauma, with improvements of 51.5%, 36.4%, and 39.4%, respectively. The least improvement was noted in orthopaedics,

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
											with test scores decreasing by 6.0%.
28	(MacCarthy et al., 2012)	Province	North America	1292	Medical doctors	CME/PD	1-3 years	Team based learning	Not given		Overall satisfied with all modules. Average perceived impact of and satisfaction with the Adult Mental Health module was statistically higher. Over 80% of GPs agreed or strongly agreed that attending the module improved their practice. Some 40.3% to 80.8% of MOAs noted that they had been asked to take on more responsibilities, and 67.9% to 86.4% said that they felt good after taking on additional responsibilities. About 86% to 96% of MOAs perceived an overall positive experience. Over 70% of MOAs had improved their relationship with their GP.

There were 12 studies on programs in remote and rural medicine for interprofessional students. Among these, 9 programs were at undergraduate level, 2 at PG level (Asia, n=1 and Oceania, n = 1) and one CME/PD program (North America). Majority of the studies at under graduation level for interprofessional students were from North America (n=7) and one study each from Asia and Oceania. Lenthall et al (2021) examined long term impacts of the training and reported positive outcomes in terms of employment and retention in remote areas. Two studies reported only the reaction of students to the training as positive. Seven studies noted that participants gained knowledge on interprofessional collaboration, working in teams, other disciplinary perspectives for care and different professions (Table 5).

Table 5: Details of inter-professional educational studies

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
1	(Opina-Tan, 2013)	University	Asia	19	Students: Interprofessional	UG	> 4 weeks < 1 year	Procedural skills	In person	Principles of Primary health care	Most unique yet enjoyable learning experience; interprofessional collaboration, working in teams, active healthcare seeking from the community, practice of holistic care
2	(Fertman, Carl I. et al., 2005)	Health Centre	North America		Students: Interprofessional	UG	Not clear/unspecified	Didactic lectures, procedural skills	In person		Services were well received by the communities, students consistently rated their ability to work effectively on an interdisciplinary team as highest.
3	(Florence et al., 2007)	University	North America	252	Students: Interprofessional	UG	1-3 years	lectures/didactic, procedural skills, Team based learning	In person		CPP graduates' interest in rural practice, primary care or community health, care for underserved, interdisciplinary group collaboration is significantly higher than that of traditional candidates. About 46% of CPP respondents identified rural practice locations compared with 28% of traditional respondents. Of the 26

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
	(Florence et al., 2007)										CPP graduates not currently working in a rural setting, 85% indicated future plans to work in rural areas compared to only 18% of the 40 traditional graduates not currently working in a rural setting.
4	(Bolte, Bennett & Moore, 2012)	University	Oceania	380	Students: Interprofessional	UG	Not clear/unspecified	Discussions	In person		Feedback is uniformly positive
5	(Erkel, Nivens & Kennedy, 1995)	Health centre and university	North America	11	Students: Interprofessional	UG	2 hours - 7 days	Lectures, experiential learning, discussions, preceptorship	Blended	Integration of context of care with selected healthcare delivery models and experiential teaching strategies	Increased sensitivity to barriers to care, appreciation for rural lifestyles, other disciplinary perspectives for care, concerns over distance to access the rural areas were expressed, increased knowledge of training components was gained
6	(Geller et al., 2002)	University	North America	361	Students: Interprofessional	UG	1-3 years	Problem based learning, small group	In person	Hypothetico deductive reasoning: PBL	Greatest change in the attitude was seen to inculcate inter disciplinary cooperation to achieve optimum health care. Increased confidence was observed, change in frequency of consulting other health professionals was identified.

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
7	(Mayne, Glascoff, 2002)	University	North America		Students: Nursing and Health Education (Interprofessional)	UG	1-3 years	discussions	In person		Understood the community mobilization stages, got more rapport with the community people
8	(Lennon-Dearing et al., 2008)	University	North America	20	Students: Interprofessional	UG	1 week - 4 weeks	Didactic lectures, procedural skills	In person	Chronic care model, Quality improvement Processes, Interdisciplinary training, Community based education	More than half of the participants were medium to highly satisfied with the course topics.
9	(Salvatori, Penny S. et al., 2007)	University	North America	136	Students: Interprofessional	UG	Not clear/unspecified	problem-based learning, small group learning and experiential learning, procedural skills	In person	Interprofessional education	New knowledge on different professions was gained, more confident about their own role in the team, new learning on aboriginal culture and lifestyle, health beliefs and non-traditional medicine, healing and healthcare practices and beliefs in native culture, the structures of family life, health inequity, psychosocial impact on health seeking; mixed reactions on

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
											interprofessional education
10	(Lenthall et al., 2021)	University	Oceania	1021	Interprofessional	PG	Not clear/unspecified	Not given	Not given		High overall rating for the courses, Majority agreed or strongly agreed that they were confident that they had the skills to practice in a remote community; 73% of students had worked in a remote or very remote location since completing their RHP course, compared to 58% when they started the course. 47% of the respondents reported RHP course facilitated employment in a remote setting, 35% reported that the course had contributed to them staying longer in a remote setting and 33% reported that the course had facilitated a workplace promotion.
11	(Pedersen, Kathy et al., 2015)	Health Centre	Asia		Students: Interprofessional	PA- PG, HA: certification	1-3 years	Didactic lectures, procedural skills	In person		The pass rate for didactic HA courses is 40%; the clinical pass rate is 50%. There may be a disconnect between the comprehensive nature of

Study no. [Ref]	Authors, year of publication	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
	(Pedersen, Kathy et al., 2015)										the HA curriculum and the performance expectations of the HA students. US PA: Students learn to participate in patient care as a member of a team.
12	(Woltenberg, Leslie N. M. S. Ed et al., 2021)	University	North America	113	Interprofessional	CME/PD	2 hours - 7 days	Didactic lectures	Blended		Students were neutral to strongly agreeing that the overall experience was valuable for professional development, provided a foundational understanding of IPE and collaboration in healthcare, able to interact with colleagues from other disciplines

Table 6 shows 20 studies on training programs for allied health professionals like Health workers, Occupational therapists, Dentists, Social workers, Pharmacists and clinical associates. In Oceania, there were 5 training programs at undergraduate level (Health workers, n=1; Nursing students, n = 1; Occupational therapy students, n = 1; and Dental students, n = 2), one study of a PG training program and two studies on CME/PD training programs for health workers. From Asia, there were two studies for CME/Professional development of health workers. In North America, there was one UG and 3 CME/PD training courses for Nursing students and Nurses respectively and one study each on UG and PG trainings in occupational therapy. One study was on UG training for pharmacy students and one on CME/PD training for social workers. There was one UG training program for clinical associates in Africa and one CME/PD for health workers in Europe. Outcomes of the programs were not evaluated in studies by Clark M et al (2015) and Peter Thompson (2021). A program by Keahey et al (2008) resulted in 80% retention after 2 years along with demonstrable effective communication skills resulting in better handling of difficult interactions. Though the training influenced the participants to incline towards working in rural areas, the participants suggested more training would be useful on functional anatomy on cadavers or hands-on activities like splinting, wheelchair prescription, general mental health, caseload management and time management (Brockwell, Wielandt & Clark, 2009). Kristy Lee et al observed that the training participants had difficulty in understanding English as medium of instruction in the training. This was a program involving aboriginal Island health workers in Australia (Hill et al., 2018).

Table 6: Details of educational studies of various allied health professions

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
1	(Wolfgang et al., 2019)	University	Oceania	394	Students : Allied health professions	UG	Not clear/unspecified	Didactic lectures, procedural skills	In person		Enjoyed understanding clients and families, supportive learning environment; wide range of clinical cases, living with health students of other disciplines helped to broaden understanding of patient care and the healthcare team, experienced rural lifestyle and culture- the unique health challenges they face, gained valuable professional experience and developed close working relationships and networks with many local community organizations and program participants
2	(Fitzpatrick et al., 2019)	University	Oceania	138	Health professionals	PG	> 4 weeks < 1 year	Discussions	Blended		"Course was relevant, valuable, very interesting, beneficial with some discomfort;" understood identity, empowerment and relationships and partnerships, gained Skills; learnt strengths-based approaches, Teams approach, can speak out after the training, explain views and make people listen; hopeful for better future.

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
3	(Hill et al., 2018)	University	Oceania	53	Health professionals	CME/PD	1 week - 4 weeks	Didactic lectures, procedural skills	In person		The course was most beneficial but challenging to understand as the medium of instruction was English; shared and learnt from each other
4	(Barker et al., 2021)	University	Oceania	91	Health professionals	CME/PD	> 4 weeks < 1 year	work integrated learning/experiential learning	Online		Increased understanding of the context for practice and service project outcomes, Improvement in knowledge, skills, time management, Improvements in service effectiveness, developed efficiency and accessibility due to engagement with consumers
5	(Banks et al., 2011)	Country	Europe	547	Health professionals	CME/PD	1-3 years	mentorship	Blended		Three quarters of newly qualified practitioners who reported having completed the concluding activities associated with 'Clinical Skills' and just over two thirds of those who had completed 'Safe practice', 'Reflective practice' and 'Communication', reported that they thought that the learning units/activities had been useful in terms of 'Clinical Skills Development'.

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
	(Banks et al., 2011)										Six out of 10 who reported having completed the concluding activities associated with 'Safe practice', 'Clinical skills' and 'Reflective practice' thought that they had been useful in increasing their confidence. Seven out of 10 newly qualified practitioners rated 'Learning the job' as their most important development need, followed by 'becoming a member of the team' and 'orientation/induction to the clinical-area'; leaving organisation-commitment/ career progression' rated as least important.
6	(Mehanni et al., 2019)	Health Centre	Asia	50	Health professionals	CME/PD	1-3 years	Didactic lectures	In person	Ericsson's theory of expertise, Kern's six-step model	Learner talk-time increased from 14 to 30% (Participation); High averages of Likert scale scores were observed for lecture evaluations (behaviour changes, attitudes and perceptions), pre-and post-curriculum knowledge assessment scores improved from 50 to 64%.

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
7	(Zhan, Zhang, Sun, Liu, Peng, Zhang & Yan, 2017)	3 Cities	Asia	1237	Health professionals	CME/PD	> 4 weeks < 1 year	Didactic lectures	Blended		After the interventions, there were more knowledge gains in the experimental group than in the control group. A majority of PHCWs agreed that the contents were well relevant to their work (93.9% in experimental group vs 94.5% in control group, P=.70) and that they would like to try the training mode again (92.4% in experimental group vs 90.8% in control group, P=.37). The blended-learning trainee was found to be more in agreement than the pure e-learning trainee due to the following four issues: (1) "Participation in the training had increased my interest in learning", (2) "Participation in the training increased the interaction with others", (3) "Overall, I was satisfied with learning experience" and (4) "I achieved the objectives of each course"

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
8	(Kenny et al., 2004)	University	Oceania	3	Students: Nursing	UG	4- 5 years	Not given	Not given	-	More confidence for efficient practice, additional knowledge and skills for rural practice, increase critical skills, evidence-based practice
9	(Schuelke, Ellermeier, 2022)	University	North America	135	Students : Nursing	UG	Not clear/un specified	Didactic lectures	Online	Concept based curriculum approach	Students felt most knowledgeable at identifying agriculture as a high-risk occupation and about the types of injuries. The largest change of means was seen in the knowledge of types of agricultural hazards and how to treat an agricultural injury. Statistically significant change in knowledge is seen.
10	(Floyd Barbara O'Malley, Kretschmann Sue & Young Heather, 2005)	Health Centre	North America	37	Nurses	CME/PD	1 week - 4 weeks	Didactic lectures	In person	The Benner Framework	Forty-six topics were evaluated using this format. Forty-two of the topics were positively rated, while four topics were perceived as less useful. The topic areas were categorized in four groups: professional and personal development (n = 7 topics), clinical skills (n = 24 topics), organization orientation (n = 6 topics), and patient and family advocacy (n = 9 topics). About half of the participants wished for monthly continuation of the program

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
11	(Clark et al., 2015)	Hospital	North America		Nurses	CME/PD	Not clear/unspecified	Procedural skills, Networking	In person	Benner's theory	-
12	(Keahey, 2008)	Health Centre	North America		Nurses	CME/PD	> 4 weeks < 1 year	Didactic lectures, discussions	In person	Principles of adult learning by Knowles	The residents exuded confidence and demonstrated excellent clinical decision-making skills, flexibility, and ability to handle emergencies. They demonstrated effective communication skills, were able to handle difficult interactions, 80% retention rate was observed 2 years later, expressed appreciation for receiving guidance and immediate constructive feedback
13	(Brockwell, Wielandt & Clark, 2009)	University	Oceania	43	Occupational therapists	UG	Not clear/unspecified	procedural skills	In person		Rural placements influenced to work rurally for those who are currently working in rural areas. More focus was sought for functional anatomy on cadavers or hands-on activities like splinting, wheelchair prescription, general mental health, caseload management and time management. Top 10

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
13	(Brockwell, Wielandt & Clark, 2009)										subjects perceived to have best prepared graduates for practice: Advanced Rural or Urban Practice with field work, Rural and Urban Practice with field work, Rural and Remote Primary & Public Health Care, Remote Primary & Public Health Care, Health Promotion for Health Professionals, Management and Organisational Skills, Health Education and Promotion, Communication Skills for Therapy, Tasks and Roles of Occupational Therapy, Advanced Professional Skills
14	(Brandt, 2014)	University	North America	102	Students: Occupational Therapy	UG	1-3 years	Didactic lectures, procedural skills	Blended	-	More than 98% of employment rate, more than 90% reported working in rural health environments and increase in the income. Impact of the course on life: 5 themes: 1. rewarding career 2. Financial security 3. Foundation for professional success 4. Degree completion through flexible program design 5. Career ladder opportunities

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
15	(Smallfield, Anderson, 2008)	University	North America	30	Students : Occupational Therapy	PG	> 4 weeks < 1 year	Didactic lectures, procedural skills	In person		Evaluations for the rural issues course have been above the average for other courses, ranking greater than 4.0 on a 5-point Likert-type scale.
16	(Thomson, Peter, 2021)	University	Oceania		Students : Dental	UG	4- 5 years	Didactic lectures, procedural skills	In person		Expected outcomes: Assess oral health and preventative care requirements of individuals and populations, especially in regional, rural, remote, Indigenous and tropical contexts. Practise comprehensive dentistry in a range of clinical environments, including community sites in regional, rural, remote, Indigenous and tropical contexts.
17	(Johnson, Blinkhorn, 2012)	University	Oceania	32	Students : Dental	UG	1 week - 4 weeks	procedural skills	In person		Mean scores for five areas of clinical practice (Treatment planning, time management, Communication, clinical ability and treatment skills) increased in the volunteer group but remained static in non-volunteer group. Students noted increased clinical confidence and time management skills. About 96.9% of the volunteers post placement would consider

Study no.	Authors, year of publication [Ref]	Setting	Region	Population	Study subjects	Training type	Duration category	Type of instruction	Delivery methods	Underpinning concept	Effectiveness
	(Johnson, Blinkhorn, 2012)										working in a rural location after they graduate, a 42% increase in favour of working rurally.
18	(Bac et al., 2017)	University	Africa	6	Students : Clinical associates	UG	1-3 years	Didactic lectures, procedural skills	In person		Excellent clinical skills, interprofessional collaborations and relationships;
19	(Scott, Mollie Ashe et al., 2017)	University	North America	15	Students : Pharmacy	UG	1-3 years	Discussions, procedural skills	Blended		Seminar course evaluations have indicated that students highly value the program as a whole and particularly enjoy the interprofessional components of their education.
20	(Cunningham, Vande Merwe, 2009)	University	North America	251	Social workers	CME/PD	2 hours - 7 days	Didactic lectures	Online		Average rating for satisfaction with the training session, improvement in the knowledge and ability to do the work out of 10 were 7.2 and 6.9 respectively. Majority of the participants agreed or strongly agreed that the program would change practice, ability and knowledge and attitude of the subject for providing good care.

Among the 21 UG-Medicine training program-studies, nine studies included 'clinical skills' in their curriculum followed by 'Health systems and services' (n=8), 'Community Orientation and experiences' (n=7) and Personal and professional development (n=5). 'Indigenous health, Cultural competency', 'Health needs assessment' and 'Rural Practice' were in the curricula of four studies respectively. Topics like 'Health of remote and rural populations' (n=3), 'Health resources' (n=3), 'Population health' (n=3), 'Environmental and occupational health' (n=3), 'Health Promotion' (n=3), 'Communication skills' (n=3), 'Research methods' (n=3), 'Community oriented primary care' (n=2), 'Medical ethics' (n=2), 'Decision making skills' (n=2), 'Epidemiology', 'Evidence based practice', 'Behavioural sciences', 'Planning, implementation and evaluation', 'Health advocacy', 'Sustainable interventions for health', 'Rural health economics', 'Workload coping strategies', 'Clinical pharmacology', 'Complementary and alternative medicine', 'Interdisciplinary work' and 'Trauma management' were in the curricula of a study each respectively (Table 7).

