Health Education

Guest editorial: Digital solutions to bridging the gap between health services and workforce in rural areas

Introduction to this special issue

The papers in this special issue of *Health Education* explore the changing role of digital technology in rural health. Submissions were invited that provided evidence of digital interventions aimed at increasing access to education, training and development or support for rural health professionals. In particular, articles examine enablers and barriers to using digital technology for this purpose and aim to better understand the conditions under which digital support to rural locations can work and make recommendations about appropriate models.

Recruitment and retention of health professionals to rural and remote areas is a challenge in Australia and globally. A strong rural health workforce, particularly supporting public health and primary prevention, is a vital component of improving rural communities and rural population health (reference). And yet, high staff turnover and long-term unfilled positions limit the health services that can be provided (Onnis, 2019; Wakerman *et al.*, 2019). There is without doubt a significant amount of scholarship that has, over time, sought to examine the attraction, recruitment and retention of health professionals to rural locations (Ogden *et al.*, 2020; Onnis, 2016; Russell *et al.*, 2017).

The literature indicates the factors and solutions are complex (Malatzky *et al.*, 2019; Russell *et al.*, 2017). In recent research with rural and remote allied health professionals, the most cited factors that negatively influence retention were lack of professional development opportunities, professional isolation and insufficient supervision (Campbell *et al.*, 2012; Cosgrave, 2020). For rural and remote clinicians, quality education is often difficult to access because of geographic isolation, travel, time, expense constraints and lack of an onsite educator (Calleja *et al.*, 2022).

There is also an emerging literature that relates to the acceptance and advancement of telehealth and digital technologies to positively impact on professional practices (Pit *et al.*, Ramsden *et al.*, 2021, Safi *et al.*, 2018). However, to date there is limited examination of the impact of digital access on professional education and support to health professionals in rural areas. Digital access is a complex and multi-dimensional concept, as it includes access to hardware, software and connectivity to the Internet as well as meaningful, high-quality and culturally relevant content and the ability to create, share and exchange knowledge (Willems *et al.*, 2019).

This special issue is the result of a wonderful group of people's time and considerable expertise that enabled this publication. Authors of the paper thank the authors for interesting insights into the impact of technology on rural health, the reviewers for valuable feedback on all the manuscripts, and attention to detail, guidance and experience from the great team of *Health Education* staff and copy and lead editors is greatly appreciated. The authors thank the reviewers, authors, the team of *Health Education* staff and copy and lead editors for encouragement and support as the authors navigated the processes and systems to bring together this special issue.

Health Education
Vol. 122 No. 2, 2022
pp. 121-125

0965-4283
DOI 10.1108/HE-02-2022-137

It is from this lens we explore health education in the digital age, covering current concerns and providing evidence in relation to initiatives and ideas in line with *Health Education*'s focus on healthier lives. Focussing on the impact of digital technology on the factors and initiatives that facilitate access to education training and support in rural areas, we aim to use our research to influence real world change in people's health and well-being in rural areas/that contribute to the reduction of health inequalities. It is important to stay at the forefront of this scholarship and to continue to explore and understand where the challenges and opportunities lie.

Overview of the papers

There are seven papers in this special issue. The papers utilise different approaches to critical scholarship and provide insights into digital technology use in India, Turkey and Australia. They demonstrate the currency and rapid adoption of the use of technology in rural health. They largely focus on asynchronous learning to take advantage of the various forms of digital and online learning in which participants learn on their own at their own pace from instruction that is not delivered in person or in real time. Asynchronous learning may include pre-recorded video lessons and webinars, readings, podcasts animations or game-based learning tasks. The seven papers are important in identifying a range of innovative online practices to support diverse areas of rural health including continuing professional education, tertiary health student training and professional support for treating paediatric autism and cancer. Several papers identify how the COVID-19 pandemic has fast-tracked developments in areas including mobile phone innovations in rural India, the pragmatic development of multi-disciplinary tertiary programs in Australia and nurse and midwifery training in Turkey.

The first paper by Ramsden, Colbran, Christopher and Edwards is a scoping review of the peer-reviewed literature to determine, "The role of digital strategies in providing education, training, continuing professional development and support to the rural health workforce". The authors note there is mounting evidence demonstrating the potential for online platforms to address the challenges of rural health professional practice and the tyranny of distance. The focus of their investigation was on the use of online education, training and continuing professional development that is outside the undergraduate and postgraduate learning experiences of a university. The authors concluded there is value in technology for asynchronous learning in rural health, as it affords the opportunity to engage in learning at a time and location that is convenient and enables the learner to balance professional development with personal and work commitments. However, the authors also identified that this form of learning is not without its challenges in rural and remote areas, including poor Internet connection, skill level and need for technology support. Further, in most of these studies there was also a link between e-learning literacy and engagement in online learning. Therefore, it could be concluded that whilst the expansion of available e-learning resources and continuing advances in technology will enable many rural health professionals to access learning, it is of utmost importance that the intended audience is adequately supported to develop digital literacy and to put the learning into practice.

The papers in this issue take up some of the challenges with digital learning outlined in the scoping review. The article by Johnsson, Lincoln, Bundy, Costley and Bulkeley titled "Evaluation of a webinar and video-conferencing support program designed to upskill staff working with children with autism in remote areas", evaluated a novel webinar training and individual online support programme for 36 allied health, education and community support staff. The increase in "knowledge and skills" and "confidence" in working with children with autism reported by participants was positively related to the number of webinars the participants accessed (asynchronous learning). Synchronous learning via individual online

sessions was accessed by a small number of participants, mostly allied health professionals. The authors concluded that technology may provide a low-cost and widely accessible platform for providing education and support for staff in these areas. This pilot study progressed the scholarship around how asynchronous learning can be effective in addressing inequity by increasing programme access and flexibility for remote rural health professionals. However, it is important to note that some barriers to engaging in the programme were identified including workload and scheduling.

Two papers refer to the growth and acceleration of the use of digital technology/innovation and its impact in rural settings during COVID-19 (Cox *et al.*, and Venkataraghavan *et al.*). The study by Cox *et al.*, titled "Co-designing multi-disciplinary telehealth education for on-line learning, focusses on students in the tertiary education sector". The authors note the role of telehealth as an adjunct to face-to-face health service delivery in providing improved access to healthcare for residents in more rural and remote settings. They identified that students graduating from health courses and current health professionals need to have some proficiency in using telehealth. This need was accelerated with COVID-19 as health care professionals were left with no option but to transform their service into a virtual clinic despite a lack of knowledge and experience in this mode of delivery. However, there is limited accessibility to multi-disciplinary-based material to meet this need, and as a consequence, the authors experienced an increased number of clinicians and students seeking out online courses in telehealth to inform and upskill them during this time. The authors present a case study that demonstrates the value of a co-design process and key learning design choices in online course development to meet the educational needs of learners from broad disciplinary backgrounds, in various stages of learning/understanding of telehealth and/or requiring a practice-based resource in the context of a rapidly changing policy environment. Initial results from the study highlight the potential of an online self-paced course such as the one described to contribute to "introductory" competency development in telehealth.

The paper by Venkataraghavan *et al.*, titled "'Through their eyes, I can work'- Rural physicians' perceptions about mobile phone use among community health workers (CHWs) – a qualitative analysis" relates to the Udupi district of Karnataka, India. It examines the benefits and challenges of mobile phone use by CHWs from the perspectives of rural medical officers' (rural physicians'). Scarcity of health professionals in rural areas, distribution of Public Health Centres and a dearth of paramedical personnel continue to be challenging in many districts of the country. Hence, it is the CHWs in the Udupi district that help bridge the gap between thousands of India's rural remote populace and the health systems. Mobile phone technology assisted the CHWs in sending real-time COVID-19 pandemic reports and data to the health systems as well as for showing patients their test results or guidelines issued by health systems and government. It is evident from the study that mobile phone technology has the capability to be an effective support tool for the CHWs. However, the article provides a critical assessment on the inequity of technology access and the challenges in using technology as a tool for supporting health and well-being. Challenges including poor network coverage, technical illiteracy and insufficient training need to be addressed. The authors offer suggestions including increasing the number of mobile towers in rural areas, providing dual SIM cards from two different service providers and providing smartphones for using voice messaging and the photo and video functions. Whilst initial results from the study highlight the potential of this approach, the authors argue for more rigorous research to identify the perspectives of all the stakeholders involved in the primary health system including the beneficiaries.

Two articles specifically appraise the role of technologies to address the challenges associated with COVID-19 (Barraclough and Pit; Uçuk and Yildirim). Barraclough and Pit provide an Australian case study outlining a multi-disciplinary teaching programme that

was adapted to allow students from various disciplines and universities to learn together during the COVID-19 pandemic. They note that the COVID-19 pandemic led to "forced innovation" in the health education industry due to the fact that academics and students were less able to be physically present. This is an outcome of border restrictions, other movement restrictions, placement cancellations in aged care facilities and rural schools, school closures and family commitments such as children not being able to go to school or day care. Again, the value of asynchronous learning is highlighted so that students have a choice of learning online, independent of time or location. The originality of this programme centres around students from multiple universities and disciplines and various year levels learning together in a rural area over an extended period of time. Collaboration amongst universities assisted educators in rural areas to achieve a critical mass of students to enable viable teaching programs. Whilst the authors note the need for further evaluation, they conclude that a rural multi-disciplinary online education programme was found to assist in reducing some of the perceived barriers to uptake of rural practice, including lack of knowledge around rural training, limited research opportunities, fear of the unknown and a limited rural training pipeline. The authors propose guidelines for remote multi-disciplinary learning amongst health professional students, including those in medical, nursing, pharmacy, dentistry and allied health disciplines.

Uçuk and Yildirim, in their paper, "The effect of COVID-19 prevention methods training given through distance learning on state anxiety level: the case of private sector", argue that COVID-19 prevention methods training given by distance learning techniques can positively impact on the anxiety level of the workers of a company serving in the communication sector in Turkey. The authors concluded that it is important to provide training and support to those with high anxiety levels as an outcome of COVID-19 and that informative support delivered by nurses/midwives can make it easier to control anxiety. Nurses and midwives were involved in delivering supportive training activities. The authors recognise some limitations in terms of generalisability such as the relationship between the knowledge score and anxiety could not be evaluated.

In the paper, "Digital Solutions for Paediatric Oncology Health Professionals in Rural and Low-Resource Settings" Martiniuk, Challinor, Arora, Handayani, Sri and Lam note that digital solutions have a valuable role in increasing health professional knowledge, skills and empowerment. They focus on the area of diagnosing, treating and caring for children and adolescents with cancer. In relation to paediatric oncology, the authors identify that a significantly lower percentage of children will survive cancer in low-resource settings. This review sought to identify digital resources that support the training and development of the paediatric oncology workforce in resource-poor settings. This paper presents a narrative descriptive review of peer-reviewed publications and digital platforms that contribute to health professionals' education and training regarding paediatric oncology, particularly in rural and other low-resource settings. A total of 33 resources are discussed in depth and a quality assessment of the digital resources is provided. The authors anticipate that this summary of digital resources for the global paediatric oncology professional community will inform digital health investments and the design of digital innovations to meet emerging needs contributing to health workforce improvements.

Conclusion

The seven papers demonstrate important international innovations in the use of digital health, suggesting it is undoubtedly here to stay. As telehealth and other digital health technologies gain momentum, it will almost certainly have more prominent inclusion in health curricula, clinical placements and ongoing professional learning and support. This is

particularly important in the rural context. There is room for other countries to utilise or extend the innovations showcased in these papers. For example, online support for autism and paediatric cancer can be extended to other health conditions.

The opportunity that this body of work identifies should be carefully evaluated and built upon. Although multiple barriers are outlined, technology has shown itself to be an asset for rural health professionals' in circumstances where access to ongoing rural education, training and support is not currently available to many. The complementary use of telehealth or digital platforms for professional development delivery could play a large part in retaining health professionals rurally and improving health services and outcomes if appropriate models and adequate funding are brought together.

Robyn Ramsden
NSW Rural Doctors Network, Hamilton, Australia and
School of Health and Social Development, Deakin University, Melbourne, Australia, and

Michelle Lincoln
Faculty of Health, University of Canberra, Canberra, Australia

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Received 12 November 2020
Revised 4 January 2021
Accepted 3 February 2021

The role of digital technology in providing education, training, continuing professional development and support to the rural health workforce

Robyn Ramsden
School of Health and Social Development, Deakin University, Victoria, Australia
Richard Colbran
Chief Executive Officer, NSW Rural Doctors Network, Newcastle, Australia
Ellice Christopher
School of Health and Social Development, Deakin University, Victoria, Australia, and
Michael Edwards
Director Service Delivery, NSW Rural Doctors Network, Newcastle, Australia

Abstract

Purpose – Education, training and continuing professional development are amongst the evidence-based initiatives for attracting and retaining rural and remote health professionals. With rapidly increasing access to and use of digital technology worldwide, there are new opportunities to leverage training and support for those who are working in rural and remote areas. In this paper we determine the key elements associated with the utility of digital technologies to provide education, training, professional learning and support for rural health workforce outside the University and tertiary sector.

Design/methodology/approach – A scoping review of peer-reviewed literature from Australia, Canada, US and New Zealand was conducted in four bibliographic databases – Medline complete, CINAHL, Academic Search complete and Education Complete. Relevant studies published between January 2010 and September 2020 were identified. The Levac *et al.* (2010) enhanced methodology of the Arksey and O'Malley (2005) framework was used to analyse the literature.

Findings – The literature suggests there is mounting evidence demonstrating the potential for online platforms to address the challenges of rural health professional practice and the tyranny of distance. After analysing 22 publications, seven main themes were found – Knowledge and skills ($n = 13$), access ($n = 10$), information technology ($n = 7$), translation of knowledge into practice ($n = 6$), empowerment and confidence ($n = 5$), engagement ($n = 5$) and the need for support ($n = 5$). Ongoing evaluation will be critical to explore new opportunities for digital technology to demonstrate enhanced capability and retention of rural health professionals.

Originality/value – To date there has been limited examination of research that addresses the value of digital platforms on continuing professional development, education and support for rural health professionals outside the university and tertiary training sectors.

Keywords Digital technologies, Digital strategies, Online learning, E-learning, Web-based training, Education, Web-based learning, Continuing professional development, Professional learning, Rural health workforce, Digital rural health workforce support, Rural and remote

Paper type Literature review

Introduction

On average, Australians living in rural and remote areas have shorter lives, higher levels of disease and injury and poorer access to and use of health services, compared with people living in metropolitan areas (AIHW, 2019). A major contributor to these health disparities is that many communities face a disproportionate share of the rural health workforce shortage

Health Education
Vol. 122 No. 2, 2022
pp. 126-149

0965-4283
DOI 10.1108/HE-11-2020-0109

(AIHW, 2019; Durey *et al.*, 2015). In Australia and globally, recruiting and retaining health professionals in rural and remote areas is challenging (Martiniuk *et al.*, 2020). In recent research, some of the most cited factors that negatively influence health professional's retention in rural and remote areas include lack of access to professional development opportunities and professional isolation along with psychosocial and personal factors (Allen *et al.*, 2020; Cosgrave, 2019; Dolea, 2010; Durey, 2015; Humphreys *et al.*, 2010; Martiniuk *et al.*, 2020; McGrail and Humphreys, 2015). The literature in relation to rural doctors, nurses and allied health professionals identifies retention factors they have in common and also factors that differ. However, the practical availability of continuing professional development (CPD) is common to all three (Cosgrave *et al.*, 2019; Keane *et al.*, 2012).

Continuing professional development is how health practitioners maintain, improve and broaden their knowledge, expertise and competence, and develop the personal and professional qualities required throughout their professional lives (AHPRA, 2020). Lack of access to CPD is known to be problematic for the rural workforce (Allen *et al.*, 2020; Cosgrave, 2019), and contributes to professional and social isolation (Mbemba *et al.*, 2013; Schoo *et al.*, 2005). Rural health professionals cite barriers to accessing CPD including additional costs of travel to attend CPD (Lincoln *et al.*, 2014), expensive registrations (Vela and Bardyn, 2019), and being required to travel long distances without being given time to travel (Place *et al.*, 2012). With rapidly increasing access to, and use of, digital technology worldwide, there are new opportunities to leverage training and support for those who are working in rural and remote areas (AMA, 2017; Lamph *et al.*, 2018). In the last few years digital technologies have changed the health communication landscape with attention being paid to online tools for enhanced communication and consumer content (Chou *et al.*, 2013). In October 2020, there were 4.57 billion active Internet users worldwide, encompassing 59% of the global population (Statista, 2020). In January 2020, there were 22.31 million Internet users in Australia, constituting 88% of the Australian population. Ninety-three percent of these Internet users use the Internet every day (Dataportal, 2020). In very recent times the COVID-19 pandemic has led to an inevitable surge in the use of digital technologies due to social distancing requirements and nationwide lockdowns (De' *et al.*, 2020).

Electronic learning or e-learning can be broadly defined as any type of educational media that is delivered in an electronic form (Clark and Mayer, 2016). Terms such as computer-assisted learning, online learning, web-based learning and elearning are often used synonymously but all reflect information delivery via an electronic device (Clark and Mayer, 2016). This broad definition allows a range of multimedia to be used in constructing, delivering and assessing professional learning, training or support to rural health professionals.

The literature suggests that web-based education is flexible (Castro and Tumibay, 2019), can be time and cost-saving (Clark and Mayer, 2016; De' *et al.*, 2020; Nguyen, 2015) and provides opportunities for professional development (Bond *et al.*, 2018). The online environment has become more multidirectional in its communication characterised by participation, collaboration and openness (Eysenbach, 2008; Kreps and Neuhauser, 2010) and allows health practitioners to create health-focused groups to communicate with peers (Ali, 2015; Myneni, 2016). Furthermore, the web empowers users through the formation of communities and the mass publication of user-generated content (Darwish *et al.*, 2011).

While Chou *et al.* (2013) suggest that web platforms make the communication landscape increasing accessible, empirical evidence is needed regarding their impact on, and utility for, rural health workforce education, training and support. Some evidence is available about the impact of e-learning on the knowledge and attitudes of learners, but very limited evidence exists on the impact of e-learning on learning outcomes (den Harder *et al.*, 2016), education performance (Frehywot *et al.*, 2013) and on patient care (Lahti *et al.*, 2014). However, Du *et al.* (2013) suggest that to be effective and functional, web platforms must contain features that

promote learning and facilitate knowledge translation into practice. Further, Bell and Federman (2013) urge developers and promoters of online learning to look beyond "does it work" to focus on issues of content, immersion, interactivity and communication to increase its effectiveness.

This scoping review therefore seeks to identify and synthesise the key elements reported in the literature about the benefits, enablers and barriers of web platforms in providing education, training, CPD and support of rural health professionals. There is significant scope for better understanding the issues related to enablers and facilitators associated with e-learning (Regmi and Jones, 2020). Research into factors influencing participation and satisfaction with online learning have largely focused on health professionals studying through universities and tertiary training sectors. The focus of our investigation is the use of online education, training and CPD that is outside the undergraduate and postgraduate learning experiences of a university. This includes formal and informal work-related CPD that occurs via conferences and seminars, member associations, short courses, certificate courses, webinars, in-service education, mentoring, and discussions with colleagues (Professionals Australia, 2020). Further, this kind of e-learning is often mediated via the Internet asynchronously (Melhuish and Falloon, 2010). Asynchronious learning is self-directed and does not require a human to facilitate, rather, technology officiates the learning process and the learner negotiates meaning independently (Melhuish and Falloon, 2010). It affords the opportunity to engage in learning at a time and location that is convenient and enables the learner to balance professional development with personal and work commitments (Sinclair *et al.*, 2015). This review however, does not exclude facilitated learning whereby a teacher, instructor, or trainer provides support to learners.