Table 7: Training topics across the studies (Medicine: UG courses)

	Medicine: UG	(Tani et al., 2005)	(Newbury Jonathan et al., 2005)	(Dowell Anthony, Crampton Peter & Parkin Chris, 2001)	(Ross, Cameron & Greenwood, 2019)	(Diab, Mcneill & Ross, 2014)	(Naidu, Claudia S. et al., 2012)	(Navin an, Mitrakrishnanrajapase & Wijayar atne, 2011)	(Amalbal et al., 2019)	(Holst, Norman & Herrmann, 2015)	(MacDowell, Glasser & Hunsaker, 2013)	(Quinn et al., 2011b)	(Lee et al., 2011)	(Worley et al., 2000)	(Eley, Baker, 2009)	(Glasser et al., 2008a)	(Waslowski, Paton, Freymond, Patel, Brownrigg, Olesovskiy & NyhofYoung, 2021)	(Eley et al., 2008)	(Rourke et al., 2017)	(Cleland et al., 2012)
1	Community orientation and experiences	✓	✓		✓			✓									✓	✓	✓	
2	Population health										✓		✓			✓				
3	Environmental and occupational health	✓					✓									✓				
4	Health systems and services	✓	✓	✓		✓	✓			✓	✓					✓				

	Medicine: UG Topics	(Tani et al., 2005)	(Newbury Jonathan et al., 2005)	(Dowell Anthony, Crampton Peter & Parkin Chris, 2001)	(Ross, Cameron & Greenwood, 2019)	(Diab, Mcneill & Ross, 2014)	(Naidu, Claudia S. et al., 2012)	(Navin an, Mitrakrishnanrajapase & Wijayar atne, 2011)	(Amalbal et al., 2019)	(Holst, Norman & Herrmann, 2015)	(MacDowell, Glasser & Hunsaker, 2013)	(Quinn et al., 2011b)	(Lee et al., 2011)	(Worley et al., 2000)	(Eley, Baker, 2009)	(Glasser et al., 2008a)	(Waslowski, Paton, Freymond, Patel, Brownrigg, Olesovskiy & NyhofYoung, 2021)	(Eley et al., 2008)	(Rourke et al., 2017)	(Cleland et al., 2012)
5	Health Promotion	✓					✓		✓							✓			✓	
6	Communication skills	✓				✓			✓											
7	Clinical skills	✓	✓			✓						✓	✓	✓	✓			✓	✓	
8	Indigenous health, Cultural competency		✓	✓								✓			✓					
9	Personal and professional development		✓						✓			✓	✓			✓				

10	Health needs assessment			✓				✓	✓										✓	
11	Health resources					✓			✓						✓					
12	Epidemiology						✓													
13	Evidence based practice						✓													
14	Research methods						✓	✓							✓					
15	Behavioural sciences																			✓
16	Planning, implementation and evaluation						✓													
17	Health advocacy						✓													
18	Sustainable interventions for health							✓												
19	Social determinants of health							✓	✓										✓	
20	Rural health economics									✓										
21	Workload coping strategies									✓										

	Medicine: UG Topics	(Tani et al., 2005)	(Newbury Jonathan et al., 2005)	(Dowell Anthony, Crampton Peter & Parkin Chris, 2001)	(Ross, Cameron & Greenwood, 2019)	(Diab, Mcneill & Ross, 2014)	(Naidu, Claudia S. et al., 2012)	(Navin an, Mitrakrishnanr ayno, Rajapakse & Wijayar atne, 2011)	(Amalbal et al., 2019)	(Holst, Norman & Herrmann, 2015)	(MacDowell, Glasser & Hunsaker, 2013)	(Quinn et al., 2011)	(Lee et al., 2011)	(Worley et al., 2000)	(Eley, Baker, 2009)	(Glasser et al., 2008)	(Waslowski, Paton, Freymond, Patel, Brownrigg, Olesovskiy & NyhofYoung, 2021)	(Eley et al., 2008)	(Rourke et al., 2017)	(Ciela nd et al., 2012)
22	Community oriented primary care										✓					✓				
23	Rural Practice										✓	✓			✓				✓	
24	Clinical pharmacology													✓						
25	Medical ethics													✓		✓				
26	Health of remote and rural populations														✓	✓		✓		
27	Complementary and															✓				

	alternative medicine																				
	Medicine: UG Topics	(Tani et al., 2005)	(Newbury Jonathan et al., 2005)	(Dowell Anthony, Crampton Peter & Parkin Chris, 2001)	(Ross, Cameron & Greenwood, 2019)	(Diab, Mcneill & Ross, 2014)	(Naidu, Claudia S. et al., 2012)	(Navin an, Mitrakrishnanrajapase & Wijayarathne, 2011)	(Amalbalal et al., 2019)	(Holst, Norman & Herrmann, 2015)	(MacDowell, Glasser & Hunsaker, 2013)	(Quinn et al., 2011)	(Lee et al., 2011)	(Worley et al., 2000)	(Eley, Baker, 2009)	(Glasser et al., 2008)	(Waslowski, Paton, Freymond, Patel, Brownrigg, Olesovskiy & NyhofYoung, 2021)	(Eley et al., 2008)	(Rourke et al., 2017)	(Cleland et al., 2012)	
28	Decision making skills					✓															✓
29	Interdisciplinary work												✓								
30	Trauma management													✓							

‘Emergency care’ was included in four studies on PG Vocational, PGDip/Cert, CME/PD and PG training programs in the discipline of medicine. ‘Comprehensive family medicine’ and ‘Communication skills’ were included in PG vocational and PG training programs respectively. PG vocational training also had ‘Health promotion’ component. ‘Trauma care’ was taught in 3 programs and clinical skills in two. CME/PD trainings included topics like ‘Infectious diseases’, ‘malnutrition’, ‘dehydration’, ‘ambulance services’ along with ‘emergency and trauma care’, ‘Chronic diseases’, ‘mental health’ and ‘health promotion’ (Table 8).

Table 8: Training topics across the studies (Medicine: PG Courses)

	Medicine	PG Vocational	PG	PGDip/Cert	CME/PD	
		(Rourke et al., 2017)	(Blattner et al., 2017)	(Blattner et al., 2022)	(VanRooyen, M. J. et al., 2000)	(MacCarthy et al., 2012)
1	Comprehensive family medicine	✓				
2	Rural context		✓	✓		
3	Communication skills		✓			
4	Trauma care		✓	✓	✓	
5	Emergency care	✓	✓	✓	✓	
6	Clinical skills		✓	✓		
7	Infectious diseases				✓	
8	Malnutrition				✓	
9	Dehydration				✓	
10	Ambulance services				✓	✓
11	Chronic diseases					✓
12	Mental health					✓
13	Health promotion	✓				✓

Among UG courses for interprofessional training, a study by Lenthall et al (2021) did not report details about the curriculum. The topics ‘Social determinants of health’, ‘Interdisciplinary teaming’ and ‘Health promotion’ were taught in four programs. The topics ‘Rural context’ (n=3), ‘Rural health services’(n=3), ‘Disease prevention and health care’ (n=2), ‘Professionalism’ (n=2), ‘Community health needs assessment’ (n=2), ‘Chronic care model’ (n=2), ‘Decision making skills’ (n=1), ‘Leadership’ (n=1),

'Health behaviours' (n=1), 'Environmental & occupational health' (n=1), 'Biostatistics' (n=1), 'Clinical skills' (n=1), 'Medical ethics' (n=1), 'Community oriented primary care' (n=1), 'Communication skills' (n=1), 'Quality improvement' (n=1), 'Research' (n=1) and 'Simulation' (n=1) were included in various training programs (Table 9). Table 10 elaborates on training contents in each study on trainings at PG and CME/PD levels.

Table 9: Training topics across the studies (Interprofessional: UG courses)

	Interprofessional: UG	(Opina-Tan, 2013)	(Fertman, C. I. et al., 2005)	(Florence et al., 2007)	(Bolte, Bennett & Moore, 2012)	(Erkel, Nivens & Kennedy, 1995)	(Geller et al., 2002)	(Mayne, Glascoff, 2002)	(Lennon- Dearing et al., 2008)
1	Interdisciplinary teaming	✓	✓				✓	✓	
2	Social determinants of health	✓	✓				✓		✓
3	Disease prevention and health care		✓	✓					
4	Rural context		✓		✓	✓			
5	Decision making skills		✓						
6	Leadership		✓						
7	Health Promotion	✓	✓	✓					✓
8	Epidemiology			✓					
9	Health behaviours						✓		
10	Environmental & occupational health	✓							
11	Biostatistics			✓					
12	Clinical skills				✓				
13	Medical ethics				✓				
14	Rural health services		✓			✓			✓

	Interprofessional: UG	(Opina-Tan, 2013)	(Fertman, C. I. et al., 2005)	(Florence et al., 2007)	(Bolte, Bennett & Moore, 2012)	(Erkel, Nivens & Kennedy, 1995)	(Geller et al., 2002)	(Mayne, Glascoff, 2002)	(Lennon- Dearing et al., 2008)
15	Community oriented primary care					✓			
16	Professionalism						✓		✓
17	Planning, implementation, monitoring and evaluation	✓						✓	
18	Community health needs assessment			✓				✓	
19	Communication skills								✓
20	Quality improvement								✓
21	Chronic care model		✓						✓
22	Research		✓						
23	Simulation				✓				

Table 10: Training topics across the studies (Interprofessional: PG courses)

	Interprofessional	PG & Certification	CME/PD
		(Pedersen, Kathy M. P. A. S., P.A.C. et al., 2015)	(Woltenberg, Leslie N. et al., 2021)
1	Clinical skills	✓	
2	Trauma care	✓	
3	Emergency care	✓	
4	Ayurveda	✓	
5	Homeopathy	✓	
6	Health literacy-Basics		✓
7	Social determinants of health		✓
8	Team based approach to care		✓
9	Transitions of care		✓

A study of a training at UG level for health workers included ‘Community participation’ and ‘Research’ in the training curriculum. At PG level, ‘Social determinants of health’, ‘Indigenous culture’, ‘Psychosocial health challenges’, ‘Wellbeing’ and ‘Physical health’ were taught. At CME/PD trainings, ‘Clinical skills’ (n=4) followed by ‘Health care services’ (n=3), ‘Project management’ (n=2), ‘Quality improvement’ (n=1), ‘Communication skills’ (n=1), ‘Equality, equity & diversity’ (n=1), ‘Reflective Practice’ (n=1), ‘Team work’ (n=1), ‘Professionalism’ (n=1) and ‘Health policy’(n=1) were included in the curricula (Table 11). Table 12 depicts training topics incorporated for nursing students at UG and CME/PD levels. ‘Clinical skills’, ‘Professionalism’, ‘Health advocacy’, ‘Critical thinking’ and ‘interpersonal relationship skills’ were included in CME/PD programs. Broadly, ‘Clinical skills’ component of curriculum was included in majority of studies across various disciplines of allied health professionals (Table 13).

Table 11: Training topics across the studies (Allied health professions courses)

	Health workers	UG	PG	CME/PD				
		(Wolfgang et al., 2019)	(Fitzpatrick et al., 2019)	(Hill et al., 2018)	(Barker et al., 2021)	(Banks et al., 2011a)	(Mehanni et al., 2019)	(Zhan, Zhang, Sun, Liu, Peng, Zhang, Yan et al., 2017)
1	Community participation	✓						
2	Research	✓						
3	Social determinants of health		✓					
4	Indigenous culture		✓		✓			
5	Psychosocial health challenges		✓					
6	Wellbeing		✓	✓				
7	Physical health		✓					
8	Clinical skills			✓	✓	✓	✓	
9	Planning and implementation			✓				
10	Monitoring & evaluation			✓				
11	Health care services			✓	✓			✓
12	Project management				✓			✓
13	Quality Improvement				✓			
14	Communication skills					✓		

	Health workers	UG	PG	CME/PD				
		(Wolfgang et al., 2019)	(Fitzpatrick et al., 2019)	(Hill et al., 2018)	(Barker et al., 2021)	(Banks et al., 2011a)	(Mehanni et al., 2019)	(Zhan, Zhang, Sun, Liu, Peng, Zhang, Yan et al., 2017)
15	Equality, equity & diversity					✓		
16	Reflective practice					✓		
17	Team work					✓		
18	Professionalism					✓		
19	Health policy					✓		

Table 12: Training topics across the studies (Nursing courses)

	Nursing	UG		CME/PD		
		(Kenny et al., 2004)	(Schuelke, Ellermeier, 2022)	(Floyd, Kretschmann & Young, 2005)	(Clark et al., 2015)	(Keahey, 2008)
1	Management	✓				
2	Leadership	✓				
3	Research	✓				
4	Clinical skills	✓	✓	✓	✓	
5	Environmental & occupational health		✓			
6	Mental health		✓			
7	Veterinary pharmaceuticals		✓			
8	Trauma care		✓			
9	Disease prevention		✓			
10	Health resources		✓			
11	Evidence based practice		✓			
12	Population health		✓			
13	Professionalism			✓		
14	Health advocacy			✓		
15	Critical thinking					✓
16	Interpersonal relationship skills					✓

Table 13: Training topics across the studies (Other allied health professional courses)

		<i>Occupational therapy: UG</i>	<i>Occupational therapy: PG</i>	<i>Dentistry: UG</i>		<i>Clinical Associate: UG</i>	<i>Pharmacy: UG</i>	<i>Social work: CME/PD</i>
		(Brockwell, Wielandt & Clark, 2009a)	(Smallfield, Anderson, 2008)	(Thomson, Peter, 2021)	(Johnson et al., 2020)	(Bac et al., 2017)	(Scott, Mollie Ashe Pharm D. et al., 2017)	(Cunningham et al., 2009)
1	Clinical skills	✓		✓	✓	✓		
2	Rural cultural context	✓	✓				✓	
3	Occupational health		✓					
4	Behavioural sciences		✓			✓		✓
5	Communication skills			✓				
6	Lifespan development			✓				
7	Health research			✓				
8	Oral health promotion			✓				
9	Primary health care			✓				
10	Public health care			✓				
11	Community health					✓		
12	Social determinants of health						✓	
13	Health statistics						✓	
14	Geriatrics						✓	

		<i>Occupational therapy: UG</i>	<i>Occupational therapy: PG</i>	<i>Dentistry: UG</i>		<i>Clinical Associate: UG</i>	<i>Pharmacy: UG</i>	<i>Social work: CME/PD</i>
		(Brockwell, Wielandt & Clark, 2009a)	(Smallfield, Anderson, 2008)	(Thomson, Peter, 2021)	(Johnson et al., 2020)	(Bac et al., 2017)	(Scott, Mollie Ashe Pharm D. et al., 2017)	(Cunningham et al., 2009)
15	Basic pharmacology							✓
16	Health resources							✓
17	Health informatics							✓
18	Professionalism							✓
19	Fire and life safety							✓
20	Care giving for Dementia							✓
21	Mental health							✓
22	Problem solving skills							✓

Discussion

This review sought to look at training programs and their effectiveness on medical and health professionals in remote and rural medical/health practice around the world. Overall, 60 articles were included in this review. The studies were heterogenous in terms of location, study subjects, sample size, study designs and publication types. There was one (2%) study that incorporated randomised controlled trial study design (Zhan, Zhang, Sun, Liu, Peng, Zhang & Yan, 2017). The first study was published in 1995 followed by a gap of 5 years for next publication. Despite early studies, until the date of writing there is a lack of strong evidence on the outcomes of such training programs in terms of retention, performance and professional growth for health care providers in remote and rural areas.

We attempted to look at training of all health disciplines concerned with provision of health care in rural and remote areas. Though the studies included were focused on educating and training, only a quarter of them were reported in education related journals.

As indicated by both the MERSQI and the RAG risk of bias in reporting tool, the overall quality of the evidence base was very variable. It is important to note that study methodology and reporting, two interrelated yet distinct areas, needed most improvement. There were 7(11.7%) studies that failed to describe the curricular components at all and a further 16 (27%) studies detailed about the underpinning theoretical concepts for the development of the training program. It is to be noted that only 3 (5%) studies had low risk of reporting bias. Quality analysis of the study methodology highlights that many studies did not have enough consideration for sampling response and instrument validation which might potentially result in sampling bias and rendering the precision of the findings less reliable.

The approaches used to deliver healthcare education, and create effective learning environments, varied according to different disciplines. They in turn determined the choice of delivery methods and location, collaborations - whether the programme involved multi-professional educators and/or learners, delivery pattern and duration. A variety of adaptations and creative approaches were used to ensure accessibility and engagement of learners along with sustainable delivery. Long term effectiveness of the programs was documented only in a handful of studies. Response on effectiveness differed among the participants of different disciplines. While interprofessional and allied health providers expressed interest in providing services in remote and rural areas, medical doctors' views and interests in the same differed across different regions of the world. Most of the papers

focused on sharing experiences rather than robust evaluation. One (2%) study looked briefly at the perspective of care receivers from the training (Fertman, C. I. et al., 2005).

The programs on existing professionals already working in the remote and rural regions suggested that the participants improved their skills in various techniques like interviewing, patient management and disease prevention. They also learnt involvement of communities in health care decisions, preventive measures, team approach for patient management and empowering the communities to actively seek health care. However, few studies which assessed prospective willingness of the participants to provide services in rural areas, observed the unwillingness of the participants for the same, citing multiple reasons such as uncertainty in duty hours, better life options in urban areas and increased career advancement opportunities in the cities. A few longitudinal program evaluation reports from North America suggested that the programs had a positive impact as the majority of the past students reported that they are currently providing services in rural areas regardless of the challenges due to skills developed from the curriculum. Participants of CPD/CMD wished for refresher trainings for higher and continual motivation to carry on service provision in remote and rural regions.

The literature exclusive to educational interventions for improving remote and rural health care is sporadic. There have been few reviews on this topic. Unlike the review by Saito et al (2022) which focused on Post graduate remote and rural training programs worldwide and had 26 studies reviewed, our focus was on educational interventions at all levels of medical and health education, right from under graduation to post-graduation and professional development level therefore with higher number of studies included, giving a broader evidence base to draw conclusions from. Dymmott et al (2022) have focused on early career allied health professionals and doctors in remote and rural regions and explored factors influencing their experiences in 30 studies but did not investigate educational factors as opposed to our study. Carol Reeve et al (2020) conducted a scoping review for health professionals' education on remote health contexts at undergraduate and graduate levels following methodological framework proposed by Arskey and O'Malley (2005). They included 40 studies published between 2009 and 2019 while we did not set a time duration as we aimed to look at examining evolution of the educational development and interventions for remote and rural medical and healthcare providers even before the distinction between "remote" and "rural" concepts started surfacing. Deborah Russel et al (Russell et al., 2021) reviewed educational interventions component for retention of health workforce in remote and rural areas interventions beyond 2010. They attempted to look at

the methodological quality of the studies using JBI critical appraisal checklists for cross sectional studies, cohort studies and case reports. Our search strategy was like that of the systematic review of WHO on Retention of Health Workforce in Rural and Remote Areas. (World Health Organisation, 2020).

Our systematic review included a robust search strategy developed in phases through piloting ensuring the reproducibility. We refined our inclusion and exclusion criteria to ensure the practicality and feasibility of our review in remote and rural medical education, focusing on studies describing developments that had already been deployed. We particularly assessed the risk of reporting bias with an easy visual tool (RAG). We also assessed the quality of study methodology in the medical or health care education interventional studies selected using MERSQI which is unique in the systematic reviews conducted in the similar area so far. This was important to understand the existing standards in educational interventions which imply for significant changes in conducting medical educational research and reporting them in the future. The use of electronic data management tools like 'Ref Works' and auto-deduplication feature in electronic data bases to organize, identify duplicates and ineligible articles potentially increased the accuracy of the review and added efficiency to the process. We followed BEME guidance (Hammick, Dornan & Steinert, 2010) for extracting the data while the other reviews missed that.

As per Pong et al (2005) the rural education pipeline needs to be adopted in four stages: Pre-college, undergraduate training, post graduate training and professional career training. We have looked at all except pre-college level around the world making this study comprehensive and global. We attempted to cover educational interventions of all the health disciplines that are involved in remote and rural medical care around the world making it an exhaustive systematic review.

Timely review of articles and discussions among the authors reduced the scope for measures of inter-rater reliability and the risk of inconsistent judgements during data extraction. However, omitting grey literature is a limitation in our study. Considering the time limitation and global aspect of the review, we decided to continue with the available literature online. There is a possibility of citation bias, however, we strongly considered eligibility criteria before including them for the review. We included reports, commentaries etc to ensure gathering data about all the interventions present in the remote and rural medical education. This could be one of the reasons for the low quality in study methodologies that was depicted in our study.