Methods

A scoping review was selected to appraise evidence about the use of web platforms to provide education, training CPD and support to the rural health workforce. Scoping reviews involve "the synthesis and analysis of a wide range of research and non-research material to provide greater conceptual clarity about a specific topic or field of evidence" (Davis *et al.*, 2009, p. 1386). We used the five-stage framework of a scoping review developed by Arksey and O'Malley (2005). Additionally, we applied the recommendations by Levac *et al.* (2010) that clarify and enhance the framework. The framework includes the following steps:

Stage 1 – identify the research question by clarifying and linking the purpose and research question

A broad question and key terms were defined to enable breadth of coverage of available literature. The review question is, "What are the key elements associated with the utility of digital technologies in providing education, training or professional learning and support for the rural health workforce outside the University and tertiary training sectors?" As part of the scoping, we sought studies that showed the benefits, enablers or barriers of e-learning in supporting rural health professionals. In particular we sought studies that investigated whether providing access to learning and support impacted on the retention of rural health professionals.

The research question was deliberated by a multidisciplinary clinical, research, management, technical and policy team from the NSW Rural Doctors Network and Deakin University. The Rural Doctors Network NSW Rural Doctors Network (RDN), is a 30-year-old independent, non-governmental organisation based in New South Wales, Australia. RDN's purpose is to improve health access for Australians living in remote, rural, regional, Aboriginal and disadvantaged communities. To achieve this, RDN is responsible for a range

of programs and initiatives that support the attraction, recruitment and retention of a sustainable rural health workforce.

Stage 2 – identify relevant studies by balancing feasibility with breadth and comprehensiveness

To be as comprehensive as possible in identifying primary studies in the key areas of interest, a selection of search terms was mapped, based on the review question. These were iteratively developed to maximise generalisability while being sensitive to the broad range of health professionals, education and training formats, digital modes and the rural context of interest.

The search terms are outlined in the following table. Title (TI) and Abstract (AB) were applied to the search concepts which enabled identification of articles that contained the search terms in either the title or abstract to maximise results (see Tables 1–3).

The authors of this manuscript agreed there was likely to be greater similarity in policy, strategy and resources in high incomes countries. However, the search method was not restricted to low and middle incomes countries due to the risk of missing relevant articles that related to more than one country. Therefore, during the screening process articles focussing

Search concept 1: rural or remote* or isolat* or region* or "small town" or geograph*
AND
Search concept 2: TI ("online learn*" or "digital learn*" or "online platform*" or "digital technolog*" or "virtual educat*" or "digital educat*" or "e-learn*" or e learn*" or "online support" or "online network" or "support network" or webinar or web-based or "web based") OR AB ("online learn*" or "digital learn*" or "online platform*" or "digital technolog*" or "virtual educat*" or "digital educat*" or "e-learn*" or e learn*" or "online support" or "online network" or "support network" or webinar or web-based or "web based")
AND
Search concept 3: TI ("health care work*" or healthcare or doctor or "general practitioner*" or "allied health" or nurs* or midwi* or "health profession*") OR AB ("health care work*" or healthcare or doctor or "general practitioner*" or "allied health" or nurs* or midwi* or "health profession*")

Table 1.
Search terms

	Inclusion	Exclusion
Date of publication	January 2010–September 2020	Pre 2010
Geography	Rural or remote areas or explicit statements that initiative facilitated access from any location	Main cities, capital cities, non-urban
	Articles from Australia, New Zealand, Canada, USA, UK, Norway	Low to middle income countries
Type of publication	Peer reviewed articles using quantitative, qualitative or mixed methods design	Full text not available
Publication focus	To find the utility and key elements of learning and support for rural health workers using an online platform	Academic courses, education or training delivered through the university as part of an undergraduate or postgraduate degree
	Web platforms, e-learning, internet-based learning, online learning	Use of mobile or smartphone applications only
	Asynchronous or facilitated e-learning	Use of clinical decision support tools
Demographics	Any health professionals practising in rural locations	Non-health professionals
Language	English	Not in English

Table 2.
Inclusion and exclusion criteria applied to the scoping review

on low to middle income countries were removed manually. Due to more rapid advancements in technology since 2010, only literature published after 2010 was considered. All study designs were eligible, including those that utilised qualitative, quantitative or mixed methods. Study method and sample size varied as outlined in Table 4.

Four data bases, judged to in scope and relevant to the question were used: Medline complete, CINAHL, Academic Search complete and Education Complete. Two additional articles found in the publications of this file search were subsequently included. In order to develop inclusion criteria, the first three authors reviewed the articles. The literature was entered into Endnote, duplicates removed, and articles sorted, manually screened and excluded based on the inclusion and exclusion criteria, which had been iteratively developed through discussion between the authors (Table 2).

Stage 3 – select studies using an iterative team approach to study selection and data extraction

Study selection involved reviewing article titles and abstracts for inclusion. This required regular discussions between the authors of this manuscript to develop inclusion criteria. The first author then conducted full-text screening. Extraction criteria were developed based on the research question, pilot tested and refined until considered fit for purpose. Extracted material included country, year, study design, description of intervention, use of digital platform, study sample, methods and delivery context (training calendar, webinar, information, chat, conference session, health information etc.). Other criteria included its relevance to the research question, to regional, rural or remote, and the outcomes being investigated. The second author undertook full screening of the final selection against the selection criteria to verify inclusion. At that point, after further discussion, an additional eight articles were excluded.

Stage 4 – chart the data incorporating numerical summary and qualitative thematic analysis

Material was interpreted, sorted and charted according to key issues and themes. The extracted material was initially recorded into preliminary ideas and thoughts, and discussed with main authors of this manuscript. After initial analysis, articles were re-read and progressively organised into consistent themes using inductive analysis. The material was considered without using a pre-existing coding framework.

Articles were categorised according to the main themes covered, and findings were presented in relevant sections of the results and discussion.

Stage 5 – collate, summarise and report the results, including the implications for policy, practice or research

The results were organised into commonly reported themes that related to rural health professionals' experiences with online learning. Details of the study design and sample and main findings were briefly reported to inform future research.

Table 3. Article numbers by theme

Themes	Article number as per Table 4
Improvement in knowledge and skills	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 16 17, 18, 19, 20, 21
Access	2, 3, 4, 5, 11, 12, 13, 14, 16, 17, 20
Information technology and online learning	2, 3, 5, 7, 12, 14, 16, 22
Improved knowledge translation into practice	2, 3, 6, 14, 16, 19, 20
Engagement	2, 3, 8, 11, 15, 16
Empowerment and confidence	1, 7, 10, 17, 21
Need for support	2, 5, 7, 16, 17

Table 4.
Methodological details and relevant findings

No	Author and year	Title	Method	Sample	Main findings
1	Abel *et al.* (2019)	Empowerment of front-line leaders in an online learning, certificate programme	A pre- to post-study design	29 acute care front-line leaders in the USA and Australia	Online learning was effective and could be integrated into orientation and/or continuing education plans to develop empowering work environments
2	Bell and MacDougal (2013)	Adapting online learning for Canada's Northern public health workforce	Focus groups, surveys and journal logs	32 public health professionals	Appropriate adaptations to online professional development can provide practical, accessible means for a wide range of Northern/Aboriginal public health workers to acquire core competencies for public health
3	Berndt *et al.* (2017)	Effectiveness of distance learning strategies for continuing professional development (CPD) for rural allied health practitioners: a systematic review	Systematic review of Allied health professionals working in rural areas	14 studies	Technology based options of delivery have a high utility, however the complex inter-relatedness of time, use, travel, location, costs, interactivity, learning outcomes and educational design suggest a need for more sophisticated consideration by educational providers
4	Bond *et al.* (2018)	Evaluating the Effect of a Web-Based E-Learning Tool for Health Professional Education on Clinical Vancomycin Use: Comparative Study	Cochrane review Conducted a comparative pre-post intervention study	14 hospitals of two health districts in New South Wales, Australia. 577 responses	The e-learning tool was associated with improved knowledge scores among nurses, whereas the comparator email was associated with improved scores among doctors. This implies that that different strategies may be required for optimising the effectiveness of education among different health professional groups

(*continued*)

Table 4.

No	Author and year	Title	Method	Sample	Main findings
5	Davies *et al.* (2013)	Australian maternity health professionals' experience of an e-learning foetal surveillance package	Cross-sectional design to collet user experience and pre/post to test knowledge evaluation	56 clinicians provided user experience feedback and 42 completed pre/post and follow-up across three data collection periods	K2MS provided an effective, relevant and sustained means to educate clinicians. Knowledge was significantly improved and retained for a period of nine to 11 months However, strategies are needed to ensure that those in rural and remote areas can successfully access K2MS with protected time to complete the package
6	DeSouza *et al.* (2020)	Translating facilitated multimodal online learning into effective person-centred practice for the person living with dementia among health care staff in Australia: an observational study	Three clusters of online questions post completion	First cluster (1,455), second cluster (520), third cluster (343)	A facilitated multimodal online program may contribute to a more skilled healthcare workforce when person-centred care knowledge is translated to the practice environment. Furthermore, from the learners' perspective, the results support a concept that online learning programs can be designed on an entire educational experience that may potentially result in the best possible provision of care for people living with dementia
7	Hills *et al.* (2010)	Outcomes from the Trial Implementation of a Multidisciplinary Online Learning Program in Rural Mental Health Emergency Care	Pre and post survey	35 rural health clinicians and non-clinical assistants working in mental health	Statistically significant improvements were detected in participant confidence in managing key mental health problems, perceived self-efficacy in dealing with challenging, aggressive behaviours and confidence in key online learning skills

(*continued*)

No	Author and year	Title	Method	Sample	Main findings
8	Hunt-Smith and Butler (2018)	LEADS case Study: Partnering to Offer a Diabetes Management e-Learning Module to Nursing and Allied Health Staff	Case study	512 participants	Participants found the diabetes management module to be very useful (58.9%)
9	Lineker *et al.* (2019)	Getting a Grip on Arthritis Online: Responses of rural/remote primary care providers to a web-based continuing medical education programme	A pre/post survey design. Best practice scores	89 participants represented various professions in primary care. The response rate at 3 months was too small for analysis	With knowledge gained from the online modules, participants were able to apply a greater number of best practices to OA and RA hypothetical case scenarios. The online program demonstrated that it can provide some of the information rural/remote primary care providers need to deliver optimal care
10	Maguire *et al.* (2019)	Evaluating the effectiveness of an evidence-based online training program for health professionals in eating disorders	Pre and post training questionnaires	1,160 completed at least 80% of the five learning modules	An online learning program can be an effective method to support the professional development of healthcare providers working with patients with eating disorders. Results suggest that psychologists, dieticians, and those working in rural areas were more willing to treat eating disorders after completing the program
11	Moehead *et al.* (2020)	A Web-Based Dementia Education Program and its Application to an Australian Web-Based Dementia Care Competency and Training Network: Integrative Systematic Review	Systematic literature review to determine key features of an effective web-based education program	Six electronic data bases	14 key features were identified that support an effective and functional web-based learning environment
12	Place *et al.* (2012)	Finding my own time": Examining the spatially produced experiences of rural RNs in the rural nursing certificate program	Qualitative surveys Descriptive statistics and content analysis	33 rural nurses who completed a geographical issues and access survey	Online learning improved access to nursing education. The realities of rural nursing made it impossible to completely overcome geography

(*continued*)

Table 4.

Table 4.

No	Author and year	Title	Method	Sample	Main findings
13	Rasouli *et al.* (2020)	Virtual Spine: A Novel, International Teleconferencing Program Developed to increase the Accessibility of Spine Education During the COVID-19 Pandemic	Metrics re participants obtained through an online form	955 Physicians and residents/ fellows	The early success and positive reception of the VGSC suggests this educational model can be emulated by other medical and surgical specialties to encourage national and international education and collaboration. Many clinicians and trainees want to see "virtual" education continue post COVID-19
14	Regmi and Jones (2020)	A systematic review of the factors – enablers and barriers – affecting e-learning in health sciences education	Systematic review on e-learning in health sciences education	57 articles	The study identified the factors including enablers and barriers which impact on e-learning: interaction and collaboration between learners and facilitators; considering learners' motivation and expectations; utilising user-friendly technology; and putting learners at the centre of pedagogy. Suggests creating a broader framework to understand how e-learning can be effective
15	Resop Reilly *et al.* (2012)	"Me and my computer": emotional factors in online learning	Qualitative study, Telephone focus groups	18 registered nurses across the US	Pedagogical strategies that foster a sense of community in online courses between students and faculty enhance cognition through affective engagement of students
16	Riley and Schmidt (2016)	Does online learning click with rural nurses? A qualitative study	Qualitative study, Semi-structured interviews	14 Facility managers and nurses from three public health facilities in NSW	Rural nurses' engagement with online learning would be enhanced by a whole of system redesign in order to deliver a learning environment that will increase satisfaction, engagement and learning outcomes

(*continued*)

No	Author and year	Title	Method	Sample	Main findings
17	Robinson *et al.* (2011)	The evaluation of an online orientation to rural mental health practice in Australia	Pre and post questionnaire	26 clinicians, of whom 50% were nurses	The *Introduction to Rural Mental Health Practice* program was successful in orienting clinicians to rural mental health but the small sample size highlights the need to evaluate the programme with a larger cohort of rural clinicians. The program did help clinicians maintain their professional skills and successfully manage their career options
18	Sinclair *et al.*, (2015)	The effectiveness of Internet-based e-learning on clinician behaviour and patient outcomes: A systematic review	Systematic review of RCTs to assess effectiveness of e-learning programs on clinician behaviour and patient outcomes	Seven trials	Results suggest that e-learning was at least as effective as traditional learning approaches, and superior to no instruction at all in improving health care professional behaviour. There was variation in behavioural outcomes depending on the skill being taught, and the learning approach utilised
19	Sinclair *et al.* (2019)	The CKD-DETECT study: An RCT aimed at improving intention to initiate a kidney health check in Australian practice nurses	Double blinded pre-post interventional randomised control	212 practice nurses completed pre and post	A targeted behavioural online intervention was no more effective than a knowledge based online program to improve primary health care nurses' intention to initiate a kidney health check in people at risk of chronic kidney disease
20	Taylor *et al.* (2013)	Online vs Live Delivery of Education to Pharmacists in a Large Multicentre Health Region: A Non-inferiority Assessment of Learning Outcomes	Randomized, parallel-group, open-label non-inferiority trial	A total of 74 pharmacists consented to participate, 38 randomly assigned to use the enhanced online module and 36 to attend the face-to-face learning session	The enhanced online module was deemed to be non-inferior to the face-to-face learning session in terms of knowledge application and knowledge gain. Pharmacists had similar levels of satisfaction with the 2 modes of learning

(*continued*)

Table 4.

Table 4.

No	Author and year	Title	Method	Sample	Main findings
21	Tchernegovski *et al.* (2014)	"Let's Talk about Children": A pilot evaluation of an e-learning resource for mental health clinicians	A sequential mixed-method design Pre and post questionnaire and interviews	There were 21 mental health clinicians	The e-learning resource was effective at enhancing participants' practices, such as assessing the impact of mental illness on parenting and child development. The e-learning resource may be an effective professional development tool for clinicians
22	Vela and Bardyn (2019)	Increasing rural nurses' awareness of a state-wide health information resource: an educational outreach initiative	Evaluation survey	Nurses –315 evaluations received and 116 received to follow up survey one month on	The webinar series, coupled with in-person workshops and an online tutorial, reached nurses in rural areas of Washington state to increase awareness of HEALWA

Ethics approval

This study used published data and so did not require an ethics approval.

Findings

Overall, a total of 590 articles were identified from four databases. After 217 duplicates were removed (Figure 1), abstract and title screening was completed for 373 articles. Of these, 86 articles were retained. After full-text review, 22 publications met the inclusion criteria: 18 quantitative and qualitative empirical studies and four systematic literature reviews (Table 4). In total, 14 (64%) of the articles were published in the last 5 years. Of all included literature, most was from Australia (n = 12), Canada (n = 5), USA (n = 4), United Kingdom (n = 1).

Seven main themes were identified and are sorted in descending order by the number of articles supporting that theme (Table 3). They are increased knowledge and skills, access, information technology, transference of knowledge into practice, engagement, empowerment and confidence, and the need for support.

Theme 1: improvement in knowledge and skills

The most commonly cited advantage of online learning and CPD for rural health professionals was improvement in knowledge and skills. Seventeen of the 22 studies

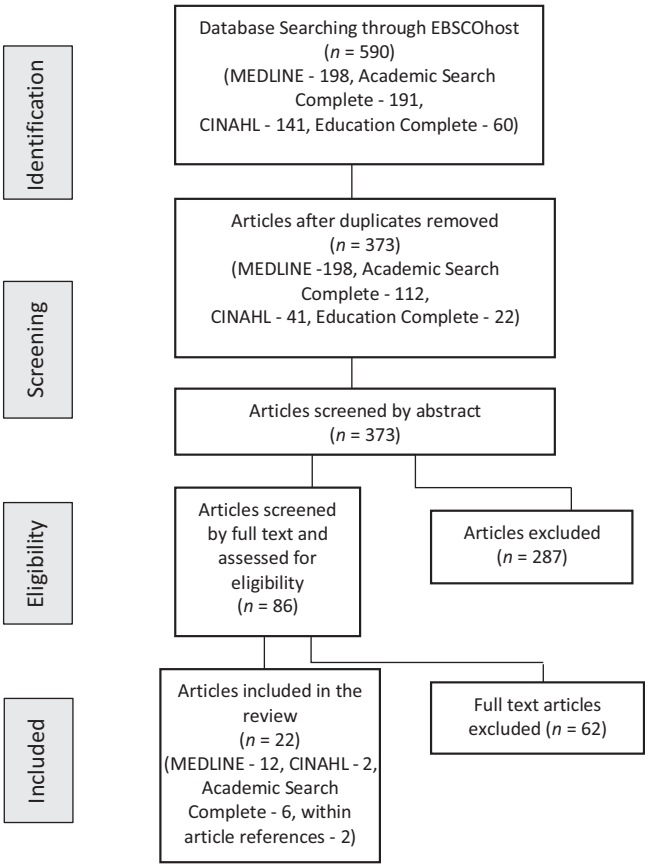

Figure 1.
Flow chart of study selection

acknowledged how useful rural health professionals found online learning in terms of enhanced knowledge or skills or both (Abel *et al.*, 2019; Bell and MacDougal, 2013; Berndt *et al.*, 2017; Bond *et al.*, 2018; Davies *et al.*, 2013; DeSouza *et al.*, 2020; Hills *et al.*, 2010; Hunt-Smith and Butler, 2018; Lineker *et al.*, 2019; Maguire *et al.*, 2019; Regmi and Jones, 2020; Riley and Schmidt, 2016; Robinson *et al.*, 2011; Sinclair *et al.*, 2015; Sinclair *et al.*, 2019; Taylor *et al.*, 2013; Tchernegovski *et al.*, 2014). Some studies found online learning to be as good as/or equivalent to face-to-face learning in relation to knowledge and satisfaction (for example, Berndt *et al.*, 2017; Davies *et al.*, 2013; Maguire *et al.*, 2019; Taylor *et al.*, 2013).

Sixteen of the 17 studies reported increased knowledge and skills as specific benefits of completing web-based modules. A Western Australian study of 42 maternity health professionals who completed a foetal surveillance package, increased their knowledge of important elements of the web-based learning program. Follow up scores from pre-test suggested that the knowledge increase was retained (Davies *et al.*, 2013). A study by Hills *et al.* (2010) found a multidisciplinary online mental health learning program impacted positively on participant knowledge and skills, as well as being a positive educational experience for an interdisciplinary cohort of rurally located clinicians and support staff. In a study of an online leadership program for 30 nurses in three health institutions in the US by Abel *et al.* (2019), 93% of participants increased their knowledge of the topics presented. More than 72% agreed that the program helped prepare them for their role. Maguire *et al.* (2019) conducted a study of a diverse group of 1,160 health professionals who completed at least 80% of an online program for detecting and treating eating disorders (EDs). Three studies noted that the increase in knowledge and skills was important given that it allows unlimited numbers of health professionals over any geographic area to access the same educational experience (Hills *et al.*, 2010; Taylor *et al.*, 2013; Tchernegovski *et al.*, 2014).