Conclusion

A potential focus for future research might be studying outcomes at levels three and four of Kirkpatrick's levels of training evaluation as well as on theoretical work to consider how and why remote rural training is /isn't effective. Less detailed literature is found around sharing of resources and learning outcomes. Additional research looking at the faculty development for remote and rural medical education is recommended. Timely sharing of training developments and outcomes and identifying specific predictors for future remote and rural medical educational programs would benefit both education and policy sectors in rural and remote medicine.

Rationale for the study

Rationale for the study

Despite its global importance and international implications, most research on remote and rural medicine and education is reported from developed regions—particularly the USA and Oceania—while areas where the majority of the world’s population lives in rural settings remain largely underrepresented. It is unclear how transferrable the findings of our systematic review are to that different context of Low- and Middle-Income countries (LMIC). So, the future work should significantly focus on both the transference and dissemination of skills and knowledge to those areas and look for areas of convergence and divergence in the findings to further enhance the evidence base. Addressing these gaps implies a vast scope in remote and rural educational development and leadership resulting in reduction of health inequity.

In this review, we have also identified a wide description of curricular content, delivery methods, and effectiveness of the training programs in remote and rural medicine and health care. We have seen that there has been explosion of research in the remote and rural health care over the last decade. The breadth of the literature covers all the stages of medical education and multiple professional groups. There is a substantial body of reporting that’s been synthesised in this review which gives conceptual and theoretical underpinning to guide future clinical teachers looking to produce their own courses. The information within this review should support dissemination and replication of remote and rural teaching in other institutions. However, a wide gap remains in health attainment between the rural and remote population and the urban population. Evidence also suggests less efficacy and confidence among health providers in remote and rural regions despite dedicated training programs.

This study seeks to make a valuable contribution to educational interventions by identifying core course content necessary for training and producing effective medical and healthcare professionals in remote and rural areas. Use of a Delphi methodology is unique and of great importance in the field of health education. The method has been used for curriculum development and consensus building in many health-related topics such as treatment procedures or nurse training. The study's findings will potentially have a significant impact on addressing existing health disparities caused by poor retention and insufficiently skilled performance among doctors and other healthcare professionals in these regions. Additionally, this research will have important pedagogical and epistemological implications for medical and paramedical education.

Research Question, Aim
Objectives

Research Question

Can global consensus be arrived at as to the essential components of training for ensuring confident and effective medical practice in remote settings?

Objectives

1. To understand the views of the experts across the world on the essential features required in training healthcare professionals working and about to work in remote and rural settings.
2. To arrive at the consensus position for required training components to ensure confident and effective practice.

Materials and Methods

Methodology

An email-based Delphi methodology was used. The Delphi technique is the process for measuring consensus among a group of experts to get controlled opinion feedback by repeated individual questioning of the experts and avoiding direct confrontation. The Delphi method was chosen as we want to analyse the views of experts with regards to ground requirements from the remote and rural practitioners. The method helps to have a balanced discussion or output from experts around the world through emails at their convenience there by ensuring representativeness and anonymisation of their responses. The three rounds or iterations provide an opportunity for careful consideration of opinions and feedback before arriving at a potential consensus on the required curricular designs for remote and rural medicine and healthcare.

Expert consultation: A convenience sample of **51** experts from across different continents to ensure heterogeneity, were chosen according to the following *criteria*:

- a. they should have a bachelor's degree or above in medicine, nursing, physiotherapy, or any other paramedical education.
- b. they should have worked or be working/volunteered in the remote and rural healthcare area at least for 3 years of their career.
- c. they should be able to complete all the rounds of consultation.

Sampling Procedure: 95 experts were contacted from an expert consultation workshop conducted in National Centre for Remote and Rural Medicine (NCRRM) Conference 2023, World Organization of National Colleges, Academies and Academic Associations of General Practitioners/Family Physicians (WONCA) Register and by consulting experts from various institutions that we shortlisted in the initial review of study programs around the world and to which we explained the aims of the study and invited them to take part.. 62 experts consented to take part in the study. The first round of Delphi study had 51 participants. The study was conducted from July 2023 till August 2025.

A list of names and emails of potential panel members was obtained from various web sites, Rural seeds, WONCA and workshop participants of NCRRM Conference, 2023. An email requesting the participant recruitment was sent out to gate keepers of various websites followed by emails sent to potential panellists requesting their thoughts and consent to take part in the study. For those who responded positively, an email with Participant Information sheet and Participant consent forms were sent out to be filled by

the potential panellists to confirm the recruitment. All the email communications and forms are provided in the appendices 2-5.

Study Instrument: Based on the earlier reviews and a workshop at NCRRM Conference, where experts came together to brainstorm areas which might be of importance for a new program for remote and rural medical and healthcare training, a **questionnaire for Round 1** was created with 2 sections: Section 1- covered the sociodemographic profile of participants (Items 1-9) and Section 2 had open ended questions with a scope for explanation on 3 items. The items were on Knowledge topics and skills that are already taught and those that are felt needed to be taught in a Remote and Rural Healthcare training course. The section also had items on “useful things” and ‘go to’ resources to help practitioners who work in remote and rural regions. The details of the forms are attached in Appendix 6. A pilot study to check for validity and reliability of the questionnaire for each round was conducted on 2 experts. The experts were defined and chosen as per the criteria described under ‘expert consultation’ section. The experts provided feedback on the questionnaire for the language, structure, understanding of the questions, ease of responding and time required to respond. Based on the feedback, the required changes were made.

Questionnaire for Round 2 was formed after analysing the results from Round 1. The questionnaire was divided into Part A and Part B due to number of themes that resulted from Round 1. *Part A* had questions on 27 themes under ‘Knowledge topics’. A summary statement formed from the responses of the participants was provided against each theme and the participants were asked to provide a rating for agreement on a scale of 1-5, 5 being strongly agree and 1 being strongly disagree. This was followed by open ended questions asking for their thoughts or reasons for giving a rating (Appendix 7). Similarly, *Part B* of the questionnaire consisted of 20 themes under ‘useful things’ to be taught and 17 themes under important skills to be trained in a remote and rural healthcare training (Appendix 8).

Questionnaire for Round 3 was created based on the results from the Round 2. The % agreement rates for the themes from the Round1 were provided along with the mean agreement score, standard deviation (SD), considering Inter Quartile Range (IQR) as test of consensus. The themes which did not reach a level of consensus were asked for re-rating on a Scale of 1-5, 1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree. Optionally, the participants were asked the reason for a particular re-rating (Appendix 9).

Method of data collection: The questionnaires for each round were created using the software tool Microsoft Forms and the link was shared with the participants through emails to which allowed them to complete the questionnaire. The panel was requested to provide initial response in 3 weeks' time. In case of non-response, two reminder emails were sent after 3 weeks to the respective experts requesting their contribution. The data was extracted from these forms into excel sheets and analysed further. The questionnaires for each subsequent round were made according to the results from previous rounds until consensus and stability was reached. Anonymity was ensured in each step of the method.

Statistical analysis: Analysis was done iteratively after each round of Delphi using Microsoft excel. Simple descriptive statistics were performed for sociodemographic features. Thematic analysis was performed on open ended judgements from round 1. Percentage agreement levels were checked for consensus. For this study, consensus is defined as a percentage agreement of 75% or more for each item. Mean agreement scores were used to rank the themes. Standard deviation is used to check the variability of the responses and Inter quartile range was used as test/measure of consensus.

Ethical considerations:

Appropriate ethical approval was obtained from Ethics, Integrity and Governance Unit, Research and Enterprise services, University of Lancashire with HEALTH Ethics Panel Application Unique Reference Number: HEALTH 01115, dated 04/06/2024 (**Appendix 1**).

Results

Results:

The first step towards the Delphi study was undertaken by facilitating a workshop in an international conference hosted by the National Centre for Remote and Rural medicine in 2023. This conference focused on developments of remote and rural medicine and education and was identified to be a suitable site to recruit panellists.

The aims of the workshop were to introduce the participants to the problem statement of health inequity between urban and rural areas around the world, educational interventions present to reduce the inequity and the required competencies with the educational curricula. The participants were formed into groups and asked to brainstorm on the question 'What are the most expected skills from rural and remote healthcare providers?' with the help of 5 fictional case studies. Content analysis of the group responses provided 12 skills as essential for remote and rural practitioners. The workshop provided an opportunity to interact with participants about their experience in remote and rural practice and their interest in taking part in the study. They were also requested to suggest other peers or colleagues who might be interested in becoming expert panellists.

The content analysis of the course topics in the disciplines of medicine and other allied health professionals in my systematic review revealed up to 30- 50 topics incorporated in various training programs based on different disciplines at UG and PG levels. This was further followed by another workshop at the WONCA conference on remote and rural medicine in Sydney Australia, facilitated by Prof Cathy Jackson and Prof Stuart Maitland-Knibb with a similar structure and experts were identified and recruited from this conference.

Results from Round 1:

Sociodemographic characteristics of the participants revealed that the majority of them were from Africa (29%) followed by Europe and Australia (17.6%). Mid-level to senior experienced professionals who worked in remote and rural health setups constituted most of our study population as depicted in the proportion of the participants in age group above 40 years and those with years of experience more than 10 years (**Table 14**). The profile remained consistent across all rounds of the Delphi study.

Table 14: Sociodemographic features of the participants across 3 rounds of Delphi study

	Sociodemographic Feature	Round 1 (n=51)		Round 2 - Part A (n=47)		Round 2- Part B (n=43)		Round 3 (n=44)	
		n	%	n	%	n	%	n	%
Discipline	Education	3	5.9	3	6.4	3	7.0	3	6.8
	Health Science	4	7.8	4	8.5	4	9.3	4	9.1
	MEDICINE	33	64.7	29	61.7	26	60.5	26	59.1
	Midwifery	1	2.0	1	2.1	0	0.0	1	2.3
	Nursing	3	5.9	3	6.4	3	7.0	3	6.8
	Physiotherapy	4	7.8	4	8.5	4	9.3	4	9.1
	Public health	2	3.9	2	4.3	2	4.7	2	4.5
	Rural and Remote Medicine -	1	2.0	1	2.1	1	2.3	1	2.3
Age group	31- 40 years	5	9.8	5	10.6	4	9.3	5	11.4
	41- 50 years	12	23.5	11	23.4	11	25.6	11	25.0
	51- 60 years	12	23.5	11	23.4	10	23.3	9	20.5
	Above 60 years	19	37.3	18	38.3	16	37.2	17	38.6
	Less than 30 years	3	5.9	2	4.3	2	4.7	2	4.5
Location	Africa	15	29.4	14	29.8	13	30.2	14	31.8
	America	2	3.9	1	2.1	1	2.3	1	2.3
	Asia	4	7.8	3	6.4	3	7.0	3	6.8
	Australia	9	17.6	9	19.1	8	18.6	9	20.5
	Europe	13	25.5	12	25.5	10	23.3	11	25.0
	Newzealand	3	5.9	3	6.4	3	7.0	3	6.8
	North America	5	9.8	5	10.6	5	11.6	3	6.8
Experience	</= 10 Years	10	19.6	8	17.0	7	16.3	8	18.2
	11- 20 Years	10	19.6	10	21.3	10	23.3	9	20.5
	21- 30 Years	11	21.6	10	21.3	8	18.6	9	20.5
	31- 40 Years	15	29.4	15	31.9	14	32.6	14	31.8
	41- 50 Years	5	9.8	4	8.5	4	9.3	4	9.1
Education level	Masters' level	15	29.4	13	27.7	11	25.6	12	27.3
	PhD/D Phil	21	41.2	21	44.7	19	44.2	19	43.2
	Post Graduate qualification be	10	19.6	8	17.0	8	18.6	8	18.2
	Undergraduation	5	9.8	5	10.6	5	11.6	5	11.4

PhD/Dphil: Doctor of Philosophy, n: frequency

Thematic analysis was conducted for the open-ended questions using the six-step framework outlined by Braun and Clarke (2014) :

1. Familiarization with the data
2. Generating initial codes
3. Searching for themes
4. Reviewing themes
5. Defining and naming themes
6. Writing up

Thematic analysis was done manually for more nuanced interpretations of the data. This resulted in 27 themes for 'Knowledge topics' that participants felt were most helpful (16 themes that were taught) and need to be taught (11 themes that are needed to be taught) for RRH Practice. 12 themes emerged for topmost 'useful skills' that were taught and used during RRH practice. Skills necessary to be taught in a course on RRH Practise had 6 themes (**Tables 15-18**). 20 themes resulted for most 'useful things' to be taught in a RRH training. Table 19 elaborates on themes that emerged under Useful things that could be taught in a remote and rural health/medical course.

In this study, **Knowledge topics** are defined as conceptual areas or theoretical understandings that participants identified as essential for foundational competence in the subject. These include facts, principles, and frameworks that underpin professional or academic practice, most often covered in didactic lectures.

Useful skills refer to practical competencies or abilities that enable individuals to apply knowledge effectively in real-world contexts. These include technical, interpersonal, analytical, and procedural skills.

Operational definition of **Useful things** refers to personal qualities, attitudes, and cognitive dispositions that enhance professional performance and interpersonal effectiveness. These include values, mindsets, and ways of thinking that, while not directly measurable as skills or knowledge, are considered essential for successful practice in the field.

Table 15: Themes resulted under 'Useful knowledge topics' taught in a RRH course

	Themes from the responses	Summary statements
1	Basic Medical subjects	Anatomy, Physiology, Microbiology, Pathology, and Pharmacology to build a strong clinical base
2	Dermatology	Knowledge in diagnosing and treating common skin conditions prevalent in rural areas.
3	Diagnostic procedures & interpretation	Performing and interpreting diagnostic tests, including lab work, imaging, and point-of-care testing.
4	Emergency Medicine and Acute Care	Knowledge about urgent and life-threatening conditions, initial assessment and stabilization.
5	ENT	Understand common ENT conditions and their management.
6	General Medicine	A broad range of medical conditions and their management, focusing on holistic patient care.
7	Geriatrics & Palliative care	Common geriatric conditions and end of life care concepts
8	General surgery	Essential surgical procedures like Caesarean section, wound care, suturing and intravenous access
9	Health Education	Learn to educate patients and communities about health promotion and disease prevention.
10	Health Legislation & policy	Awareness on the legal and policy frameworks governing healthcare delivery in rural areas.
11	Health services	Gain knowledge about the organization and management of health systems and services, e.g., primary care centres, hospitals, etc.
12	Home therapies	Some safe and effective home-based treatments for common conditions, promoting self-care and reducing hospital visits.
13	Indigenous Health	Understand the unique health practices, endemic health conditions, health needs and cultural considerations of Indigenous populations.
14	Chronic Disease Screening & management	Screening procedures for and management of chronic diseases

15	Obstetrics and Gynecology	Concepts of women's reproductive health, pregnancy, childbirth and gynecological conditions.
16	Psychiatry	Diagnosis and management of mental health conditions, promoting mental well-being in rural communities.

Table 16: Knowledge topics that were felt needed to be taught in RRH training course

	Themes from the responses	Summary statements
1	Anaesthesia	Administering safe and effective anaesthesia for various procedures
2	Basic Dental procedures	Common dental procedures such as extractions, fillings, and preventive care.
3	Elementary alternative medicines	Basic principles of alternative medicine practices that are commonly used in rural areas for safe and complementary use with conventional treatments.
4	Environment Health	Impact of environmental factors on health - water quality, sanitation, and pollution control.
5	Health Economics	Understanding of economic principles related to healthcare delivery, including cost-effectiveness and resource allocation.
6	Health Preparedness	Planning and responding to health emergencies, including natural disasters and disease outbreaks along with ambulance services
7	Occupational Health	Health risks associated with various occupations in rural areas and strategies for prevention and management.
8	Point of care Ultrasonography (POCUS)	Use of portable ultrasound devices for rapid diagnosis and management of various conditions.
9	Psychosocial determinants of Health	Explore the social, economic, and psychological factors that influence health and well-being in rural communities.
10	Resource management	Methods of efficient management of limited human and material resources
11	Rural- Specific Ethics	Awareness and response to ethical issues unique to rural healthcare, such as confidentiality in small communities and equitable access to care.

Table 17: Useful skills that were taught in a training on RRH provision

	Themes from the responses	Summary statements
1	5S Implementation	Applying the 5S methodology (Sort, Set in order, Shine, Standardize, Sustain) to improve workplace organization and efficiency.
2	Active follow ups	Ensures continuous patient care, improved treatment adherence.
3	Administrative and managerial skills	Skills in managing healthcare facilities like budgeting, staffing and strategic planning.
4	A-E assessment	Perform systematic assessments of patients using the Airway, Breathing, Circulation, Disability and Exposure (A-E) approach.
5	Basic Physiotherapy skills	Basic physiotherapy interventions to aid in patient rehabilitation and recovery.
6	Critical care skills	Manage critically ill patients with advanced life support and intensive care techniques.
7	Diplomacy	Navigate interpersonal and interprofessional relationships with tact and sensitivity.
8	Excellent driving skills	Safely operate vehicles, including ambulances, in various terrains and conditions.
9	Leadership skills	Lead teams effectively, inspiring and guiding others towards efficient patient care.
10	Monitoring and evaluation	Assess the effectiveness of health programs and interventions, using data to inform improvements.
11	Outbreak investigation	Identify, investigate, and control infectious disease outbreaks to protect public health.
12	Selfcare and wellbeing	Maintain personal health and well-being to provide sustainable care for others. Includes exploring effective stress management strategies.

Table 18: Useful skills that were taught in a training on RRH provision

	Themes from the responses	Summary statements
1	Advanced skills/specialised skills	Train in specialized medical procedures and advanced clinical techniques to handle complex cases and emergencies.
2	Consultation skills	Enhance communication skills for effective patient consultations, ensuring clear and empathetic interactions.
3	Life skills	Teach essential life skills such as self-awareness and confidence, decision making, interpersonal relationships, time management, stress management, and work-life balance to support personal and professional well-being.
4	Quiet advocacy	Advocate for patients and communities subtly and effectively, promoting health equity.
5	Self Confidence	Build self-confidence through practical experience and positive reinforcement.
6	Teaching and Mentorship skills	Ability to teach and mentor junior staff and students, fostering a supportive learning environment.