A Canadian study by Bell and MacDougal (2013) found that when content on Northern and Aboriginal health issues was incorporated and when learners actively shared knowledge, the acquisition of knowledge and skills was enhanced. One study by Bond *et al.* (2018) with nurses, doctors, and pharmacists before and after release of a web-based e-learning tool reported that effectiveness differed according to health profession. This finding led the authors of that article to conclude that different health professional groups can be educated by different targeted learning modalities.

Theme 2: access

A strong finding is that online learning is increasingly viewed as a means of providing CPD and support where access is limited (Riley and Schmidt, 2016). In nine of the eleven studies (Bell and MacDougal, 2013; Berndt *et al.*, 2017; Moehead *et al.*, 2020; Place *et al.*, 2012; Rasouli *et al.*, 2020; Regmi and Jones, 2020; Riley and Schmidt, 2016; Robinson *et al.*, 2011; Taylor *et al.*, 2013), rurally located health professionals indicated that online learning gave them access to education and new knowledge. It also informed their practice (Regmi and Jones, 2020), enabled them to keep pace with practice change (Riley and Schmidt, 2016) and provided support structures and survival skills that may contribute to rural workforce retention (Robinson *et al.*, 2011).

A number of studies valued access to online learning due to the benefits it provided to address the challenges related to geography (Bell and MacDougal, 2013; Place *et al.*, 2012; Rasouli *et al.*, 2020; Regmi and Jones, 2020). For example, a study of rural nurses cited factors such as distance, cost of travel, poor road conditions and weather (Place *et al.*, 2012). Three studies reported that access to online learning provided the opportunity to access learning flexibly (Regmi and Jones, 2020; Riley and Schmidt, 2016; Vela and Bardyn, 2019). In a systematic review of the factors affecting e-learning in health sciences, Regmi and Jones (2020) reported that health professionals valued the flexibility of e-learning. It allowed learning to take place at the learners' own pace and to access materials at any time regardless

of their geographical location. A study of a webinar series providing health information as part of a resource to increase health practitioner's access to, and awareness of, an online portal for health information was found to provide easy access, flexibility and a greater work life balance (Vela and Bardyn, 2019). Further, an Australian study of fourteen nurses noted that the flexibility in access to online learning was a positive step towards enabling them to meet their educational goals and reducing their sense of isolation (Riley and Schmidt, 2016).

Theme 3: information technology and online learning

The literature reports that rapid and changing technological advances can cause "reticence and confusion for some and a never-ending world of opportunities for others" (Wedlake, 2010. p. 145). Seven of the 22 studies explicitly reported on the challenges with information technology experienced by health professionals that hindered engagement with online learning. These mostly related to inadequate skills and training to use the technology efficiently (Vela and Bardyn, 2019) and lack of access or lack of information technology support (Davies *et al.*, 2013; Hills *et al.*, 2010). A study by Hills *et al.* (2010) confirmed that access to information technology services can be a significant issue that impacts on both professional practice and professional development. A systematic review by Berndt *et al.* (2017) identified limited access to the equipment needed, readiness of learners to use the technology for education delivered via the Internet, bugs in the program, lag time and poor Internet connection as reducing the satisfaction of distance education for rural allied health professionals. Riley and Schmidt (2016) utilised online learning as a means of providing CPD to 14 rural nurses where access to education and support were limited. Many nurses in this study expressed feelings of frustration in using computers and accessing online learning, and as a result their satisfaction and engagement with online learning and self-confidence was reduced.

A study by Vela and Bardyn (2019) found that computer literacy is a common challenge that impacts on engagement in online events, including for rural nurses. In a systematic review by Regmi and Jones (2020) eight out of 24 papers identified the lack of information technology or user-friendly information technology as one of the key challenges of making elearning successful in health sciences education.

A concern identified in the user experience feedback from maternity health professionals in a study of a foetal surveillance package was information access and navigability (Davies *et al.*, 2013). This study also noted that issues with operation and navigation of learning tools became more apparent when dealing with large geographical areas and Internet connection issues.

Some studies also noted the benefits of the use of information technology including greater access to learning and flexibility in relation to education and CPD for rural health professionals (Lineker *et al.*, 2019; Regmi and Jones, 2020). Bell and MacDougal (2013) found that online learning is effective in bridging the geographical barriers in remote locations. Despite technological challenges related to broadband infrastructure, connectivity and personal computer literacy, rurally located health professionals in that study remained eager to participate in the module using technology. In Place *et al.* (2012) rurally located nurses were generally comfortable with computer use; had affordable access to high-speed Internet, computer software and hardware retailers, and repair services. Online delivery of curriculum allowed them the benefit of remaining in their hometowns and fitting their courses into their work schedules.

Theme 4: transference of knowledge into practice

Seven (32%) studies made reference to a transference of knowledge into practice. However, despite efforts to report on measures of practice change only two studies reported being able to use increased knowledge to change practice (DeSouza *et al.*, 2020; Regmi and Jones, 2020).

In a systematic review by Regmi and Jones (2020), e-learning was found to be an effective approach regarding the integration of knowledge into practice through education and training, including CPD in healthcare settings. Six out of 23 papers highlighted that developing learners' motivation, satisfaction, expectation, training and support needs were the key reported factors for improving working practice. In an observational study of an online facilitated, multimodal, person-centred care dementia education program, DeSouza *et al.* (2020) found that 95% (n = 494) of participants changed aspects of their own professional practice and 85% (n = 442) had changed their beliefs or thinking about a particular approach or procedure. On the contrary, only half of participants 54% (n = 281) had changed a practice or routine in their workplace and 48% (n = 250) had changed a procedure/technique or other intervention. This suggests it is easier to change your own practice than to change shared standard work practices. The most common activities that were implemented into practice were education 49% (n = 165) and role modelling of new behaviour 47% (n = 157).

The remaining five studies did not advance an understanding of how to move from knowledge to changing practice. In a randomised control trial of nurses who were delivered a behavioural based intervention using asynchronous e-learning modules, Sinclair *et al.* (2019) found that the online intervention targeting behaviour was no more effective than a knowledge-based intervention. Taylor *et al.* (2013) in a randomised, parallel-group trial of pharmacist's knowledge and retention of an insulin teaching module in Canada reported similar results between online and face to face in terms of improving application of skills and knowledge gained.

A systematic review of distance learning strategies for CPD for rural allied health practitioners by Berndt *et al.* (2017), found only three of fourteen studies reported practice changed following the online education intervention. However, as the studies used self-reported measures, it cannot be assumed that changes in knowledge and confidence resulted in changes in practice. A study of 14 nurses by Riley and Schmidt (2016) noted that being able to transfer knowledge into practice was highlighted as a priority by nurses, however the study did not confirm success.

Theme 5: engagement

Six of the 22 studies suggest that the web provides a mechanism for users to engage with peers and gain feedback in real time (Bell and MacDougal, 2013; Berndt *et al.*, 2017; Hunt-Smith and Butler, 2018; Moehead *et al.*, 2020; Resop Reilly *et al.*, 2012; Riley and Schmidt, 2016). This reduces the sense of isolation and increases satisfaction and learning outcomes for rural health professionals.

An Australian study of 15 rurally located public health facility managers and nurses in NSW suggested that opportunities for participants to engage with others helped to overcome questions as to the validity of CPD provision outside the University sector (Riley and Schmidt, 2016). A systematic review by Berndt *et al.* (2017) found that opportunities for engagement in CPD minimised professional isolation and enhanced quality improvement for rural allied health professionals. One study in this review indicated that engagement was tied into building communities of practice. A systematic review of dementia education training programs by Moehead *et al.* (2020) found that clinicians had an urgent need for access to education that provides a community of practice through peer support, supervision and dementia champions, especially for those working in rural and remote regions.

A number of studies referred the fact that online learning provided a sense of community, which is particularly important where there is a sense of aloneness brought about by geographic isolation. A sense of community has been shown to be beneficial to engagement and persistence, course satisfaction, and success in online learning (Sadera *et al.*, 2009). A study of the emotional factors in online learning experienced by 18 nurses from across the

US indicated a sense of community was achieved through interaction and deliberation over shared interests and goals (Resop Reilly *et al.*, 2012). A study by Hunt-Smith and Butler (2018) found that engaging with and sharing ideas and knowledge across a distance as well as within the organisation provided an opportunity to educate nurses and allied health staff on management of a diabetes. In this study, engaging in partnership highlighted the importance of continuing education and CPD in today's constantly changing healthcare environment.

Theme 6: empowerment and confidence

Five of the 22 studies referred to confidence and empowerment gained through access to online education and training (Abel *et al.*, 2019; Hills *et al.*, 2010; Maguire *et al.*, 2019; Robinson *et al.*, 2011; Tchernegovski *et al.*, 2014). A US study of an online intervention program with 30 front-line nurse leaders in three health institutions was found to contribute to participants' sense of empowerment in their role and to their ability to create an empowering work environment (83%) (Abel *et al.*, 2019).

Four of the five studies related to confidence in terms of a willingness to treat or respond to mental illness (Hills *et al.*, 2010; Maguire *et al.*, 2019; by Robinson *et al.*, 2011; Tchernegovski *et al.*, 2014). Maguire *et al.* (2019) found participants in hospitals in regional and rural areas achieved a larger increase in confidence to treat patients with eating disorders, compared to those in metropolitan areas following an online program targeting a wide range of health professionals. Three Australian studies found confidence increased after online programs designed to improve knowledge and the ability of health practitioners to respond to mental health issues. In a study of an interdisciplinary cohort of rurally based clinicians and support staff, Hills *et al.* (2010) found significant improvements in their confidence in managing a range of mental health and related issues, self-efficacy in dealing with aggressive behaviours and confidence in computer and IT skills following a mental health program. However, this study was a self-reported survey and it is not clear whether self-reported confidence is a good measure of clinical competence. Evaluation of an e-learning resource for mental health clinicians by Tchernegovski *et al.* (2014) found increases approaching significance in clinician's confidence in using family-focused practices and providing resources and referrals to parents and families. A study by Robinson *et al.* (2011) to evaluate an online, interprofessional education program for clinicians commencing work in rural mental health services in NSW, Australia identified significant improvements in eight of nine items relating to confidence in responding to mental health problems. These findings suggest that online training programs, may provide a potential solution for the urgent need for professional development of mental health service providers in relation to emergency departments in rural and remote settings.

Theme 7: need for support

Five of the 22 articles referred to the need for support. The type of support varied from organisational commitment and the implementation of support systems to technical and emotional support (Bell and MacDougal, 2013; Davies *et al.*, 2013; Hills *et al.*, 2010; Riley and Schmidt, 2016; Robinson *et al.*, 2011). Riley and Schmidt (2016) identified the importance of organisational support for online education mixed with real time interaction and technical support. The study proposed that support extends beyond the online environment and requires an organisational commitment to education where online learning is enhanced with opportunities for interaction in real time. The findings of a Western Australian study of 42 maternity health professionals of a foetal surveillance package confirmed that it is of utmost importance that health professionals in rural and remote areas are adequately supported to successfully access online learning and are supported with protected time to complete e-learning activities (Davies *et al.*, 2013). An Australian study by Robinson *et al.* (2011) evaluated an online, interprofessional education program for 24 clinicians commencing work

in rural mental health services and found improvements in participant knowledge about the role of other services, the availability of professional networks and support structures. The authors of that study considered that support structures may contribute to retention in rural areas, however this was inconclusive due to the small sample.

Emotional support was deemed important in an Australian study of 35 participants from four rural health services in NSW, Australia (Hills *et al.*, 2010). It demonstrated that a systematic introduction to the online learning environment backed up by individualised problem-solving and emotional support can assist novices to rapidly master online learning. They also developed a set of skills that had much broader application, both personally and professionally (Hills *et al.*, 2010).

Bell and MacDougal (2013) referred to support in a number of contexts, including employer support to facilitate the recruitment and retention of learners in an online program, using modified approaches to support and measure knowledge acquisition and application, especially for First Nations learners and providing enhanced facilitation to adequately support diverse learners within mixed learner groups.

Discussion

There is evidence for the importance of appropriate education and professional support in helping to produce a "competent, accessible, acceptable and fit-for-purpose" rural health workforce (Wakerman *et al.*, 2019). Increasingly over the last decade, the availability and acceptability of the web for providing education, training, CPD and support was reported in the literature. However, much of the existing literature focussed on the university and training sectors with teacher facilitated delivery to students (Anderson and Krichbaum, 2017; Geraghty *et al.*, 2019; Klaassen *et al.*, 2013; Miller and Griffiths, 2017). A surprisingly small range of research focussed on using the web for providing training, education, CPD and support for rural health professionals or the implications of this for retention. This is surprising due to the well documented challenges in attracting and retaining health professionals to work rurally (AIHW, 2019; Durey *et al.*, 2015).

The research in this review was predominantly a mix of pre- and post-quantitative measures and qualitative evaluation focussing on knowledge development and satisfaction with and utilisation of the education and training delivery. All studies in this review reported different interventions including variances in format and duration. The variation in intervention design and evaluation measures of included studies means that we were unable to make generalisable inferences about the effectiveness of particular formats beyond the benefits of the use of digital technologies for rural health professionals.

In this scoping review we identified that digital technology is a valuable resource for rural health professionals. Seven themes important to e-learning for rural health professionals were identified from 22 unique papers. In total, seventeen studies reported increases in knowledge, attitudes and self-efficacy for health professionals in rural communities. This suggests that rural health professionals who undertake online education, training or CPD are likely to learn and therefore in this regard, online delivery should be considered as part of a comprehensive learning strategy. Given the finding by Bell and MacDougall (2013) that there were differences in knowledge between health professionals, further investigation as to whether different formats may suit different rural health professionals is also warranted.

The high value placed on access to online education, training and support opportunities by rural health professionals was another outcome of interest. This is important given issues such as time, geography and cost faced by rural health professionals in accessing education, training CPD and support (Lincoln *et al.*, 2014; Place *et al.*, 2012). This online access was also accompanied by much needed flexibility for rural health professionals to enable learning without being restricted to attend face to face sessions.

Information technology was found to be both an enabler and barrier to accessing education, training CPD and support. However, seven papers explored barriers to technology use for rural health professionals. These included technology challenges such as skill level, access to high-speed Internet and need for technology support. Given that without technology, access to education, training, CPD and support would be much more difficult, we must assume that despite the challenges identified it is fundamentally an enabler for rural health professionals. In the majority of these studies there was also a link between e-learning literacy and engagement in online learning. Having access to information technology support was found to be as important as organisational and emotional support. Therefore, it could be concluded that while the expansion of available e-learning resources and continuing advances in technology will enable many rural health professionals to access learning, it is of utmost importance that the intended audience is adequately supported to complete e-learning activities and to put the learning into practice.

A key issue raised in seven studies was whether digital technology enabled translation of knowledge and skills into practice emerged. Only one study reported that changes in practice were sustained by more than half of the participants for 12 months or more and management support was considered important to allow for learning to be implemented into practice (DeSouza, 2020). This finding is consistent with studies of continuing medical education that indicate educational meetings alone are not effective for practice changes (Bank *et al.*, 2017; Forsetlund, 2009) and suggest that further studies are required.

Engagement with other rural health professionals through online education and training was an outcome of interest. The opportunity to interact with other rural health professionals through engagement in education and CPD provided a mechanism for rural reducing their sense of isolation and increasing their sense of engagement. Engagement was linked to developing communities of practice which have been shown to be beneficial to course persistence, course satisfaction, and success in online learning (Sadera *et al.*, 2009). This suggests that it is important to design digital strategies that not only consider content but that also facilitate engagement and the development of communities of practice. Further research to learn what influences engagement and what characteristics would be most effective in online learning to facilitate engagement would be worthwhile. While opportunities for engagement in CPD have been shown to minimise professional isolation and support recruitment and retention (Schoo *et al.*, 2005), only one paper examined this by asking about "intent to stay" in their current organisation (Abel *et al.*, 2019). A systematic review by Berndt *et al.* (2017) also noted that none of the studies they examined in relation to distance learning strategies for rural allied health practitioners measured the relationship between access to CPD and workforce retention. Further consideration should be given to how to build engagement and reduce rural isolation.

Five studies reported on the role of e-learning in increasing a rural health professionals sense of empowerment and confidence (Abel *et al.*, 2019; Hills *et al.*, 2010; Maguire *et al.*, 2019; Robinson *et al.*, 2011; Tcherengovski *et al.*, 2014). In this context, empowerment might be considered in terms of the need for health professionals to work to scope of practice. This is a common theme in the broader rural workforce literature and has major implications for primary healthcare workforce retention (AMA, 2017; Larkins, 2014; Muirhead and Birks, 2020). While there are a number of contextual, practice and educational factors impacting on working to scope of practice (Muirhead and Birks, 2020) , being empowered to support rural health professionals to work to scope of practice may have the potential to contribute to our understanding of appropriate planning?.

This review indicates that there are still limited studies about the effectiveness of online training in providing support to rural health professionals. The ability of the online environment to offer support was mentioned in five articles. The role of a facilitator/mentor or instructor can help clinicians feel supported during their online training and was considered a

key feature of effective online training in rural dementia care (DeSouza, 2020). Further reviews might explore whether there is a connection between engagement and a sense of feeling supported. Given the literature and the potential for designing online CPD with an engagement and support focus, this may have ramifications for professional capability and retention. A greater understanding of the nature of that support and how it might reduce feelings of professional and personal isolation as a health professional working in rural areas deserves consideration.

While it is suggested that the provision of professional development is a strategy to retain staff (Brown *et al.*, 2013; Buykx *et al.*, 2010), only two studies emerged that considered the impact of online education and training on rural retention (Abel *et al.*, 2019; Berndt *et al.*, 2017). It could be assumed that some features or elements of design of the various online learning options may be of greater benefit in retaining health professionals rurally. This needs to be explored further. This needs to be explored further. While opportunities for engagement in CPD have been shown to minimise professional isolation and support recruitment and retention (Schoo *et al.*, 2005), only one paper examined this by asking health professionals about "intent to stay" in their current organisation (Abel *et al.*, 2019). Abel *et al.* (2019) noted that a significant amount of research links structural empowerment with an increase in "intent to stay" at their place of employment, however their study did not draw specific conclusions about "intent to stay" working rurally. According to Berndt *et al.*, (2017), it appears that the element of design of these two initiatives that may be of most benefit to retention in rural sectors is interactivity between participants and or the facilitator. This might provide the confidence needed to apply learning in practice. To progress the online training research agenda for rural health, more clarity around links to retention are needed. This would provide an opportunity to tailor learning and support initiatives more appropriately.

Study limitations and future research

It is important to acknowledge that the rural health landscape is complex. There are vast differences within rural health professions and rural and remote locations regarding access to education, training, CPD and support opportunities. Secondly, a comprehensive search strategy was undertaken to identify all relevant articles associated with the important aspects of web platforms for providing education and support outside the University and tertiary training sectors for rural health professionals. However, studies relevant to geographical distance that did not include the term "rural" were not including this review. Further, studies outside the four well-known electronic databases used may have been missed and no grey literature was searched. Thirdly, the identified research studies were variable in quality, sample size and study population. Our findings relied on secondary analysis of published data which comprised largely self-reported feedback surveys or questionnaires.

While the studies showed that online learning had the potential to improve rural health professionals' level of knowledge and skills, there were limited results in relation to translating knowledge into practice. Furthermore, there was no demonstrated link with workforce retention. This suggests that future research could explore the extent and manner in which online learning should be supported by additional knowledge translation strategies to improve practice and then to consider if improved practice contributes to improved rural health professional's retention.