Table 19: Useful things that were felt might be taught in a training on RRH provision

	Themes from the responses	Summary statements
1	Altruism	Acts of selflessness and concern for the well-being of others are highly valued and contribute significantly to the community
2	Clinical reasoning	Teach systematic approaches to diagnose and manage patient conditions rather than relying heavily on investigations
3	Collaborative working	Teamwork, communication, shared goals and outcomes with multiple disciplines
4	Digital healthcare	Integration and awareness of digital technologies to enhance healthcare access and patient care
5	Drug Inventory	Maintaining an efficient and accurate inventory of drugs, appropriate storage and the tracking of expiry dates, especially as demand fluctuates
6	Health informatics	Use of information technology to collect, store, analyse and share health data to improve health care delivery

7	Immersive Community Engaged Education	Involving trainees to be able to achieve some training in rural areas and take part in local health initiatives to foster strong ties with the communities
8	Immunisation activities	Learning about and becoming involved in immunisation programs and activities such as vaccination logistics, campaigning and administration during training
9	Maternal and child health issues	Concepts focusing on Health and well-being of mothers, infants and children- Preventive care, early intervention, essential health services
10	Mental Health concepts	The way in which emotional, psychological and social aspects influence a human's thoughts, feelings and actions which are crucial for wellbeing
11	Nutrition	Principles of nutrition and dietary management-essential in preventing chronic diseases and supporting patient recovery and wellbeing
12	Advantages of working in rural areas	For example, the unique benefits such as close-knit communities, diverse clinical experiences, and opportunities for leadership and innovation
13	Principles of Practice	Adhering to core principles of clinical practice such as ethics, patient centred care and prompt decision making based on local context rather than relying on international standards
14	Principles of Public Health	Disease prevention, health promotion and prolongation of life through organised efforts of the stakeholders
15	Quality improvement methods	Introduction to the tools and techniques for improving healthcare processes and patient outcomes
16	Reflective Practice	Encouragement of self-assessment and continuous learning through regular reflection on clinical experiences and patient interactions
17	Research skills	Development of skills in designing, conducting, and analysing research to contribute to evidence-based practice and problem solving (Action research)
18	Supervision skills	Equip trainees with the ability to mentor and supervise junior staff and students effectively
19	Types of medical practice	An understanding of the various models which might be used in different settings for example solo practice, Group practice, hospital-based practice, community health centres, etc
20	Volunteering	The many ways in which it is possible to demonstrate a commitment to helping others

Apart from the above themes, the participants shared their lessons learned from their experience of providing health and medical care for remote and rural populations as below:

Table 20: Experience and learnings from Remote and rural practice

SI No.	Lessons learned from practice
1	Serving as an example
2	Open mindedness
3	Change takes time
4	Community involvement for health is key to success
5	Many opportunities in the remote and rural health provision
6	Need for resilience and Selfcare
7	Networking
8	Resource limitation is a constant
9	Health education enhances practise
10	Structure and Politics of the health system
11	Clinical courage
12	Developing a rural lifestyle
13	Caring about people & relationships
14	Dynamic and creative
15	Stakeholders are important
16	Impactful leadership
17	Respecting and being sensitive
18	Digital equipment is important
19	Empathy

The participants mentioned that standard textbooks, online resources like official websites of governments where guidelines are provided, manuals, handbooks, journal articles, colleague networks, conferences, webinars, Artificial intelligence and certain web based, and mobile based applications are all useful resources helping them with their practice in Remote and rural areas. More details are given in table 21.

Table 21: Most useful resources that help in remote and rural health and medical practice

	Most Useful Resources
1	Oxford Handbook of Humanitarian Medicine
2	British National Formulary
3	UpToDate (Online Clinical Resource)
4	BMJ Best Practice (Online Resource)
5	Remote Primary health care manuals,au
6	ACRRM resources
7	Guidelines for Preventive care
8	Queensland Health Pathways for Rural Practice
9	Agency for Clinical Innovation
10	Emergency NSW Rural Adult Emergency Clinical Guidelines

11	Rural paediatric Emergency Clinical guidelines-3rd Edition
12	RFDS clinical manuals
13	Rural Emergency Care Institute
14	"General Practice" by John Murtagh
15	On call Principles and Protocols, 7th Edition/Shane Marshall
16	Australia's rural, remote and indogenous health/Janie Dade Smith
17	Tropical surgery
18	Tropical dermatology
19	Haspel's book on Obstetric urgencies
20	Manson's tropical diseases
21	Paediatric care in tropics
22	King's book on Fractures
23	Medscape
24	National guidelines
25	Artificial Intelligence
26	The Primary Clinical care manual, emergency and trauma care for nurses and Paramedics
27	Youtube videos of RACGP
28	https://en.hesperian.org/hhg/Disabled_Village_Children
29	AAFP website
30	European Resuscitation council books
31	Dynamed
32	Medical Letter
33	Rx Files
34	Drugs and Drugs
35	DermNet
36	Where there is no doctor by David Werner
37	The South African Family Practice Manual
38	EML guidance App
39	Colleague networks
40	The ECG Made Easy Paperback by John Hampton
41	Local community health data and resources
42	Norsk legehandbok
43	WONCA rural group
44	Mind the Gap
45	Rural seeds
46	Webinars
47	Digital emergency medical handbook
48	Digital pediatric guide
49	EDCare- a handbook for emergency practice
50	Rural Rehab South Africa
51	Textbook of Family Medicine by Rakel
52	UN & WHO websites
53	EmONC- COURSE
54	Leadership and Management in Health
55	WHO primary Healthcare leadership course

56	AMREF Jibu Leadership and Management in Health Systems Strengthening Program
57	Comprehensive Advanced Life Support (CALs) Program
58	CRANaplus courses
59	National Rural and Remote Nursing Framework
60	Emergency simulation courses
61	Beyond Blue
62	Quitline
63	Society of Rural Physicians of Canada website
64	CARE course- Comprehensive Approach to Rural Emergencies
65	Harrison' medicine
66	Books by story tellers talking about Country Doctor
67	Books on motivational interviewing

Results from Round 2:

After round 2 of rating the themes on a Likert scale of 1-5 for agreement on the appropriateness for Knowledge topics to be taught in a remote and rural healthcare/medical training, 13 themes achieved higher mean scores with standard deviation less than or equal to 1. These themes had % agreement levels greater than 75% and IQR was also narrow or below or equal to 1 indicating consensus. However, 9 themes had borderline consensus. The theme 'Anaesthesia' had lower support with % agreement less than 50% but due to its significance, all these themes were sent for re rating for third round of Delphi to observe for consensus (**Table 22**). The Themes *ENT, Basic Dental Procedures, Health economics and Elementary alternative medicine*, had lower support (lesser % and mean scores) with wider SD and IQR and hence were eliminated at this stage (**Table 22**).

Similarly, under Useful skills, 5S Implementation, Basic Physiotherapy and Excellent driving skills were eliminated. Themes such as 'Advanced skills, 'Diplomacy', 'Monitoring and Evaluation', 'Outbreak investigation', 'Active follow ups' and 'Admin and managerial skills' were sent for reconsideration in Round 3 (**Table 23**).

Under Useful things, 'Altruism', 'Drug Inventory', 'Immunisation activities', 'Nutrition', 'Research skills', 'Types of medical practice' and 'Volunteering' were sent for re-rating in the next round due to inconsistent comments from the participants in round 2 (**Table 24**).

Table 22: Essential KNOWLEDGE TOPICS for a course on remote and rural practice

SI No.	Theme	Rating: n (%)	Mean (SD), IQR	Comments
1	Emergency Medicine & Acute care	Agree 45 (97.83) Disagree 1 (2.17) Neutral 0 (0.0)	4.9 (0.6), 0	Extremely important as most patients lose their lives in this stage and this is where most early career rural health professionals lack confidence in.
2	General Medicine	Agree 42 (89.13) Disagree 0 (0.0) Neutral 5 (10.87)	4.6 (0.7), 1	'Backbone' of all the medical care- essential for holistic patient care.
3	Psychiatry	Agree 41 (87.23) Disagree 0 (0) Neutral 6 (12.76)	4.5 (0.7), 1	Has a huge impact on quality of life and ability to carry out essential tasks of daily living.
4	Geriatrics & Palliative care	Agree 43 (78.26) Disagree 2 (4.35) Neutral 2 (4.35)	4.5 (0.9), 1	Important due to demographics in Remote and rural areas but some panelists opine that higher specialized services are required.
5	Chronic disease screening & management	Agree 40 (85.10) Disagree 1 (2.13) Neutral 6 (12.76)	4.5 (0.8), 1	Crucial due to the growing disease burden but these are only effective only when treatments are available locally.
6	Diagnostic Procedures	Agree 39 (82.97) Disagree 2 (4.25) Neutral 6 (12.76)	4.4 (0.9), 1	Key to ordering appropriate investigations and to interpret them- Cost & time effective, can even avoid referrals.
7	Rural specific ethics	Agree 39 (83.0) Disagree 4 (8.51) Neutral 4 (8.51)	4.4 (1.1), 1	Culture and prevailing ethics may have a significant impact on communication and consultation- Under recognized area
8	Health Education	Agree 37 (78.72) Disagree 2 (4.25) Neutral 8 (17.02)	4.3 (1.0), 1	Important for all doctors, nurses and other community health workers as preventive medicine is the core of primary care. Rural appropriate communication is the key.
9	Psychosocial determinant of health	Agree 37 (78.72) Disagree 2 (4.25) Neutral 8 (17.02)	4.3 (1.0), 1	Most important of all as health system accounts for only about 25% of an individual's health.
10	Health Services	Agree 38 (80.85) Disagree 2 (4.25) Neutral 7 (14.89)	4.3 (1.0), 1	Extremely important for rural health workers to understand how the health services are organized.

11	Indigenous Health	Agree Disagree Neutral	39 (82.97) 3 (6.38) 5 (10.63)	4.3 (1.0), 1	Indigenous populations are substantial in rural and remote communities & they have special needs. Cultural safety & strengths-based approach are necessary components.
12	Basic medical subjects	Agree Disagree Neutral	36 (76.60) 3 (6.38) 8 (17.02)	4.2 (1.1), 1	Are a must, should be taught based on principles rather than facts to memorise.
13	POCUS	Agree Disagree Neutral	38 (80.85) 2 (4.25) 7 (14.90)	4.2 (1.0), 1	Basic and vital diagnostic tool for doctors to assist with timely diagnosis and management of conditions. It has become as important as stethoscope and BP Cuff for rural generalists- a game changer!
14	Obstetrics & Gynaecology	Agree Disagree Neutral	35 (74.46) 0 (0) 12 (25.53)	4.3 (0.8), 1.5	Improving women's health is fundamental to improving general population health. But independent midwives and falling birth rate means it has become peripheral for rural doctors.
15	Health Preparedness	Agree Disagree Neutral	35 (74.50) 2 (4.25) 10 (21.27)	4.2 (1), 1.5	Important recently due to increased climate-based events and pandemics- Again a basic information is enough and a separate discipline helps.
16	Resource Management	Agree Disagree Neutral	34 (72.34) 3 (6.4) 10 (21.27)	4.1 (1), 2	Key determinant of clinical coverage- but mostly theoretical and hence not a priority.
17	Home therapies	Agree Disagree Neutral	33 (70.21) 4 (8.51) 10 (21.27)	4.1 (1.1), 2	Reduces burden on health system, economic and locals prefer this. Home therapies vary significantly across different cultures and populations and hence effectiveness is not ensured.
18	Environment Health	Agree Disagree Neutral	33 (70.21) 5 (10.63) 9 (19.15)	4 (1.2), 2	Most diseases are caused by environmental factors- aetiology but mainly a domain of public health officer.
19	Dermatology	Agree Disagree Neutral	34 (74.34) 4 (8.51) 9 (19.15)	4 (1.1), 2	High prevalence of skin conditions are reported from rural areas however there are plenty of online resources for help.

20	General Surgery	Agree Disagree Neutral	32 (68.08) 8 (17.02) 7 (14.89)	4 (1.1), 2	Basic procedures like IV access, c-section, wound care, suturing are essential- again vary with region. These could be lifesaving but may not be essential in all rural setups.
21	Health Legislation	Agree Disagree Neutral	35 (74.46) 4 (8.51) 8 (17.02)	4 (1), 1.5	Awareness is fine not the detail concepts such as geographical narcissism and structural foundational urbanism would be.
22	Occupational Health	Agree Disagree Neutral	29 (61.70) 6 (12.76) 12 (25.53)	3.8 (1.1), 2	Understanding occupational risks specific to certain region comes handy for rural generalist but is more suitable for PG study.
23	Anaesthesia	Agree Disagree Neutral	22 (46.80) 10 (21.27) 15 (31.91)	3.4 (1.2), 1	Only required in special cases and very isolated communities. This needs to be done in specialized hospitals and clinics.
Themes that did not reach the consensus in Round 2 and eliminated					
24	ENT	Agree Disagree Neutral	27 (57.5) 5 (10.6) 15 (31.9)	3.7 (1.1), 2	Desirable with regards to quality of life but unsure if more important than Ophthalmology.
25	Basic Dental Procedures	Agree Disagree Neutral	14 (29.8) 18 (38.3) 15 (32)	2.8 (1.3), 2	Separate dental services are provided in rural areas and need not be part of RRH.
26	Health Economics	Agree Disagree Neutral	24 (51) 9 (19.2) 14 (29.8)	3.6 (1.2), 2	For responsible finance management, but not very important nor a priority.
27	Elementary Alternative Medicine	Agree Disagree Neutral	17 (36.2) 20 (42.5) 10 (21.3)	3 (1.4), 2	Might be cost effective but not backed by evidence and efficiency is doubtful.

Table 23: Useful Skills to be incorporated in a course on RRH provision

SI No.	Theme	Rating: n (%)	Mean (SD), IQR	Comments	
1	Selfcare & Wellbeing	Agree Disagree Neutral	40 (93) 0 (0) 3 (7)	4.7 (0.6), 1	Essential for a sustainable and fulfilling career and for coping with burnout.
2	Consultation skills	Agree Disagree Neutral	39 (90.7) 0 (0) 4 (9.3)	4.6 (0.7), 1	Training in and being able to switch consultation modes is critical for rural generalists.

3	A-E assessment	Agree Disagree Neutral	36 (83.7) 1 (2.3) 6 (14)	4.6 (0.8), 0.5	Learning skills in a systematic approach to patient assessment is important. And this method is best in emergency and to act first.
4	Leadership skills	Agree Disagree Neutral	37 (86.04) 0 (0) 6 (14)	4.4 (0.7), 1	How to build and support functioning teams is a key and sometimes that will need leadership and followership- this is critical part of developing identity as a rural clinician.
5	Critical care skills	Agree Disagree Neutral	35 (81.4) 1 (2.3) 7 (16.3)	4.4 (0.8), 1	Vital lifesaving skills- to stabilize patients, however it is important to be aware of limitations.
6	Teaching & Mentorship skills	Agree Disagree Neutral	37 (86.04) 2 (4.7) 4 (9.3)	4.3 (0.8), 1	Should be a special training for professionals who are allocated trainees.
7	Life skills	Agree Disagree Neutral	36 (83.7) 2 (4.7) 5 (11.6)	4.3 (0.9), 1	Quite essential due to stress of work to improve self-care but rural immersion provides more opportunities to assess students' life skills.
8	Self confidence	Agree Disagree Neutral	33 (76.7) 2 (4.7) 8 (18.6)	4.1 (1), 1	Will grow with practicing/experience and crucial among team members.
9	Quiet advocacy	Agree Disagree Neutral	33 (76.7) 4 (9.3) 6 (14)	4.1 (1.1), 1	Not necessarily 'quite'- Physicians need to be 'along siders' in many cases, especially in advocating for communities. Patient advocacy is immediate and physician to physician advocacy is different altogether!
10	Advanced skills	Agree Disagree Neutral	30 (70) 4 (9.3) 9 (21)	4.1 (1), 2	To be geared to specific health professionals according to the needs of the community.
11	Diplomacy	Agree Disagree Neutral	27 (62.7) 3 (6.9) 13 (30.2)	4.1 (1), 2	Could be a part of leadership and communication skills. Advocacy is better word. Required for cohesive team.
12	Monitoring and evaluation	Agree Disagree Neutral	30 (70) 2 (4.7) 11 (25.6)	4 (0.9), 2	Important to track progress and sustainability of services.
13	Outbreak Investigation	Agree Disagree Neutral	27 (62.7) 4 (9.3) 12 (27.9)	3.9 (1.1), 2	More of Public health role. Basic knowledge is enough.

14	Active follow ups	Agree 30 (70) Disagree 4 (9.3) Neutral 9 (21)	3.9 (1.1), 2	Key for effective and excellent care.
15	Admin & Managerial skills	Agree 28 (65.1) Disagree 5 (11.6) Neutral 10 (23.3)	3.8 (1.2), 2	A basic understanding is helpful, elective module could help.
Themes that did not reach the consensus in Round 2 and eliminated				
16	5S Implementation	Agree 17 (39.5) Disagree 7 (16.3) Neutral 19 (44.2)	3.3 (1.2), 1	Why limit to one framework around implementation!
17	Basic Physiotherapy skills	Agree 21 (48.8) Disagree 11 (25.6) Neutral 11 (25.6)	3.4 (1.2), 1.5	Awareness of appropriate exercise activities helpful but beyond that it is a specialist discipline. Mostly referred to Physiotherapists.
18	Excellent driving skills	Agree 19 (44.2) Disagree 9 (21) Neutral 15 (34.8)	3.4 (1.1), 1	Might be necessary in some situations but most of the times unlikely- A plus not an essential.

Table 24: Useful things in a course on remote and rural practice

SI No.	Theme	Rating: n (%)	Mean (SD), IQR	Comments
1	Immersive community engaged education	Agree 42 (97.7) Disagree 0 (0) Neutral 1 (2.3)	(0.5), 0	There is no rural healthcare without engagement with the communities.
2	Clinical Reasoning	Agree 42 (97.7) Disagree 1 (2.3) Neutral 0 (0)	4.8 (0.7), 0	Extremely important in areas where availability of investigations is unreliable.
3	Mental health concepts	Agree 38 (88.4) Disagree 1 (2.3) Neutral 4 (9.3)	4.6 (0.8), 0.5	Understanding this pillar of good health is essential when other mental health services are often lacking in rural areas.
4	Advantages of working in rural areas	Agree 37 (86.04) Disagree 1 (2.3) Neutral 5 (11.6)	4.5 (0.9), 1	Advantages are not the same for each person. To thrive in rural areas valuing the advantages of working here is a must.
5	Principles of Public health	Agree 37 (86.04) Disagree 2 (4.7) Neutral 4 (9.3)	4.4 (0.9), 1	Integrating public health into rural medicine and collaborating is something to learn and vital because healthy people = healthy community.