Conclusion

In summary, our study identified seven important themes related to web-based distance learning in the provision of education, training, CPD and support for rural health

professionals. Generally, health professionals in rural areas were highly satisfied towards online education. The outcomes of this review suggest that rural health professionals' access to digital strategies for learning are likely to increase their level of knowledge and skills by making learning resources accessible. Evaluations of the impact of e-learning on practice were limited. Engagement appeared to be an important factor in the study that reported an impact on retention. With rapidly increasing access to and use of digital technology worldwide, there may be immense potential to leverage digital technologies not only to enhance knowledge, skills and support for rural health workers, but also to impact on practice changed and rural workforce retention. This would require further investigation into the factors that reduce isolation and enhance engagement and retention.

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Corresponding author
Robyn Ramsden can be contacted at: rgwaghorne@gmail.com

Received 31 August 2020
Revised 20 October 2020
Accepted 16 November 2020

Evaluation of a group webinar and individual video-conferencing support program designed to upskill staff working with children with autism in regional and remote areas

Genevieve Johnsson
Autism Spectrum Australia, Frenchs Forest, Australia and
Faculty of Medicine and Health, The University of Sydney, Sydney, Australia
Michelle Lincoln
Faculty of Health, University of Canberra, Canberra, Australia
Anita C. Bundy
University of Colorado, Colorado Springs, Colorado, USA
Debra Costley
School of Education, University of Nottingham, Nottingham, UK, and
Kim Bulkeley
Faculty of Medicine and Health, The University of Sydney, Sydney, Australia

Abstract

Purpose – The rollout of individualised disability funding in Australia resulted in an increased demand for services for people with a disability, particularly support for the high percentage of Australians with autism spectrum disorder. Continuing professional development is one way to grow and maintain a skilled workforce; however, face-to-face opportunities can be limited in remote areas of Australia. Technology may provide a low-cost and widely accessible platform for providing education and support for staff in these areas.

Design/methodology/approach – The current study evaluated a novel webinar training and individual online support program for 36 allied health, education and community support staff. Data were collected via a survey on changes in perceived "knowledge and skills" and "confidence" in supporting children with autism, as well as mode of participation, and accessibility of the program.

Findings – Participants reported a significant increase in their "knowledge and skills" and "confidence", in working with children with autism. This increase was positively related to the number of webinars the participants accessed. The mode of webinar access was predominantly via watching recordings of webinars (asynchronous learning). Synchronous learning via individual online sessions was accessed by a small number of participants, mostly allied health professionals. Workload and scheduling were identified as barriers to engaging in the program. The technology platform was found to be accessible and acceptable.

Originality/value – A predominantly asynchronous mode of delivery was successful, thereby increasing program access and flexibility for remote staff. Technology was not a barrier to accessing the program regardless of remoteness or job role.

Keywords Autism, Tele-health, Training, Education, Webinar, Video conferencing, Regional and remote, Professional development, Allied health, Disability

Paper type Research paper

Support for statistical analysis was provided by Prof Deborah Black at the University of Sydney.

Funding: Funding for this program was provided by the Department of Family and Community Services, New South Wales, Australia under Grant 1-62134537.

Health Education
Vol. 122 No. 2, 2022
pp. 150-163

0965-4283
DOI 10.1108/HE-08-2020-0077

The rollout of individualised disability funding in Australia under the National Disability Insurance Scheme (NDIS) from 2016 to 2020 has resulted in increased demand for services for regional and remote Australians with a disability (National Disability Services, 2019). This was expected to drive growth in the number of service providers operating in these areas (National Disability Services, 2017). With significant growth in any sector, there often comes challenges. One of the main challenges will be maintaining and growing a skilled and experienced workforce to keep up with the increased demand for disability-related support services. Autism spectrum disorder (Autism) is the most prevalent primary diagnosis of participants entering the scheme, representing 35% of 0–6-year-olds and 60% of 7–14-year-olds (National Disability Insurance Agency, 2018). Autism is characterised by difficulties in social communication, and the presence of atypical patterns of behaviour (American Psychiatric Association, 2013). Individuals on the autism spectrum respond well to environments that are structured, predictable and adopt a positive approach to managing challenging behaviours (Prior and Roberts, 2016). Having knowledge in these structured supports can be vital in the success of a child's early intervention program and subsequent placement in an educational setting. Researchers have also suggested that the lifelong cost of supporting an individual with autism can be reduced by up to two-thirds with early identification and intervention (Järbrink, 2007). Therefore, access to autism-related education and support in the early years is crucial.

Continuing professional development (CPD) is one way to build capacity across disability and mainstream sectors to support individuals with autism. Face-to-face access to opportunities, however, can be limited in regional and remote areas in Australia, where staff may travel more than three hours to access workshops or CPD events and few receive regular face-to-face supervision or support in their roles (Johnsson *et al.*, 2016). In order to overcome these barriers, researchers suggest that innovative models of delivering CPD, including the use of technology to improve accessibility, collaboration and frequency of professional education and support, should be trialled (Dew *et al.*, 2012; Keane *et al.*, 2012; Serna *et al.*, 2015).

Online learning is the use of modern information technology to deliver training and support programs to professionals in remote locations (Dudding, 2009). Online learning can be further broken down into two modes of delivery and participation. Asynchronous training programs occur at the time and pace of the student and do not rely on an instructor for online course delivery. Examples include email, discussion forums, blogs and websites, learning management systems, such as Moodle™ or BlackBoard™ and watching pre-recorded videos or webinars. Synchronous training programs require both the instructor and student to be simultaneously present during online delivery. Video and/or audio conferencing are the most common platforms through which synchronous training programs occur.

Synchronous online learning programs have been used as a successful education and support tool for parents and staff delivering early intervention programs to children with autism. Two major examples include training caregivers and staff in the principles and procedures of Applied Behaviour Analysis (Alnemary *et al.*, 2015; Heitzman-Powell *et al.*, 2014; Lindgren *et al.*, 2016; Machalicek *et al.*, 2010; Pantermuehl and Lechago, 2015), and the implementation of the Early Start Denver Model (Vismara *et al.*, 2009, 2013; Vismara *et al.*, 2012). When compared to in-person models of training, studies found no differences in child treatment and learning outcomes between modalities (Pantermuehl and Lechago, 2015; Vismara *et al.*, 2009).

Several studies have investigated combining asynchronous and synchronous modes of delivery, as it has been suggested that different types of communication may promote different types of learning and participation (Hrastinski, 2007; Wellman and Haythornthwaite, 2002). Vismara *et al.* (2009) combined live seminars and team supervision along with self-instruction DVDs to train therapists to implement the Early

Start Denver Model, an intervention program for treating young children with autism. They found that the synchronous elements (seminars and supervision) were necessary to improve the therapists' skill use. Similarly, in a combined web-based training and live coaching program for parents, researchers found that the live component with therapists was highly important for understanding how to implement the strategies from the web-based training into the child's daily life (Hrastinski, 2007; Vismara *et al.*, 2013; Wellman and Haythornthwaite, 2002). Baharav and Reiser (2010) further suggested that gains obtained in traditional face-to-face therapy can be maintained and even exceeded in a treatment model that uses synchronous online training for caregivers and staff supporting the child.

The benefits of using technology to deliver professional education and development include lower costs (Hay-Hansson and Eldevik, 2013; Lindgren *et al.*, 2016), reduction in travel time (Heitzman-Powell *et al.*, 2014) and greater access for disability workers, especially in regional and remote regions where they may be in short supply (Gallego *et al.*, 2015; Johnsson *et al.*, 2016). Professional isolation may also be addressed using online mentoring and network development, especially for early career staff in regional and remote locations (Dew *et al.*, 2012). As the demands for NDIS-funded services and supports increase, these benefits would allow staff to be upskilled without being removed from their roles for long periods of time. Access to combined synchronous and asynchronous professional development programs would have the added benefit of allowing staff to access learning at a time that suits their schedule.

While using technology as a way of learning can be beneficial, several barriers must also be considered. Access to equipment and training and access to a reliable Internet connection have been reported as barriers to the use of technology (Moffatt and Eley, 2011). Other barriers are related to individuals' preferences for the traditional face-to-face approach and lack of knowledge of technology-based programs (Chedid *et al.*, 2013; Johnsson *et al.*, 2016; Moffatt and Eley, 2011). In their comprehensive guidelines for developing telehealth services and troubleshooting problems, Lee *et al.* (2015) suggested addressing such issues in connectivity, hardware and software at the outset to determine suitability, while other researchers insist on providing appropriate training and technical support throughout (Tipton *et al.*, 2011). Hines *et al.* (2017) also re-iterated in their tele-practice guidelines that technology is simply the vehicle for delivery and the skill and quality of the facilitator is more important for success.

Overall, the literature to date exploring the use of online, autism-specific training programs has been limited to specific target groups (i.e. allied health or education professionals, or parents) and target approaches (i.e. Applied Behaviour Analysis, Early Start Denver Model). There is currently no investigation of the effectiveness of an online training and support program delivering a broad range of autism-specific topics to a wide variety of participants including allied health, education and social and community workers in regional and remote areas.

The aim of the current study was to conduct a pilot study of a novel online training and individual support program delivered to a broad range of staff across a large geographical area. The research questions were as follows:

RQ1. Was there a difference in perceived "knowledge and skills" and "confidence" in supporting children with autism following the program, and did these differ (1) between job groups, (2) between level of remoteness and/or (3) with additional individual online support?

RQ2. Was there a relationship between number of webinars viewed and changes in perceived knowledge and skills, and confidence?

RQ3. How did participants engage in the program i.e. synchronously through live webinars and individual online sessions and/or asynchronously through webinar

recordings. Were there any differences in overall webinar participation (1) between job groups, (2) between level of remoteness, and/or (3) when receiving additional individual online support?

RQ4. Was the technology used in the online program accessible, and was the program content valued and useful across job roles?

Methods

This study received Human Research Ethics Committee (HREC) approval [2015/622] at The University of Sydney on 4 August 2015.