6	MCH issues	Agree Disagree Neutral	36 (83.7) 1 (2.3) 6 (14)	4.4 (0.9), 1	Quite important and inputs in these phases of life can be transformational.
7	Reflective Practice	Agree Disagree Neutral	35 (81.4) 1 (2.3) 7 (16.3)	4.4 (0.8), 1	Self-audit helps in continuous improvements- Lifelong learning ; and needs to be encouraged throughout the educational journey.
8	Supervision skills	Agree Disagree Neutral	35 (81.4) 2 (4.7) 6 (14)	4.4 (1), 1	Appropriate when learnt after becoming a senior. This is important and satisfying and is an important contributor to both recruitment and retention to rural practice.
9	Collaborative Working	Agree Disagree Neutral	42 (97.7) 1 (2.3) 0 (0)	4.4 (1.2), 0	Successful rural care relies on working with teams and networks locally, at a distance and with communities.
10	Digital healthcare	Agree Disagree Neutral	33 (76.7) 1 (2.3) 9 (20.9)	4.3 (0.9), 1	'Many new advancements can benefit rural/remote populations but knowing how network and internet is not great-I bet to differ!'
11	Quality improvement methods	Agree Disagree Neutral	34 (79.1) 1 (2.3) 8 (18.6)	4.2 (0.8), 1	Very important as healthcare services must be continuously improved.
12	Principles of practice	Agree Disagree Neutral	35 (81.4) 3 (7) 5 (11.6)	4.2 (1.0), 1	'Important because patients must be treated with maximum respect but essential to know about geographical narcissism and potato ethics'
13	Health informatics	Agree Disagree Neutral	33 (76.7) 3 (7) 7 (16.3)	4.1 (0.9), 1	This is ever evolving area that learners need to be competent in- can be a part of record keeping in some rural and remote regions.
14	Altruism	Agree Disagree Neutral	25 (58.13) 7 (16.3) 11 (25.6)	3.7 (1.2), 2	Cannot be taught though important and essential. Better to model.
15	Drug Inventory	Agree Disagree Neutral	22 (51.2) 6 (14) 15 (34.8)	3.8 (1.2), 2	Others in the team can manage, though generalists should be aware of the procedure.
16	Immunisation activities	Agree Disagree Neutral	28 (65.1) 4 (9.3) 11 (25.6)	4 (1.2), 2	More of public health specific and for primary care team.

17	Nutrition	Agree 26 (60.5) Disagree 2 (4.7) Neutral 15 (34.8)	3.8 (1), 2	A lesser part of rural and remote role. Might be important to tackle malnutrition in MCH care.
18	Research skills	Agree 26 (60.5) Disagree 4 (9.3) Neutral 13 (30.2)	3.8 (1), 2	Important but not Key. An adjunct to Quality improvement.
19	Types of medical practice	Agree 23 (53.5) Disagree 10 (23.3) Neutral 10 (23.3)	3.5 (1.3), 2	Not really, a discussion on this might help!
20	Volunteering	Agree 18 (42) Disagree 13 (30.23) Neutral 12 (28)	3.2 (1.4), 2	This is more learnt by example teaching.

Results from Round 3:

Under Essential 'Knowledge topics' 7 themes out of 10 achieved a higher % agreement levels and mean agreement scores with relatively narrower SD and IQR. The remaining 3 themes namely 'Environment Health', 'Health Legislation' and 'Anaesthesia' are eliminated (**Table 25**). Under 'Useful skills' category, 'Advanced skills', 'Monitoring and Evaluation', 'Outbreak Investigation' were eliminated after round 3 as they had lesser to borderline agreement accompanied by narrower IQR, SD and appropriate justifications explained by the participants (**Table 26**). All the 7 themes under 'Useful things' did not get agreement levels and hence are eliminated after round 3 (**Table 27**).

Changes on the themes from round 2 to round 3 after not getting consensus under the 3 categories are depicted in **figures 13- 15**. Accordingly, filtration of themes in each round and finalised themes are shown from **tables 28-30**.

Ranking of all the themes that achieved consensus by the end of round 3 are listed in Table 31.

Table 25: Round 3 agreement for 'Essential KNOWLEDGE TOPICS' for a course on remote and rural practice that did not get consensus in Round 2

SI No.	Theme	Rating: n (%)	Mean (SD), IQR	Comments
1	Obstetrics & Gynaecology	Agree 40 (93) Disagree 1 (2.3) Neutral 2 (4.7)	4.4 (0.9), 1	Important component of human life cycle-forms major part of primary care in rural population.
2	Health Preparedness	Agree 35 (81.4) Disagree 5 (11.6) Neutral 3 (7)	4.1 (1.1), 1	Planning to health emergencies such as natural disasters and disease outbreaks along with transport systems is a duty of rural generalist. It is crucial for minimizing negative impacts of emergencies on public health.
3	Resource Management	Agree 32 (74.4) Disagree 3 (7) Neutral 8 (18.6)	4 (1), 2	Important knowledge in any practice even more so in locations where such resources cannot quickly be replenished.
4	Home therapies	Agree 32 (74.4) Disagree 6 (13.9) Neutral 5 (11.6)	3.9 (1.1), 2	Without these rural services become overwhelmed. Patients are empowered to self-manage health issues.
5	<i>Environment Health</i>	Agree 28 (65.1) Disagree 5 (11.6) Neutral 10 (23.3)	3.9 (1.1), 2	Environmental health factors definitely impact population health, but their management lies outside immediate responsibility of the rural health care practitioners.
6	Dermatology	Agree 33 (76.7) Disagree 4 (9.3) Neutral 6 (13.9)	4 (1.1), 1	Tele-dermatology decreases the need but currently essential for rural generalist practice.
7	General Surgery	Agree 33 (76.7) Disagree 5 (11.6) Neutral 5 (11.6)	4 (1.1), 1	Surgery remains gold standard in emergency globally.
8	<i>Health Legislation</i>	Agree 28 (65.1) Disagree 4 (9.3) Neutral 11 (25.6)	3.7 (1), 1	Not necessary, no major role – just useful for advocacy.
9	Occupational Health	Agree 32 (74.4) Disagree 4 (9.3) Neutral 7 (16.3)	3.8 (1), 0.5	Workplace is a major determinant of the health and well-being of individuals- hence essential.
10	<i>Anaesthesia</i>	Agree 24 (55.8) Disagree 8 (18.6) Neutral 11 (25.6)	3.4 (1.1), 1	Less important in primary care- more specialized role.

Table 26: Round 3 agreement for Useful Skills to be incorporated in a course on RRH provision that did not get consensus in Round 2

	Theme	Rating: n (%)	Mean (SD), IQR	Comments
1	Advanced skills	Agree 29 (67.4) Disagree 7 (16.3) Neutral 7 (16.3)	3.6 (1.1), 1	Knowing enough to stabilize and transfer is fine. Not desirable at rural set ups.
2	Diplomacy	Agree 34 (79.1) Disagree 3 (7) Neutral 6 (13.9)	4 (1), 1	Teaching with case studies might be helpful.
3	Monitoring and evaluation	Agree 31 (72.1) Disagree 5 (11.6) Neutral 7 (16.3)	3.8 (1), 1	Not essential but good to know.
4	Outbreak Investigation	Agree 28 (65.1) Disagree 9 (20.9) Neutral 6 (13.9)	3.6 (1.1), 1	'You should be aware and report, but the next steps are for Public health professionals.'
5	Active follow ups	Agree 35 (81.4) Disagree 5 (11.6) Neutral 3 (7)	4 (1.1), 1	This is the 'Breakfast of champions' – Result oriented.
6	Admin & Managerial skills	Agree 28 (65.1) Disagree 8 (18.6) Neutral 7 (16.3)	3.5 (1.1), 1	These are learnt skills to manage health care facilities, but not necessarily a primary role for all.

Table 27: Round 3 agreement for Useful things in a course on remote and rural practice that did not get consensus in Round 2

SI No.	Theme	Rating: n (%)	Mean (SD), IQR	Comments
1	Altruism	Agree 21 (48.8) Disagree 10 (23.3) Neutral 12 (27.9)	3.4 (1.1), 1	Can lead to burnout, this cannot be taught! Goes against self care!
2	Drug Inventory	Agree 24 (55.8) Disagree 12 (27.9) Neutral 7 (16.3)	3.4 (1.3), 2	Important only in remotest health centres.
3	Immunisation activities	Agree 29 (67.4) Disagree 6 (13.9) Neutral 8 (18.6)	3.8 (1.1), 2	Dedicated positions in healthcare systems take care of this- a priority for practice management, not for individuals.
4	Nutrition	Agree 29 (67.4) Disagree 4 (9.3) Neutral 10 (23.3)	3.8 (1), 1	Some knowledge helps to get alert for alarm symptoms.
5	Research skills	Agree 24 (55.8) Disagree 6 (13.9) Neutral 13 (30.2)	3.5 (1), 1	Knowing how to understand and apply research is sufficient.
6	Types of medical practice	Agree 16 (37.2) Disagree 10 (23.3) Neutral 17 (39.5)	3.1 (1), 1	Exploring 'how' helps rather than knowing the strengths and limitations of different existing models.
7	Volunteering	Agree 12 (27.9) Disagree 16 (37.2) Neutral 15 (34.9)	2.9 (1), 2	It should be part of intentions! Not to be taught! This can foster community relationship, empathy, trust building etc.

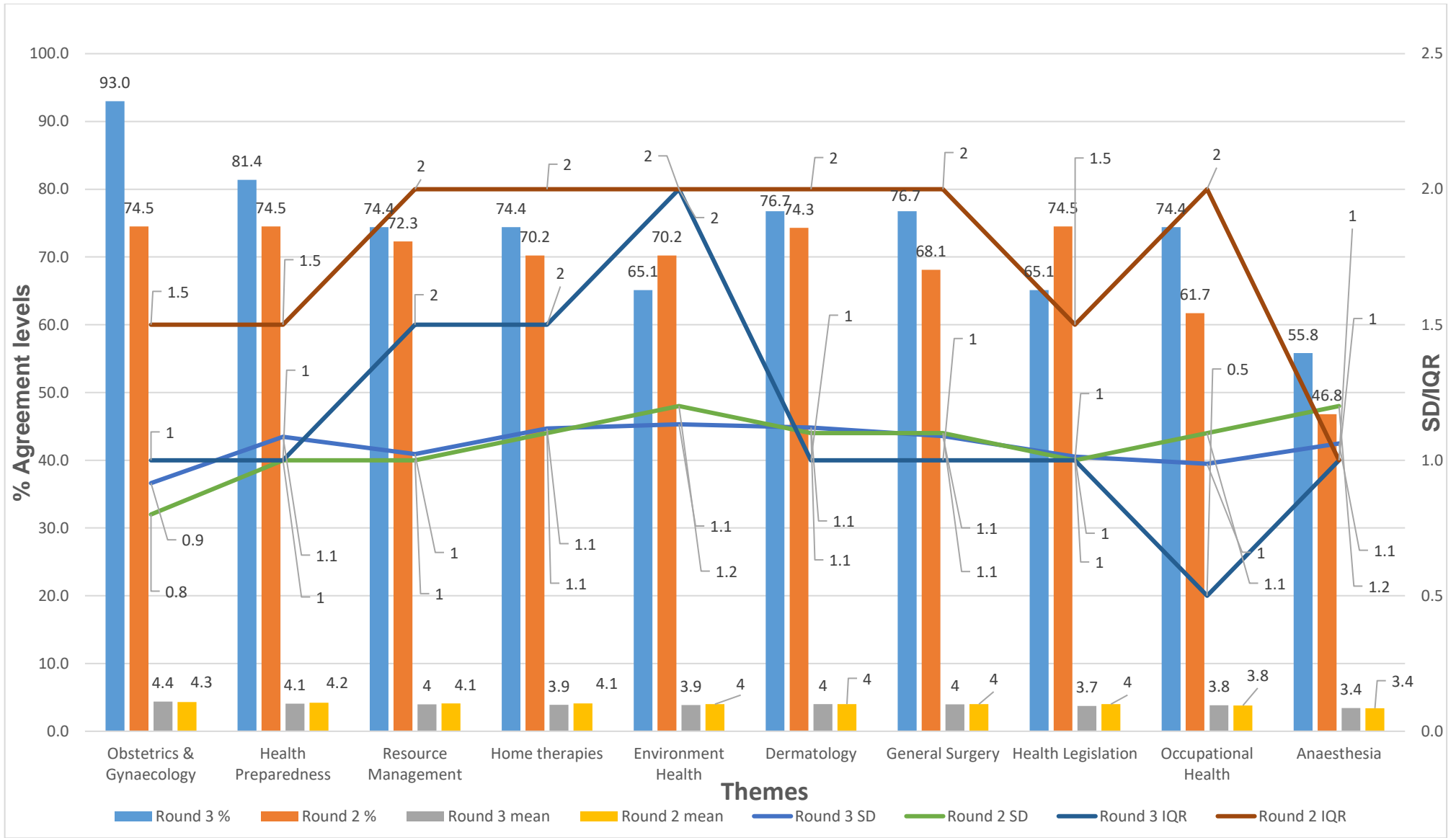


Figure 13: Variation of themes under ESSENTIAL KNOWLEDGE TOPICS in Rounds 2 and 3

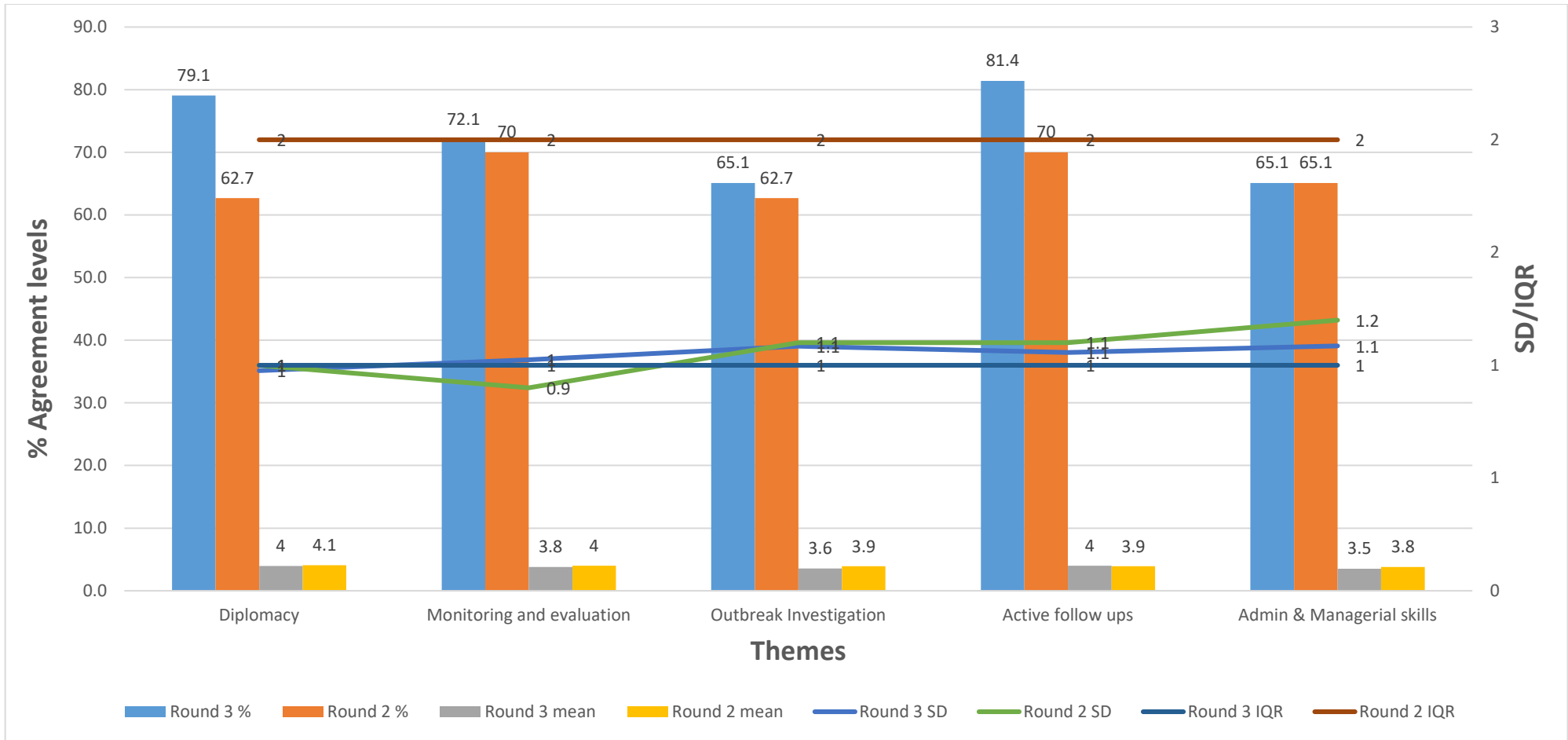


Figure 14: Variation of themes under Skills in Rounds 2 and 3

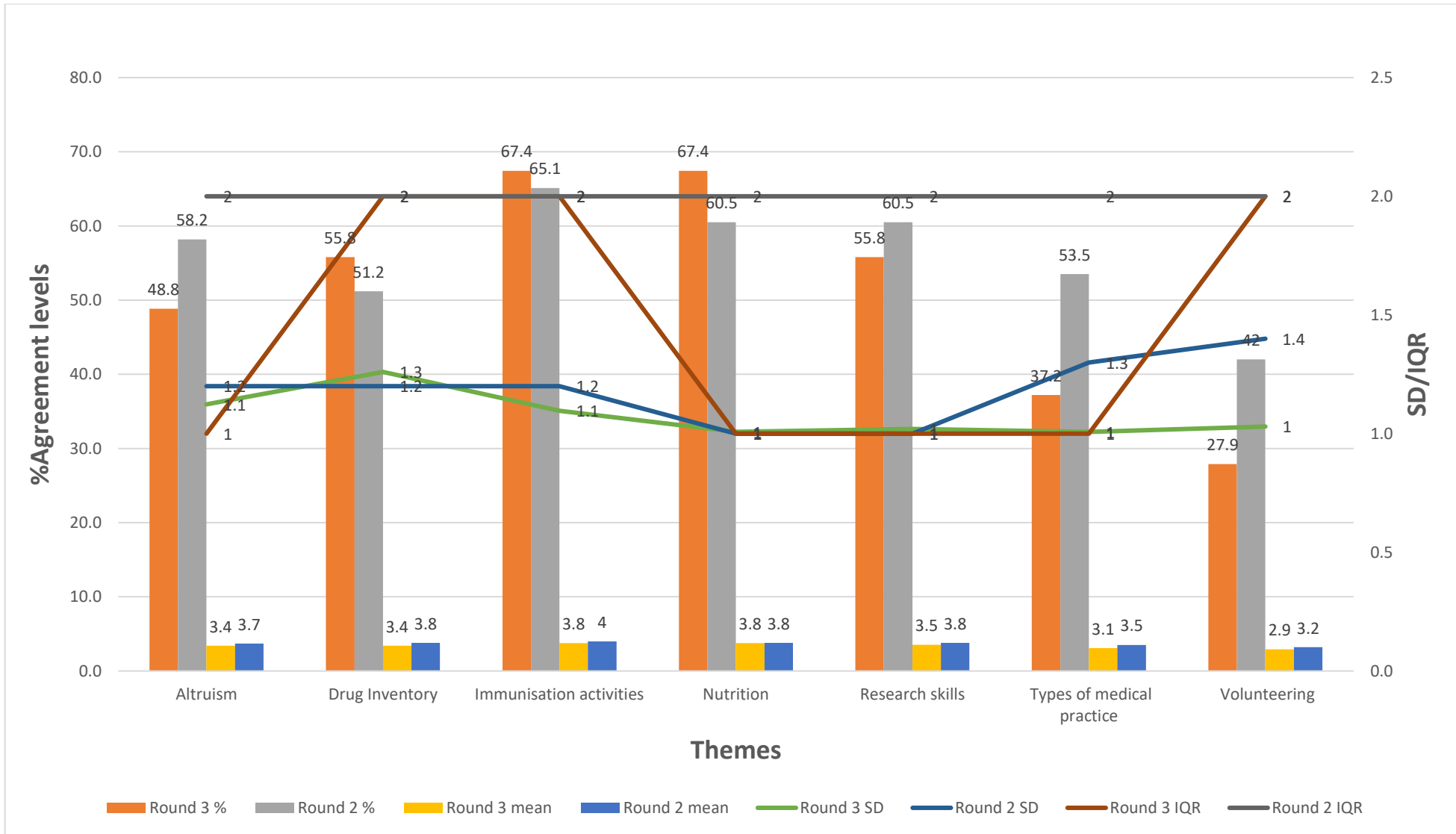


Figure 15: Variation of themes under Useful things in Rounds 3 and 2

Table 28: Filtration of themes under 'Knowledge Topics' to be covered in a RRH course

SI No.	Theme	Consensus reached in R2	Consensus reached in R3	Finalised (n=16)
1	Basic Medical subjects	Yes		✓
2	Dermatology	No	Yes	✓
3	Diagnostic procedures & interpretation	Yes		✓
4	Emergency Medicine and Acute Care	Yes		✓
5	ENT	Less than 60% agreed	No	x
6	General Medicine	Yes		✓
7	Geriatrics & Palliative care	Yes		✓
8	General surgery	No	Yes	✓
9	Health Education	Yes		✓
10	Health Legislation & policy	No	No	x
11	Health services	Yes		✓
12	Home therapies	No	No	x
13	Indigenous Health	Yes		✓
14	Chronic Disease Screening & management	Yes		✓
15	Obstetrics and Gynaecology	No	Yes	✓
16	Psychiatry	Yes		✓
17	Anaesthesia	No	No	x
18	Basic Dental procedures	Less than 30% agreed	No	x
19	Elementary alternative medicines	Less than 40% agreed	No	x
20	Environment Health	No	No	x
21	Health Economics	Less than 60% agreed	No	x
22	Health Preparedness	No	Yes	✓
23	Occupational Health	No		x

24	Point of care Ultrasonography (POCUS)	Yes		✓
25	Psychosocial determinants of Health	Yes		✓
26	Resource management	No	No	x
27	Rural- Specific Ethics	Yes		✓

Table 29: Filtration of themes under 'Useful skills' to be covered in a RRH course

SI No.	Theme	Consensus reached in R2	Consensus reached in R3	Finalised (n=11)
1	5S Implementation	Less than 40% agreed		x
2	Active follow ups	No	Yes	✓
3	Administerial and managerial skills	No	No	x
4	A-E assessment	Yes		✓
5	Basic Physiotherapy skills	Less than 50% agreed		x
6	Critical care skills	Yes		✓
7	Diplomacy	No	Yes	✓
8	Excellent driving skills	Less than 50% agreed		x
9	Leadership skills	Yes		✓
10	Monitoring and evaluation	No	No	x
11	Outbreak investigation	No	No	x
12	Selfcare and wellbeing	Yes		✓
13	Advanced skills/specialised skills	No	No	x
14	Consultation skills	Yes		✓
15	Life skills	Yes		✓
16	Quiet advocacy	Yes		✓
17	Self Confidence	Yes		✓
18	Teaching and Mentorship skills	Yes		✓

Table 30: Filtration of themes under 'Useful things' to be taught in a RRH course

SI No.	Theme	Consensus reached in R2	Consensus reached in R3	Finalised (n=13)
1	Altruism	No	No	x
2	Clinical reasoning	Yes		✓
3	Collaborative working	Yes		✓
4	Digital healthcare	Yes		✓
5	Drug Inventory	No	No	x
6	Health informatics	Yes		✓
7	Immersive Community Engaged Education	Yes		✓
8	Immunisation activities	No	No	x
9	Maternal and child health issues	Yes		✓
10	Mental Health concepts	Yes		✓
11	Nutrition	No	No	x
12	Advantages of working in rural areas	Yes		✓
13	Principles of Practice	Yes		✓
14	Principles of Public Health	Yes		✓
15	Quality improvement methods	Yes		✓
16	Reflective Practice	Yes		✓
17	Research skills	No	No	x
18	Supervision skills	Yes		✓
19	Types of medical practice	No	No	x
20	Volunteering	No	No	x

Table 31: List of all the themes that achieved consensus in round 3 and their rank order

Rank	Theme	Mean (SD), IQR	Category
1	Emergency Medicine & Acute care	4.9 (0.6), 0	Knowledge
2	Immersive community engaged education	4.8 (0.5), 0	Useful things
3	Clinical Reasoning	4.8 (0.7), 0	Useful things
4	Selfcare & Wellbeing	4.7 (0.6), 1	Useful skills
5	General Medicine	4.6 (0.7), 1	Knowledge
6	Consultation skills	4.6 (0.7), 1	Useful skills
7	A-E assessment	4.6 (0.8), 0.5	Useful skills
8	Mental health concepts	4.6 (0.8), 0.5	Useful things
9	Psychiatry	4.5 (0.7), 1	Knowledge
10	Chronic disease screening & management	4.5 (0.8), 1	Knowledge
11	Geriatrics & Palliative care	4.5 (0.9), 1	Knowledge
12	Advantages of working in rural areas	4.5 (0.9), 1	Useful things
13	Leadership skills	4.4 (0.7), 1	Useful skills
14	Critical care skills	4.4 (0.8), 1	Useful skills
15	Reflective Practice	4.4 (0.8), 1	Useful things
16	Diagnostic Procedures	4.4 (0.9), 1	Knowledge
17	Obstetrics & Gynaecology	4.4 (0.9), 1	Knowledge
18	Principles of Public health	4.4 (0.9), 1	Useful things
19	MCH issues	4.4 (0.9), 1	Useful things
20	Supervision skills	4.4 (1), 1	Useful things
21	Rural specific ethics	4.4 (1.1), 1	Knowledge
22	Collaborative Working	4.4 (1.2), 0	Useful things
23	Teaching & Mentorship skills	4.3 (0.8), 1	Useful skills
24	Life skills	4.3 (0.9), 1	Useful skills
25	Digital healthcare	4.3 (0.9), 1	Useful things
26	Health Education	4.3 (1.0), 1	Knowledge

27	Psychosocial determinant of health	4.3 (1.0), 1	Knowledge
28	Health Services	4.3 (1.0), 1	Knowledge
29	Indigenous Health	4.3 (1.0), 1	Knowledge
30	Quality improvement methods	4.2 (0.8), 1	Useful things
31	Principles of practice	4.2 (1.0), 1	Useful things
32	POCUS	4.2 (1.0), 1	Knowledge
33	Basic medical subjects	4.2 (1.1), 1	Knowledge
34	Health informatics	4.1 (0.9), 1	Useful things
35	Self confidence	4.1 (1), 1	Useful skills
36	Quiet advocacy	4.1 (1.1), 1	Useful skills
37	Health Preparedness	4.1 (1.1), 1	Knowledge
38	Diplomacy	4 (1), 1	Useful skills
39	Dermatology	4 (1.1), 1	Knowledge
40	General Surgery	4 (1.1), 1	Knowledge
41	Active follow ups	4 (1.1), 1	Useful skills

Discussion

Discussion:

The objectives of the study were achieved by collaborating with an expert panel consisting of doctors, researchers, nurses, physiotherapists and community health workers. A major contribution came from experts from Africa.

Round 1 resulted in 65 themes under sections knowledge topics, useful skills and useful things in a course on remote and rural health/medical practice. All the themes were generated following the 6 steps of Braun and Clark's suggested protocol (Braun, Clarke, 2014). Summary statements were generated based on the judgements and opinions of the experts. After round 2, they reduced to 58 and the final round resulted in consensus on 41 themes. Those themes with borderline consensus, based on the % agreement levels and wide IQR were sent for subsequent round for re consideration of ratings and then to attaining consensus. All the themes were ranked from highest to lowest based on the mean agreement scores across the group.

The Panel of experts in our study demonstrated global representation, and we employed diverse strategies to identify and recruit participants from across the world. Purposive sampling was used to select experts through global platforms and professional networks, including the NCRRM and WONCA conferences. This approach facilitated efficient identification of relevant stakeholders by providing access to geographically diverse pool of highly credible professionals. The strength of this panel significantly supports the international consensus achieved in our study. Furthermore, the high retention rate among the panel members can likely be attributed to this recruitment strategy.

The study started with approaching 95 potential participants as we were aiming for broader international consensus involving multistakeholder perspectives (Manyara et al., 2024). Given the global scope and the aim to develop a widely applicable core curriculum, a larger and diverse panel was necessary to capture the range of knowledge, skills, and contextual factors relevant to remote practice. Round 1 had 51 participants and 43 participants lasted by the end of the study indicating strong participation, participant retention and minimal attrition. This sample size is well within the recommended range for Delphi studies, which typically include between 15 and 50 participants (Dmitry Khodyakov, Sean Grant, Jack Kroger, Melissa Bauman, 2023) . The sustained engagement across all rounds further supports the reliability and validity of the consensus achieved.

The expert panel was diverse in terms of professional roles and experience levels within remote and rural healthcare as the recruitment was through broader networking groups via global platforms. The panel was stable across rounds, dominated by older, highly educated, and experienced professionals, especially from Africa while participation from other regions showed minor fluctuations. While this strengthens the credibility and depth of the consensus, it may limit diversity in age and regional representation, particularly from younger professionals and underrepresented regions.

This study is the first known application of the Delphi method in the field of remote and rural practice and training programs. Only 2 studies have employed a Delphi approach in somewhat related context. However, these differ in methodological scope, participant selection, and thematic focus. Gouveia et al (2016) have conducted a Delphi study to validate competencies for undergraduate training program in rural medicine and they have generated competencies based on a literature review and online curricular frameworks. Moreover, they used a Likert scale rating and the proportions of the participants giving a particular rating to check for consensus. The criteria was a simple majority, but the study did not look for statistical rigor by incorporating measures such as standard deviation or Inter quartile ranges. Retention of participants between the rounds was 50% while ours was 80% and all their competencies had consensus achieved. The expert panel in the case of that study consisted of Family medicine colleagues in Brazil (Gouveia et al., 2016). Another Delphi study on Junior physicians in remote and rural Indonesia had 27 participants and had consensus generation on the attributes and competencies generated by literature search. The study had consensus defined to have 80% agreement and all the competencies achieved the consensus. These themes were similar to those of our own findings. Farah C Noya, Sandra E Carr, Sandra C Thompson (2024).

The limited availability of comparable studies underscores the originality and relevance of our research. Our study represents a novel application of the Delphi method within remote and rural health and medicine, with limited precedent in existing literature. Given the exploratory nature of the research and the need to synthesize expert consensus in an emerging area, the Delphi method was deemed appropriate. Its iterative structure allowed for the refinement of perspectives and the emergence of shared understanding among participants. Anonymity among panel members resulted in the expression of truthful perspectives without peer pressure there by increasing the credibility of our study. A pilot study before round 1 ensured the face and content validity of our study. Importantly, this

study incorporated quantitative triangulation through percentage agreement levels, mean agreement scores, standard deviation, and interquartile ranges (IQR), which enhanced the robustness of the findings by providing statistical insight into the level of consensus and variability across expert responses.

Though we conducted a systematic review and stakeholder workshops before starting the Delphi study which resulted in a number of themes, we decided to also provide open ended questions for the first round of the study to ensure themes were also generated based on the participants' field experience of remote and rural health practice. To address the improved efficiency of health providers in remote and rural populations, we delineated clear sections described as 'Knowledge topics', 'Useful skills' and 'Useful things' to encourage holistic development of course contents on remote and rural medicine/healthcare in the future.

While this study offers valuable insights through the Delphi method, several limitations were encountered and addressed. The novelty of this study is a strength, it also presents challenges in benchmarking against existing literature. However, this was mitigated by grounding the study in established Delphi principles and ensuring methodological transparency. The global nature of the expert panel strengthens the applicability of the findings across contexts; however, regional and cultural differences in interpretation may still influence how certain themes are understood or prioritized.

Although expert selection may reflect certain biases in terms of professional background, clear inclusion criteria were used to ensure relevance and diversity. The participant attrition across rounds was still evident — a common challenge in Delphi studies, this was managed by maintaining regular communication and reminders, resulting in a consistent core group of contributors. Additionally, while manual thematic analysis can introduce researcher bias, this was minimized through systematic coding procedures and peer review of themes. Moreover, manual thematic analysis allowed for greater reflexivity of the text leading to higher quality codes and themes.

The themes drawn from the participant responses reflected the principal needs of rural communities (Thomas, Wakerman & Humphreys).

Essential knowledge topics for a RRH training: Based on the mean scores and % agreement, emergency medicine and acute care was leading theme followed by General

medicine, psychiatry, Chronic disease screening and management. Mixed opinions were seen for Obstetrics and Gynecology due to changing demographics and shift into physiological care than medical in the field. Insights on POCUS were suggesting the changing practices in remote and rural areas. Consensus was least for ENT, basic dental procedures, Health economics, environment health, Health legislation and alternative medicine indicating shift of practitioners towards evidence-based management of the required services. Participants also had varied opinions on home therapies though this has clear implications in reducing the burden on the health systems. Participants suggested 'Health Preparedness' to be an elective module due to both growing disasters and necessity of a separate designation to tackle the same. Though below consensus threshold, improvement on consensus from round 2 to round 3 was seen in the themes 'Resource management, home therapies and Occupational health.

Essential skills for efficient patient management in remote and rural areas:

'Selfcare & Welbeing' followed by Consultation skills were among the highest order under the useful skills list of themes. However, 5S implementation, basic physiotherapy and excellent driving skills were disregarded by majority of participants who cited that these are just a plus, awareness could help but not essential to affect the efficiency of the service provision. Decreased consensus was observed for advanced/ specialization skills theme between round 2 and round 3, well below the accepted consensus level and hence was removed along with Monitoring & Evaluation, Outbreak investigation and Admin and managerial skills.

Essential things (attributes) for efficient patient management in remote and rural areas:

'Immersive community engaged education' and 'clinical reasoning' had highest agreement levels under essential attributes or things category with IQR 0 suggesting strong consensus. All the themes that did not achieve consensus in round 2 remained the same even in round 3. These were Altruism, Drug inventory, Immunisation activities, Nutrition, Research skills, Types of medical practice and volunteering. Participants had consistent voluntary opinions on these themes and IQR was narrowed down in round 3 prompting to eliminate these themes from the finalized list.

Recommendations

Recommendations:

The final consensus on 41 themes spanning essential knowledge topics, practical skills, and useful items for training, reflects a globally informed understanding of what constitutes effective preparation for medical and healthcare practice in rural and remote settings. These findings, supported by both qualitative synthesis and quantitative analysis, offer a strong foundation for actionable recommendations in education, policy, and future research.

Recommendations for Practice and Policy

- Integrate the 41 consensus-based themes into the design of training programs for healthcare professionals preparing to work in remote and rural settings. These themes offer a comprehensive and globally validated foundation for curriculum development.
- Prioritize context-relevant training by adapting the consensus themes to local healthcare systems, especially in low-resource settings.
- Interdisciplinary training models that reflect the diversity of the expert panel, including doctors, nurses, physiotherapists, and community health workers to promote collaborative and team-based approaches in remote healthcare delivery should be encouraged.

Recommendations for Future Research

- Conduct regional Delphi studies to explore how the global consensus aligns with local needs and to identify region-specific training components.
- Evaluate the impact of implementing the consensus themes in real-world training programs through longitudinal studies, assessing outcomes such as practitioner confidence, retention, and patient care quality.

Recommendations for Methodological Development

- Encourage the use of quantitative triangulation in future Delphi studies to enhance the reliability of consensus findings. This study demonstrated the value of using percentage agreement, mean scores, standard deviation, and IQR to support expert judgments.

- Promote global expert participation in Delphi research to ensure a diverse perspective and improve the generalizability of findings across healthcare systems.
- Share best practices for managing Delphi rounds, including strategies for maintaining engagement, handling borderline consensus items, and refining themes through iterative feedback.

Conclusions

Conclusions

The findings from this work extend the current understanding of training programs on Remote and rural medicine and health by offering a structured consensus from experts, which has not been previously documented in this manner. This positions the study as a foundational reference for future research and practice. This research contributes a foundational framework for curriculum development and policymaking in remote health education. It also demonstrates the value of combining qualitative thematic analysis with quantitative triangulation in Delphi studies. The limited number of comparable studies highlights both the originality and the need for further exploration. Future research could build on this framework to replicate or extend this approach across different contexts to validate and enrich the findings and insights generated.

This study offers valuable insights for those seeking to develop a new core curriculum in remote and rural healthcare. Through a rigorous three-round Delphi process, consensus was achieved among a diverse panel of international experts, representing various professional levels and geographic regions. The consensus reached in this study reflects a shared understanding of the essential knowledge areas, practical skills, and supportive resources required for confident and effective practice in remote settings. These findings provide a robust foundation for curriculum designers, educators, and policymakers to structure training programs that are both globally informed and locally adaptable.

By identifying what should be achieved through such training and what it might usefully contain, this study contributes to the development of a curriculum that is responsive to the realities of remote healthcare delivery. It also highlights the importance of integrating perspectives from practitioners working in varied environments, thereby promoting equity, sustainability, and quality in healthcare education.

Appendices

Appendix 1: Ethics Approval letter



University of Central Lancashire
Preston PR1 2HE
01772 201201
uclan.ac.uk

4th June 2024

Catherine Jackson / Suma Rache
School of Medicine and Dentistry
University of Central Lancashire

Dear Catherine / Suma,

Re: HEALTH Ethics Panel Application
Unique Reference Number: HEALTH 01115

The HEALTH Ethics Review Panel has granted approval of your proposal application, 'Can global consensus be arrived at as to the essential components of training for ensuring confident and effective medical practice in remote settings?'.
Approval is granted up to the end of project date*.

It is your responsibility to ensure that

It is your responsibility to ensure that

- the project is carried out in line with the information provided in the forms you have submitted
- you regularly re-consider the ethical issues that may be raised in generating and analysing your data
- any proposed amendments/changes to the project are raised with, and approved, by Committee
- you notify ethicsinfo@uclan.ac.uk if the end date changes or the project does not start
- serious adverse events that occur from the project are reported to Panel
- a closure report is submitted to complete the ethics governance procedures (Existing paperwork can be used for this purpose e.g. funder's end of grant report; abstract for student award or NRES final report. If none of these are available use [e-Ethics Closure Report Proforma](#)).

Yours sincerely,

Simon Alford, Deputy Vice-Chair
HEALTH Ethics Panel

* for research degree students this will be the final lapse date

NB - Ethical approval is contingent on any health and safety checklists having been completed, and necessary approvals gained.

Appendix 2: Emails for Participant Recruitment

1. Email to be sent to gatekeeper for their approval to support with participant recruitment.

Subject: Seeking Approval for Participant Recruitment Support

Dear [XXX],

I hope this message finds you well. My name is Suma Rache, and I am reaching out to you regarding a research project my team is undertaking. I believe my research would be greatly benefited from the expertise and assistance from you and other members in the organisation. It has come to my attention that you play a pivotal role as a potential gatekeeper in XXX [specific organization].

I am planning to conduct a delphi study as a part my PhD research. The Delphi technique is the process for measuring consensus among a group of experts to get controlled opinion feedback by repeated individual questioning of the experts and avoiding direct confrontation. Hence, our crucial step is recruiting experts in the field of remote and rural medicine. We believe that your insight, connections, and support could greatly enhance our efforts in this regard. Your approval to engage with potential participants through your network or platform would be immensely valuable and would significantly contribute to the success of my research project.

I understand the importance of your time and commitments, and I assure you that we will make every effort to ensure that any collaboration is convenient and mutually beneficial. Your involvement would not only assist us in reaching our recruitment goals but would also provide an opportunity for meaningful engagement and partnership between our respective entities.

I would be grateful for the opportunity to discuss this further at your earliest convenience through email exchange.

Thank you,

Warm regards,

Suma Rache
PhD Scholar,
School of Medicine & Dentistry,
University of Central Lancashire.
Email id: srache@uclan.ac.uk

2. A letter/email to a gatekeeper of an organisation asking to forward our email to potential participants for their recruitment into the study

Subject: Request for Assistance in Recruiting Participants

Dear XXX [Gatekeeper's Name],

I hope this message finds you well. My name is Suma Rache, a PhD scholar in medicine from the University of Central Lancashire. I am currently conducting a study titled "Can global consensus be arrived at as to the essential components of training for ensuring confident and effective medical practice in remote settings?" and I Am seeking assistance in recruiting experts in remote and rural medicine who may be interested in taking part in the study. I am undertaking this research under supervision of Prof Cathy Jackson and Prof Stuart Maitland-Knibb.

We understand the importance of engaging with individuals who have a genuine interest, qualifications, and experience in the subject matter of our study. Given your esteemed position within XXX [Organization's Name] and your extensive network, we believe that you may be able to help us reach potential participants who meet our criteria.

The purpose of our study is to get consensus on essential components required for training the healthcare and medical work force to deliver effective medical practice in remote and rural areas. We are particularly interested in individuals who set in the following criteria:

- a. Have a degree level education or above in medicine/nursing/physiotherapy or any other paramedical education.
- b. Have worked/volunteered or working/volunteering in any remote and rural area at least for 5-7 years in your career.

Through their participation, they will be significantly contributing towards our steps to attain health equity around the world.

We kindly request your assistance in forwarding this email to the individuals within your network who you believe may be interested in participating in our study. Your support in sharing this information with potential participants would be greatly appreciated and would contribute significantly to the success of my PhD research.

If you have any questions or require further information about our study, please do not hesitate to contact me directly at srache@uclan.ac.uk. Additionally, if you would prefer to discuss this matter further, I would be more than happy to arrange a convenient time for us to connect over a teams meeting.

Thank you very much for considering our request. We sincerely appreciate your support and assistance in helping us reach out to potential participants for our study.

Warm regards,
Suma Rache, PhD Scholar,
School of Medicine & Dentistry,
University of Central Lancashire.

3. A letter/email of confirmation from potential participant to the gate keeper?

Dear XXX [Gatekeeper's Name],

I trust this email finds you well. I am writing to express my sincere interest in participating in the study titled " Can global consensus be arrived at as to the essential components of training for ensuring confident and effective medical practice in remote settings?" that you have forwarded to me. After carefully reviewing the information provided, I am enthusiastic about the opportunity to contribute to this research endeavour...

I would like to confirm my approval to participate in the study and provide my consent for my contact details to be shared with the research team. Please convey my confirmation to the relevant personnel, and if there are any additional steps or requirements necessary for participation, I am more than willing to fulfil them.

I believe that participating in this study aligns with my interests and values, and I am eager to contribute to the advancement of knowledge in this area. I appreciate your role as a facilitator in connecting potential participants with meaningful research opportunities like this one.

If there are any further details or instructions that I need to be aware of, please do not hesitate to inform me. I am committed to actively engaging with the research process and ensuring a smooth and productive collaboration.

I look forward to contributing to its success and gaining valuable insights from the experience.

Warm regards,

[Participant's Name]

[Participant's Contact Information]

4. Email to be sent to the potential participant while contacting for the first time.

a. Dear XXXX,

I am Suma, a PhD student in the School of Medicine & dentistry at the University of Central Lancashire, UK. I am planning to conduct a study to arrive at essential components required for training the healthcare and medical work force for effective medical practice in remote and rural areas. I am undertaking this research under supervision of Professors Cathy Jackson and Stuart Maitland-Knibb. As a preliminary step, I am looking into the existing health programs in all the countries around the world. In the process, I came across XXXXXX program by XXXXX on the website XXXXX. I found the contact details from the website. I would like to connect with you to tell you more about the program and see if you might be willing to contribute for the study.

Are you happy for me to use these contact details for the purpose above?

If you are willing to learn more, please respond to this e mail providing the most appropriate contact details for the purpose.

Thank you,

Suma R
G21038164,
PhD Student,
School of Medicine & Dentistry,
University of Central Lancashire,
United Kingdom.

b. Dear XXX,

I have received your contact information from XXX

I am Suma, a PhD student in the School of Medicine & dentistry at the University of Central Lancashire, UK. I am planning to conduct a study to see if it is possible to arrive at a consensus opinion as to what might be the essential components required for training the healthcare and medical work force for effective medical practice in remote and rural areas. I am undertaking this research under supervision of Professors Cathy Jackson and Stuart Maitland-Knibb. As a preliminary step, I am looking into the existing health programs in all the countries around the world. In the process, I approached XXXX and was directed to you.

If you are willing to learn more about the study with a view to taking part, please reply to this e mail indicating this to be the case.

Many Thanks,
Suma R
G21038164, PhD Student,
School of Medicine & Dentistry,
University of Central Lancashire, UK.

5. Email to be sent to the potential participant about inclusion criteria of the study.

Dear XXXX,

Thank you for allowing me to contact you. As stated earlier, I am doing my PhD dissertation on training programs for remote and rural medical and health care professionals to deliver effective healthcare. As per WHO recommendations, we are attempting to assist in the development of educational interventions to improve retention and efficiency of care given by remote and rural health and medical providers. I am investigating the existing training programs for remote and rural health care provision around the world and reaching out to the experts who have considerable experience (5-7 years) of serving the remote and rural population in their careers. I would like to conduct a Delphi study to aim to get a consensus among global experts as to what the essential training components of a training program for effective remote and rural healthcare/medical provision should be.

You are being approached as we understand that your knowledge and experience might be able to make valuable contribution to the area.

Please fill in the details below and reply to this email. The following details ensure that we are approaching and potentially recruiting the participants that are suitable and required for the study.

- a) Do you have a degree level education or above in medicine/nursing/physiotherapy or any other paramedical education?
- b) Have you worked/volunteered or working in any remote and rural area at least for 3 years in your career?
- c) Have you taught or conducted research in remote and rural medical and health care provision?
- d) Are you able to complete all the rounds of consultation? There would be at least 3 rounds of Delphi.

Note: The positive response for questions a and b is essential criteria for the participant to be included in the study.

Many Thanks,
Suma R
G21038164, PhD Student,
School of Medicine & Dentistry,
University of Central Lancashire, UK.

6. Email to be sent to the potential participant about being a part of the study.

Dear XXXX,

Thank you for replying to our previous email where we asked about the essential requirements to be the part of the study. We are glad to inform you that, we are recruiting participants like you with the desired qualifications and experience to contribute for our study.

Are you willing to take part in our study and contribute for the knowledge base by giving your opinions on training contents, resources, experiences, expectations etc and helping to arrive at a consensus along with other experts in the study?

If you are willing to receive further information and a consent form to take part in the study, please indicate this in a reply to this email.

Thank you,
Suma R
G21038164,
PhD Student,
School of Medicine & Dentistry,
University of Central Lancashire,
United Kingdom.

7. Email to be sent after recruitment and before the first round of the Delphi.

Dear XXXX

Thank you for your interest in our study.

Please find attached a consent form and a patient information leaflet.

Please read the information leaflet through carefully, and if you have any questions or doubts, please reach out to me here.

If you consent to take part, please sign the consent form and return that to me.

Following this, you will be emailed a link for filling in the data for the first round of Delphi.

Thank you very much for agreeing to help the study in this way.

Suma R
G21038164,
PhD Student,
School of Medicine & Dentistry,
University of Central Lancashire,
United Kingdom.

Appendix 3: Remainder emails for participant retention

Dear XX,

I hope this email finds you well. I am writing to remind you about the ongoing Round 1/2/3 of the Delphi study titled “Can global consensus be arrived at as to the essential components of training for ensuring confident and effective medical practice in remote settings?”. We have summarised your agreement levels to various themes in this document:

https://msuclanac-my.sharepoint.com/:w:/g/personal/srache_uclan_ac_uk/EfTWlyuc0a1LI1V-6sDbJCCcB60wt6NMUt_1Jfk3XiFnAIQ?e=GzCIFc. (Link for Round 3).

Your expertise and insights are crucial for the success of the study, and we are eagerly awaiting your responses in this final round as well. Your participation ensures validity and reliability of the findings.

I can see that you have not yet participated in this round. I want to assure that the time commitment for this round is much lesser than it was for the previous rounds. If there is anything that is stopping you from continuing with the study at this stage, please feel free to have a conversation with me through the email.

If you were unable to contribute yet because you missed out the email due to your busy schedule and are still willing to participate, please feel free to use the link here: <https://forms.office.com/e/W7UpwKPtWs> .

Key Details:

We would like to mention that this would be the final round in this study. This round aims to refine the consensus gathered so far and delve deeper into the key themes that have emerged. We have put the themes which are considered important by experts, **but which did not reach a level of consensus** along with their agreement rates and mean scores for you to reconsider your rating and thoughts.

Duration: 15-20 minutes

Form Link: <https://forms.office.com/e/W7UpwKPtWs>

Again, If you have any questions or need further assistance, please do not hesitate to contact me.

Thank you for your continued support and valuable contributions to this study.

With sincere appreciation,
Suma Rache,
PhD Scholar,
University of Lancashire.

Appendix 4: Participant Information Sheet

1. Title of Study

Can global consensus be arrived at as to the essential components of training for ensuring confident and effective medical practice in remote settings?

Participant Details:

Name of the participant:

Name of the information provider: Suma Rache

Date: 26.09.2024

2. Version Number and Date

V2.2-02.02.2022

3. Invitation

You are being invited to participate in a research study. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and feel free to ask us if you would like more information or if there is anything that you do not understand. Please also feel free to discuss this with your friends, relatives or other relevant person as the study dictates if you wish. We would like to stress that you do not have to accept this invitation and should only agree to take part if you want to.

4. What is the purpose of the study?

Remote and rural populations are more prone to higher risks of diseases and death compared to an urban population. The main reasons for health disparities regardless of a country's development include reduced access to care in remote and rural areas due to fewer health centres & medical facilities accompanied by reduced numbers of or no skilled doctors and other healthcare providers. As of 2015, about 55% of global rural population are not protected by legislation or affiliated to a health insurance scheme (83% in Africa, 56%- Asia-Pacific). Skilled health worker deficit of 7 million out of 10.3 million is witnessed in rural areas alone.

WHO recommends that the best strategy to tackle the situation is through educational interventions that help in retention of doctors in remote and rural areas. Many training programs of varied designs are being conducted globally to attract the practitioners to remote settings with limited success. Through this study we are trying to seek advice and capture the experiences of the medical/health experts who worked/are working in the remote and rural settings about the important requirements in the training programs.

5. Why have I been invited to take part?

The Delphi technique is the process for measuring consensus among a group of experts to get controlled opinion feedback by repeated individual questioning of the experts and avoiding direct confrontation. You have been asked to participate in the study because you have the relevant educational qualification and expertise in the field of remote and rural healthcare. We are recruiting 25 more similar participants for the study. We will be undertaking this research using Delphi methodology to arrive at consensus on the essential components of training for ensuring confident and effective medical practice in remote settings. Our findings will have high importance in guiding any curricular developments in the future that sought to train professionals to deliver effective medical/health care for remote and rural populations around the world.

6. Do I have to take part? What happens if I decide to withdraw?

Your voluntary consent to take part in the study is sought. You have the right to refuse consent or withdraw the same during any part of the study with or without giving any explanation and without incurring any disadvantage. If you have any doubts about the study, please feel free to ask for clarifications. Even during the study, you are free to contact any of the investigators – Suma Rache (SRache@uclan.ac.uk), Professor Cathy Jackson (CJackson19@uclan.ac.uk), for clarification if you desire.

If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. If you change your mind for any reason, you are still free to withdraw from the study/data collection and it will not affect you in any way. When you take part in an interview you can withdraw from the study at any point of the time. You can request for the destruction of the collected data up to 3 weeks after the initial round of Delphi. It may not be possible to destroy the data once the analysis is started, which will be after 3 weeks of data collection, as the data would have been anonymised and transcribed. It would be impossible to remove the data obtained because of anonymity and inability to identify participants. However, no further data will be collected following this period or the withdrawal.

When results are shared, you will be identified only by number code and confidentiality will be maintained.

7. What will happen if I take part?

Once you agree to take part in the study, I (Suma Rache, researcher/PhD Scholar) will contact you through an email sharing a link to MS forms that contain items seeking your responses. You will be asked for information on your role and professional details followed by your opinion and rationale for inclusion of various course elements. The identification

details that we collect would be work related such as professional email address and phone number to follow up with you in case of non-response. Once we receive responses, the data will be analysed and you will be provided feedback with further questions. This is called the Delphi method and it will happen for 3 rounds. We ensure anonymity throughout. For each round the responses are sought within a duration of 5 weeks followed by 3 weeks for analysis. You will be asked to respond on items such as essential skills, knowledge topics and resources required to effectively deliver medical and health care in remote and rural areas. The responses will be anonymized and sent across the panellists for their further input on the previous responses again in 5 weeks. A second round of analysis is done looking at the levels of agreement and judgements in 3 weeks. In the third round of Delphi, categories of responses will be made such as topics that are agreed to be most/moderately/least essential for remote and rural practice are “xxx” with “xx% of agreement” and shared among the experts for their final agreements and opinions. This data is finally analysed in a 1-month time to arrive at consensus and thematic analysis. The final report will be shared with the participants.

The detailed steps in conducting the study are as follows:

Steps	Duration	Tasks
1 st Iteration of Delphi	5 weeks (15 hours)	<ul style="list-style-type: none"> • Sociodemographic information + • Opinions will be asked along with reasons on • top 10 topics taught and wished were taught in training program, • top 10 skills used and wished to have got trained, and • top 10 resources used in remote and rural health practice
1 st round analysis	3 weeks	<ul style="list-style-type: none"> • Anonymization and tabular compilation of all responses. Themes are formed.
2 nd Iteration of Delphi	5 weeks (25 hours)	<ul style="list-style-type: none"> • Circulation of anonymized, compiled responses of all the panellists • Each panellist will be sent themes generated by the responses in previous round and asked to opine by agreeing or disagreeing to those responses
2 nd round analysis	3 weeks	<ul style="list-style-type: none"> • Calculate % Agreement rates, mean scores, Standard deviation and interquartile range of the responses of each item • Summarise comments made by individual panellists
3 rd iteration of Delphi	4 weeks	<ul style="list-style-type: none"> • Present summarized comments and associated order of responses to each

	(20 hours)	participant against their own responses and ask for feed back
3 rd round of analysis	3 weeks	<ul style="list-style-type: none"> Calculate percentage of agreement on topics, skills and resources essential for remote and rural health care to arrive at consensus among the experts

You will have to provide responses based on your observation and experiences in providing medical and health care services in remote and rural settings.

8. How will my data be used?

The University processes personal data as part of its research and teaching activities in accordance with the lawful basis of ‘public task’, and in accordance with the University’s purpose of “advancing education, learning and research for the public benefit”.

Under UK data protection legislation, the University acts as the Data Controller for personal data collected as part of the University’s research. The University privacy notice for research participants can be found on the attached link https://www.uclan.ac.uk/data_protection/privacy-notice-research-participants.php

Further information on how your data will be used can be found in the table below.

How will my data be collected?	Data will be collected through MS forms for about 3 rounds over a period of 5 months approximately. Each round of data collection would be in 3 weeks followed by 3 weeks of analysis.
How will my data be stored?	All the data will be stored in UCLan’s one drive. On completion of the study and PhD, the data will be handed over to the director of studies ensuring no storing of data off UCLan premises.
How long will my data be stored for?	According to UCLan’s data management policy, the data will be stored securely for 7 years.
What measures are in place to protect the security and confidentiality of my data?	Only the researcher and research team have access to the data and are fully aware they are not to share any of the data with any unauthorised party. All the electrical data obtained will be stored and secured on the University research drive and encrypted password protected computers.
Will my data be anonymised?	Data will be anonymised using a study id code for each participant during the

	analysis of the data. All the original data will be accessed only by the research team consisting of researcher and PI.
How will my data be used?	The data will be collected using Delphi technique in three rounds so that consensus among experts about the research question be reached. The resultant conclusion will be added to evidence based medical practice.
Who will have access to my data?	The research team and UCLan's data protection officer will have access to the data. There will not be any data processor required for the study.
Will my data be archived for use in other research projects in the future?	The data will be archived in UCLan one drive for 7 years after the completion of the research based on the research data management policy of UCLan.
How will my data be destroyed?	The hard copies of the data will be disposed according to the University's confidential waste services while data from electronic media and hardware will be disposed using LIS mechanisms at UCLan.

Transferring data outside the EU

The personal data collected in the study will not be transferred outside EU.

9. **Are there any risks in taking part?**

There are no risks involved in this study.

10. **Are there any benefits from taking part?**

There is no direct benefit for taking part, but it may be that you may get meaningful insights in remote and rural health care practice which may act as continuing medical education. You may also enjoy contributing to service and curriculum design in the field of remote and rural health services. Your participation also makes a difference by contributing for narrowing the Urban-rural gap in accessing medical and health care.

11. **Expenses and / or payments**

You will not have any additional visits nor incur loss of earnings for the purpose of the study as everything is done through internet, at the time of your convenience. Thus, for participating in the study you will not receive any compensation for inconvenience and travel.

12. What will happen to the results of the study?

The results obtained after analysing the data will be reported in the thesis written for the award of the PhD. The dissertation will be stored in the UCLan's library. The final report of findings will be shared across the study participants by circulating the soft copy via emails. No identification details of the participants are disclosed in any of the documents. In case of analysis, only study identification number or code will be used. As the findings are of important value addition for evidence-based practice, the knowledge may be disseminated in the conferences and research publications.

13. What if I am unhappy or if there is a problem?

If you are unhappy, or if there is a problem, please feel free to let us know by contacting us (contact details provided below) and we will try to help. If you remain unhappy or have a complaint which you feel you cannot come to us with, then please contact the Ethics, Integrity and Governance Unit at OfficerForEthics@uclan.ac.uk.

The University strives to maintain the highest standards of rigour in the processing of your data. However, if you have any concerns about the way in which the University processes your personal data, it is important that you are aware of your right to lodge a complaint with the Information Commissioner's Office by calling 0303 123 1113.

Contact details of investigatory team

1. Professor Cathy Jackson,

Pro Vice Chancellor Academic Leadership (interim), University of Central Lancashire.

Email: cjackson19@uclan.ac.uk

2. Suma Rache,

PhD student, School of Medicine, University of Central Lancashire.

Email: SRache@uclan.ac.uk

Appendix 5: Participant and Consent form

Version number & date: V2.1 02.02.2022

Research ethics approval number:

Title of the research project: Can global consensus be arrived at as to the essential components of training for ensuring confident and effective medical practice in remote settings?

Name of researcher(s): Suma Rache, Professor Cathy Jackson

Please initial box

1. I confirm that I have read and have understood the information sheet dated [DATE] for the above study, or it has been read to me. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. I understand that taking part in the study involves responding to the questions over google forms and email conversations.
3. I understand that my participation is voluntary and that I am free to stop taking part and can withdraw from the study at any time without giving any reason and without my rights being affected. In addition, I understand that I am free to decline to answer any question or questions.

Choose appropriate option EITHER 4a or 4b

4. a) I understand that if I withdraw from this study, data collected before the first round of analysis (which is done 3 weeks after the initial round of data collection) will be retained but no further data will be collected.
b) I understand that I can ask for access to the information I provide and request the destruction of that information at any time ONLY prior to initial analysis which is done 3 weeks after the first round of Delphi technique.
5. I understand that the information I provide will be held securely and in line with data protection requirements at the University of Central Lancashire.
6. I understand that signed consent forms and original responses in the google forms will be retained in UCLan one drive with access to the director of studies and the research team for 10 years.
7. I understand that other authorised researchers may use my words in publications, reports, webpages, and other research outputs, if their study has been approved by a research ethics committee, and they agree to preserve the confidentiality of the information as requested in this form.
8. I understand that personal information collected about me that can identify me, such as my name or where I live, will not be shared beyond the study team.
9. I understand that I must not take part if I do not hold a medical or paramedical degree and have no experience in remote and rural healthcare provision.
10. I understand that the research team will respect my confidentiality and I give permission for them to have access to my responses.

11. I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any reports, presentations or publications arising from the research as I will be identified only with study id codes/number.

12. I agree to being contacted later and invited to take part in future relevant studies. I understand that I am only agreeing to receive information and I am under no obligation to take part in any future studies. I understand that if I do not consent to being contacted in the future it will not have any influence on my involvement in this research study.

13. I agree to take part in the above study.

Participant name

Date

Signature

Principal Investigator
Professor Cathy Jackson
Allan Building (AL005)
Cjackson19@uclan.ac.uk

Student Investigator
Suma Rache
Brook Building (BB204)
SRache@uclan.ac.uk

Appendix 6: Study instrument – Round 1

Section 1: Sociodemographic profile

Many thanks for your interest in participating in this Delphi project. We very much value the time and effort taken to complete the questionnaires. This will be the first of three rounds and will take the longest time although hopefully no longer than 30 minutes to complete.

Thank you once again for all your help it is very much appreciated.

Please return your responses by December 13th 2024 at the latest to allow for analysis before the next stage.

In the section we would like to obtain socio demographic information to understand the diversity and expertise of our participants which will help us refine our instrument for the next rounds of consultation. Please answer all the questions if you feel able.

1. Name *
2. Phone number including country code
3. Email address *
4. Age *
 - Less than 30 years
 - 31- 40 years
 - 41- 50 years
 - 51- 60 years
 - Above 60 years
5. Highest Educational qualifications *
 - High School
 - Post school certification
 - Undergraduation
 - Post Graduate qualification below Masters' level
 - Masters' level
 - PhD/D Phil
6. Discipline of the educational qualification *
7. Professional title *
8. Experience in years *
9. Work contact address *

Section 2: Please answer the following questions

10. In your opinion, what are the topmost useful things that can be taught in a course preparing health care practitioners for remote and rural practice (Up to a maximum of 10) and why would you choose these? *
11. In your opinion, what are the topmost useful knowledge topics that you learned which helped to prepare you for working in rural practice and why? (Up to a maximum of 10) *
12. In your opinion, what would have been the topmost useful knowledge topics to help prepare you for working in rural practice you wish you had learned but have not yet and why do you think so? (Up to a maximum of 10) *
13. In your opinion, what do you believe to be the topmost useful skills you have used in your time as a rural health care practitioner and why? (Up to a maximum of 10) *
14. In your opinion, what are the topmost useful skills necessary for rural practice that you wish you had learned in your professional training program but did not and why would you think so? (Up to a maximum of 10) *
15. In your opinion, what are the topmost useful resources e.g., book, online resource etc that you use in your practice and would recommend to every health care professional entering the remote and rural practice and why would you think so? *
16. In your opinion, what have you learned about rural practice since doing it that you wish you had known when you started your practice as a rural health care professional? *

Appendix 7: Study instrument – Round 2- Part A

Sociodemographic Profile

This is Part A of the Round 2 questionnaire of Delphi Study. This part includes items on Knowledge topics related to remote and rural health course. Due to the need for your personal detailed expert experience, we ask you to provide your demographic information. It is likely that you will require up to 20 mins for this survey.

At a minimum, please provide a score from 1-5, but if you feel able, please also offer more information as to why you have given that score for any item. Many thanks in advance for participating.

1. Name
2. Email address *
3. Correspondence address & work contact number including country code *

Please answer the following questions

The thematic analysis of your responses on topmost useful KNOWLEDGE TOPICS that you feel would be most helpful during your remote and rural practice resulted in 16 themes. Summary statements explaining these themes are provided.

On a Scale of 1-5,

1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree,
please rate the themes.

Following this, kindly provide reason as to why you have chosen a particular rating.

	Themes from the responses	Summary statements	Rate (1-5)	Why?
1	Basic Medical subjects	Anatomy, Physiology, Microbiology, Pathology, and Pharmacology to build a strong clinical base		
2	Dermatology	Knowledge in diagnosing and treating common skin conditions prevalent in rural areas.		
3	Diagnostic procedures & interpretation	Performing and interpreting diagnostic tests, including lab work, imaging, and point-of-care testing.		

4	Emergency Medicine and Acute Care	Knowledge about urgent and life-threatening conditions, initial assessment and stabilization.		
5	ENT	Understand common ENT conditions and their management.		
6	General Medicine	A broad range of medical conditions and their management, focusing on holistic patient care.		
7	Geriatrics & Palliative care	Common geriatric conditions and end of life care concepts		
8	General surgery	Essential surgical procedures like Caesarean section, wound care, suturing and intravenous access		
9	Health Education	Learn to educate patients and communities about health promotion and disease prevention.		
10	Health Legislation & policy	Awareness on the legal and policy frameworks governing healthcare delivery in rural areas.		
11	Health services	Gain knowledge about the organization and management of health systems and services, e.g., primary care centres, hospitals, etc.		
12	Home therapies	Some safe and effective home-based treatments for common conditions, promoting self-care and reducing hospital visits.		
13	Indigenous Health	Understand the unique health practices, endemic health conditions, health needs and cultural considerations of Indigenous populations.		
14	Chronic Disease Screening & management	Screening procedures for and management of chronic diseases		
15	Obstetrics and Gynaecology	Concepts of women's reproductive health, pregnancy, childbirth and gynaecological conditions.		

16	Psychiatry	Diagnosis and management of mental health conditions, promoting mental well-being in rural communities.		
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The thematic analysis of your responses on topmost useful knowledge topics *to be incorporated* in a course preparing students for remote and rural practice resulted in 11 themes. Summary statements explaining these themes are provided.

On a Scale of 1-5,

1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree,

please rate the response from your co-panellists regarding this. Following this, kindly provide reason as to why you have chosen a particular rating.

	Themes from the responses	Summary statements	Rate (1-5)	Why?
1	Anaesthesia	Administering safe and effective anaesthesia for various procedures		
2	Basic Dental procedures	Common dental procedures such as extractions, fillings, and preventive care.		
3	Elementary alternative medicines	Basic principles of alternative medicine practices that are commonly used in rural areas for safe and complementary use with conventional treatments.		
4	Environment Health	Impact of environmental factors on health - water quality, sanitation, and pollution control.		
5	Health Economics	Understanding of economic principles related to healthcare delivery, including cost-effectiveness and resource allocation.		
6	Health Preparedness	Planning and responding to health emergencies, including natural disasters and disease outbreaks along with ambulance services		
7	Occupational Health	Health risks associated with various occupations in rural		

		areas and strategies for prevention and management.		
8	Point of care Ultrasonography (POCUS)	Use of portable ultrasound devices for rapid diagnosis and management of various conditions.		
9	Psychosocial determinants of Health	Explore the social, economic, and psychological factors that influence health and well-being in rural communities.		
10	Resource management	Methods of efficient management of limited human and material resources		
11	Rural- Specific Ethics	Awareness and response to ethical issues unique to rural healthcare, such as confidentiality in small communities and equitable access to care.		

Appendix 8: Study instrument – Round 2- Part B

Please answer the following questions

We have conducted thematic analysis of open-ended questions regarding the topmost *useful things that were felt might be taught* in a remote and rural healthcare training and the following 20 themes were most frequently mentioned. Summary statements explaining these themes are also provided.

On a Scale of 1-5,

1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree,

please rate the response from your co-panellists regarding this. Following this, kindly provide reason as to why you have chosen a particular rating.

	Themes from the responses	Summary statements	Rate (1-5)	Why?
1	Altruism	Acts of selflessness and concern for the well-being of others are highly valued and contribute significantly to the community		
2	Clinical reasoning	Teach systematic approaches to diagnose and manage patient conditions rather than relying heavily on investigations		
3	Collaborative working	Teamwork, communication, shared goals and outcomes with multiple disciplines		
4	Digital healthcare	Integration and awareness of digital technologies to enhance healthcare access and patient care		
5	Drug Inventory	Maintaining an efficient and accurate inventory of drugs, appropriate storage and the tracking of expiry dates, especially as demand fluctuates		
6	Health informatics	Use of information technology to collect, store, analyse and share health data to improve health care delivery		

7	Immersive Community Engaged Education	Involving trainees to be able to achieve some training in rural areas and take part in local health initiatives to foster strong ties with the communities		
8	Immunisation activities	Learning about and becoming involved in immunisation programs and activities such as vaccination logistics, campaigning and administration during training		
9	Maternal and child health issues	Concepts focusing on Health and well-being of mothers, infants and children- Preventive care, early intervention, essential health services		
10	Mental Health concepts	The way in which emotional, psychological and social aspects influence a human's thoughts, feelings and actions which are crucial for wellbeing		
11	Nutrition	Principles of nutrition and dietary management- essential in preventing chronic diseases and supporting patient recovery and wellbeing		
12	Advantages of working in rural areas	for example the unique benefits such as close-knit communities, diverse clinical experiences, and opportunities for leadership and innovation		
13	Principles of Practice	Adhering to core principles of clinical practice such as ethics, patient centred care and prompt decision making based on local context rather than relying on international standards		
14	Principles of Public Health	Disease prevention, health promotion and prolongation of life through organised efforts of the stakeholders		
15	Quality improvement methods	Introduction to the tools and techniques for improving healthcare processes and patient outcomes		

16	Reflective Practice	Encouragement of self-assessment and continuous learning through regular reflection on clinical experiences and patient interactions		
17	Research skills	Development of skills in designing, conducting, and analyzing research to contribute to evidence-based practice and problem solving (Action research)		
18	Supervision skills	Equip trainees with the ability to mentor and supervise junior staff and students effectively		
19	Types of medical practice	An understanding of the various models which might be used in different settings for example solo practice, Group practice, hospital-based practice, community health centres, etc		
20	Volunteering	The many ways in which it is possible to demonstrate a commitment to helping others		

The thematic analysis of your responses on top most useful SKILLS that it is felt could be usefully taught and used during your remote and rural practice resulted in 12 themes. Summary statements explaining these themes are provided.

On a Scale of 1-5,

1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree,

please rate the response from your co-panellists regarding this. Following this, kindly provide reason as to why you have chosen a particular rating.

	Themes from the responses	Summary statements	Rate (1-5)	Why?
1	5S Implementation	Applying the 5S methodology (Sort, Set in order, Shine, Standardize, Sustain) to improve workplace organization and efficiency.		
2	Active follow ups	Ensures continuous patient care, improved treatment adherence.		

3	Administerial and managerial skills	Skills in managing healthcare facilities like budgeting, staffing and strategic planning.		
4	A-E assessment	Perform systematic assessments of patients using the Airway, Breathing, Circulation, Disability and Exposure (A-E) approach.		
5	Basic Physiotherapy skills	Basic physiotherapy interventions to aid in patient rehabilitation and recovery.		
6	Critical care skills	Manage critically ill patients with advanced life support and intensive care techniques.		
7	Diplomacy	Navigate interpersonal and interprofessional relationships with tact and sensitivity.		
8	Excellent driving skills	Safely operate vehicles, including ambulances, in various terrains and conditions.		
9	Leadership skills	Lead teams effectively, inspiring and guiding others towards efficient patient care.		
10	Monitoring and evaluation	Assess the effectiveness of health programs and interventions, using data to inform improvements.		
11	Outbreak investigation	Identify, investigate, and control infectious disease outbreaks to protect public health.		
12	Selfcare and wellbeing	Maintain personal health and well-being to provide sustainable care for others. Includes exploring effective stress management strategies.		

The thematic analysis of your responses on topmost useful skills that are *necessary to be taught* in a course preparing students for remote and rural practice resulted in 5 themes.

Summary statements explaining these themes are provided.

On a Scale of 1-5,

1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree,

please rate the response from your co-panellists regarding this.

Following this, kindly provide reason as to why you have chosen a particular rating.

	Themes from the responses	Summary statements	Rate (1-5)	Why?
1	Advanced skills/specialised skills	Train in specialized medical procedures and advanced clinical techniques to handle complex cases and emergencies.		
2	Consultation skills	Enhance communication skills for effective patient consultations, ensuring clear and empathetic interactions.		
3	Life skills	Teach essential life skills such as self-awareness and confidence, decision making, interpersonal relationships, time management, stress management, and work-life balance to support personal and professional well-being.		
4	Quiet advocacy	Advocate for patients and communities subtly and effectively, promoting health equity.		
5	Self Confidence	Build self-confidence through practical experience and positive reinforcement.		
6	Teaching and Mentorship skills	Ability to teach and mentor junior staff and students, fostering a supportive learning environment.		

Appendix 9: Study instrument – Round 3

Essential Knowledge topics for a course on Remote and Rural health care practice

In this section, we have provided the findings from the Round 2 in diagramatic form. It includes % agreement rates for various themes considered essential for topics to be included in a course on Remote and Rural Practice. We have also provided the mean agreement score with standard deviation (SD) considering Inter Quartile Range (IQR) as test of consensus. Please review the summary before answering the questions.

We have put the themes which are considered important by experts but did not reach a level of consensus along with their agreement rates and mean scores for you to reconsider your rating.

So, please re-rate the follow up questions on a Scale of 1-5,

1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree.

Kindly provide reason as to why you have chosen a particular rating/if you have changed your thoughts/opinions.

	Theme	Re-rate	Why?
1	Obstetrics & Gynaecology		
2	Health Preparedness		
3	Resource Management		
4	Home therapies		
5	Environment Health		
6	Dermatology		
7	General Surgery		
8	Health Legislation		
9	Occupational Health		
10	Anaesthesia		

Most useful things to be taught in a Remote and Rural Healthcare training

	Theme	Re-rate	Why?
1	Altruism		
2	Drug Inventory		
3	Immunisation activities		
4	Nutrition		
5	Research skills		
6	Types of medical practice		
7	Volunteering		

Most useful skills required in a course on remote and rural practice

	Theme	Re-rate	Why?
1	Advanced skills		
2	Diplomacy		
3	Monitoring and evaluation		
4	Outbreak Investigation		
5	Active follow ups		
6	Admin & Managerial skills		

Appendix 10: Extended acknowledgements to the study participants

I would like to express my sincere gratitude to all the expert participants who contributed to this Delphi study and completed all three rounds of data collection. Their sustained engagement, thoughtful insights, and professional expertise were instrumental in achieving consensus on the essential components of training for confident and effective medical practice in remote and rural settings.

This study greatly benefited from the diversity of perspectives represented, particularly from experts based in Africa and other global regions. Their contributions enriched the findings and enhanced the relevance of the outcomes across varied healthcare contexts. I am deeply appreciative of their time, commitment, and collaboration throughout this research process.

List of Delphi Study Participants

Below is the list of expert participants who completed all three rounds of the Delphi study, presented in alphabetical order:

AK Obot	Nigeria
AB Chater	Australia
A Wheatley	Oceania
A Fosse	Norway
AB Edward	Uganda
B Fatusin	Nigeria
B Morrow	South Africa
C Alseny	Guinea
C Lionis	Greece
E Ahimbisibwe	Uganda
F Biegon	Kenya
Hal Maxwell	UK
H Wehner	USA
I Couper	South Africa
J Muller	South Africa
JA Hotz	Australia
J George	New Zealand
J Erickson	USA

J Munchaa	Africa
JV Alaball	Spain
J Blitz	South Africa
K Costello	New Zealand
K Morgan	Australia
L McArthur	Australia
L White	Australia
L Walters	Australia
L Ebert	Australia
M Hjortdahl	Norway
M Wanjala	Kenya
N Mrduljas-Dujic	Croatia
PV Hombergh	Netherlands
P Hurali	India
P A Lekhi	Malaysia
R Hays	Australia
R Stasser	Australia
R Falanga	Italy
R Lawrenson	New Zealand
S Rahim	South Africa
S Lesperance	Canada
SP Kariyawasam	Sri Lanka
T Pekez	Croatia
T Banda	Malawi
T Baker	USA

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