Program information

The Building Connections program was funded by the Australian government to build capacity in western New South Wales (NSW) staff to support children with autism under the incoming NDIS. NSW is Australia's most populous state with 7.48 million residents, 3.8% of which live in western NSW across a land mass of approximately 26 million hectares (Australian Bureau of Statistics, 2016a).

Building Connections used Adobe Connect© to deliver online interactive webinars and individual support. Based on the results of the needs analysis, a total of 18 webinars were co-developed by an experienced, multi-disciplinary team including a speech pathologist, occupational therapist, teacher and psychologist for quality assurance. This team then delivered two consecutive series of the webinars, each across a 12-month period focussing on a broad range of topics identified in the needs analysis (Johnsson *et al.*, 2016). A webinar was delivered every three weeks on a Thursday from 1pm to 2pm with some variations during school holidays. Each participant was required to have their own login and password to access the online platform.

During the collaborative webinars, participants logged in using their web browser and were taken through a practical discussion on the webinar topic (synchronous learning). Participants were free to ask questions at any time throughout the webinar and engage in discussion surrounding the topic with the host and other participants. Participants were also able to access a recording of the webinar at another time using their login and password if they were unable to attend the live webinar or wanted to review the material (asynchronous learning).

Participants were randomly assigned to one of two groups halfway through the 12-month program. Group one was offered additional individual online support sessions (synchronous learning) with a frequency of up to one hour every three weeks for the remaining six months of the program. Group two continued to access the group webinar program alone.

During individual online support sessions, participants were able to set an agenda or engage in free discussion regarding previous workshop content, their current caseload, or questions they may have around other topics or specific children and families with whom they were working. Participants were also able to request discipline specific support within their own discipline (speech pathologist, occupational therapist, teacher, psychologist).

Participants

Individuals were invited to participate in the program and research study if they were in a role where they work with children with autism and/or developmental delay (0–8 years), and lived in the western region in the Australian state of NSW. Researchers met with local school administrators, disability and allied health services, and community support services in the targeted funding region to discuss the content, suitability and technology requirements of the novel online training and support program. A participant information and consent form was

distributed in-person or via email. Interested participants returned the consent form to researchers via email. A total of 102 people registered for the online program and of these, 36 participants completed both the pre-and post-survey.

Remoteness classification. Geographical location was calculated and classified according to the Australian Standard Geographical Classification–Remoteness Area system (Australian Bureau of Statistics, 2016b). The system includes five classifications: (1) major cities, (2) inner regional, (3) outer regional, (4) remote, and (5) very remote.

Measures

We used an online survey via Survey Monkey™ to collect data pre- and post-program. Demographic data was collected in both surveys including gender, age range, education, area of residence and years lived in this area, job role, years worked in current role and years intended to remain in role.

At the time of design, it was determined that a purpose-built survey be adapted from the needs analysis conducted by Johnsson *et al.* (6) on a similar participant group in regional and remote NSW. The survey was developed to gather meaningful responses relating specifically to the broad range of topic-related content within the online training and support program. Based on this, the measures of perceived "knowledge and skills" and "confidence" comprised25 questions scored on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). "Knowledge and skills" was operationally defined as the degree to which a participant felt that they had understanding of, and ability to implement, targeted strategies to support children with autism and their families. "Confidence" was operationally defined as the degree to which a participant felt confident in their role supporting children with autism and their families in a variety of support areas. Higher scores on these measures indicate higher levels of perceived "knowledge and skills" and "confidence". (See Appendix for "knowledge and skills" and "confidence" survey questions). To ensure clarity of survey questions, the authors used the Validation Rubric for Expert Panel (White and Simon, 2015) to determine that the questions were balanced, did not overlap, limited the use of jargon and technical language and were sufficient to answer the research questions, and obtain data relevant to the purpose of the study. To investigate face and content validity, the survey was iteratively reviewed by two research team members and was deemed as a reasonable way to gain the required information and reflected the specific intended domain of content; autism-specific "knowledge and skills" and "confidence" as related to the training program. Finally, the scales had good internal consistency, with a Cronbach's alpha coefficient of 0.77 for Confidence and 0.92 for Knowledge and Skills (Pallant, 2016).

Participation in the online program and information on the participants experience with the technology was collected in the post-program survey. For each webinar the participant had attended, they were asked to select from "Attended Live" or "Watched On-line later". Participants responded "yes" or "no" as to whether they had been offered and engaged in individual online support sessions. Those that engaged were asked an additional four questions rating their experience of the individual online sessions on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). Those that did not engage were asked to provide a comment on their reason for not taking up the individual online support. To evaluate the technology, and value and usefulness of the program content, four questions were included in the online survey asking participants to rate the above on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree).

Statistical analysis

Statistical Package for the Social Sciences (SPSS) version 24 was used for statistical analyses (IBM Corp, 2016). Exploratory statistical analysis was conducted prior to analyses to check

assumptions were met. The pre- and post-scores on measures of perceived "knowledge and skills" and "confidence", were converted into single difference scores. All variables met the assumption of normality using the Kolmogorov–Smirnov test ($p > 0.05$). Cases were excluded pairwise if they were missing data for a specific analysis. Job roles were sorted into three groups: (1) Allied Health, (2) Education and (3) Social and community work.

A paired samples *t*-test was used to measure differences from pre- to post-program on measures of perceived "knowledge and skills" and "confidence" for the total sample. A Wilcoxon Signed Rank test was used to measure differences from pre- to post-program on measures of perceived "knowledge and skills" and "confidence" for each condition (group webinars plus individual online sessions, and group webinars alone). Where effect sizes were calculated, Cohen's d was used (Cohen, 1988) and interpreted as 0.2 = small effect, 0.5 = moderate effect, 0.8 = large effect. A one-way between groups analysis of variance (ANOVA) was used to measure whether job role or level of remoteness had an impact on the differences from pre- to post-intervention for the total sample.

A Pearson product-moment correlation coefficient was used to investigate the relationships between number of webinars viewed and measures of perceived "knowledge and skills" and "confidence" in supporting children with autism. Preliminary analysis was performed to ensure no violation of the assumption of normality, linearity and homoscedasticity.

Webinar attendance and individual online session outcomes was tallied and reported descriptively.

Results

Participants

Participation in the program and research was voluntary and it is unknown the extent of participation of those who did not complete the post-survey. Possible reasons for perceived attrition include program drop out, lack of time to complete survey, changing jobs, changing email addresses (point of contact), changing work sectors and moving out of the area. To investigate the impact of this, a missing data analysis was performed on the groups to check for significant differences. A chi-square test for independence indicated no significant association between completing the post-survey and participant age (χ^2 (2, $N = 102$) = 0.025, $p = 0.99$), job role (χ^2 (2, $N = 102$) = 2.21, $p = 0.33$), or regional or remote residential location ($p = 0.99$, Fisher's exact test). An independent samples *t*-test also confirmed there were no significant differences between groups in pre-survey scores on perceived knowledge and skills (t (100) = 1.36, $p = 0.18$) or confidence (t (100) = 1.39, $p = 0.17$) in supporting children with autism. Participant information is summarised in Table 1.

Perceived knowledge and skills, and confidence

There was a statistically significant increase in perceived "knowledge and skills" from pre-program ($M = 3.41$, SD = 0.49) to post-program ($M = 4.1$, SD = 0.45) (*Mean difference* $D = 0.64$, SD = 0.50), $t(34) = 7.41$, $p = 0.000$ for the total sample. There was also a statistically significant increase in perceived "confidence" from pre-program ($M = 3.7$, SD = 0.38) to post-program ($M = 4.11$, SD = 0.42) (*Mean difference (D)* = 0.40, SD = 0.33), $t(34) = 7.17$, $p = 0.000$ for the total sample. The mean increase in scores was 0.64 in "knowledge and skills" with a 95% confidence interval ranging from 0.46 to 0.81, and an increase of 0.40 in "confidence" with a 95% confidence interval ranging from 0.29 to 0.52. The Cohen's d for confidence (1.46) and "knowledge and skills" (1.03) indicated a large effect size for both. There were no statistically significant differences found within the above results between job groups (allied health, education and social work) or levels of remoteness.

Both conditions, including group webinars plus individual online sessions, and group webinars alone, were found to have a statistically significant increase in perceived "knowledge and skills" and confidence from pre-program to post-program. See Table 2.

There was a moderate, positive correlation between the number of webinars viewed and both knowledge and skills ($r = 0.46$, $N = 30$, $p = 0.011$), and confidence ($r = 0.39$, $N = 30$, $p = 0.033$).

Mode of webinar access

Overall, 30% ($N = 132$) of webinar viewings were live at the time of the webinar while 70% ($N = 302$) were viewed by accessing the recording online at a later time. This disparity increased over time. Data extracted from Adobe Connect© revealed significantly higher viewing rates of recorded webinars ($N = 1{,}788$); however, this data is not included in the analysis as participants in the current sample were not tracked when they logged in. There

Table 1. Participant information ($N = 36$)

Gender	*N* (%)
Male	1 (2.8)
Female	35 (97.2)
Age	
21–30 years	11 (30.6)
31–40 years	7 (19.4)
41–50 years	10 (27.7)
51–60 years	6 (16.6)
Not reported	2 (5.5)
Residential location (ASGC-RA classification)	
Inner Regional	16 (44.4)
Outer Regional	3 (8.3)
Remote	14 (38.9)
Very Remote	3 (8.3)
Time lived in regional or remote region	
Less than 2 years	2 (5.6)
2–5 years	3 (8.3)
6–15 years	5 (13.9)
15 years+	25 (69.4)
Not reported	1 (2.8)
Occupational Group	
Education	17 (47.2)
Allied Health	14 (38.9)
Social and Community Work	5 (13.9)

Table 2. Changes in perceived knowledge and skills, and confidence across conditions

	Pre	Post	*z*	*p*	Pre	Post	*z*	*p*
Group + Individual ($N = 6$)	3.23(0.50)	4.31(0.47)	−2.20	0.028*	3.48(0.51)	4.34(0.36)	−2.20	0.028*
Group alone ($N = 29$)	3.33(0.54)	4.00(0.44)	−4.03	0.000**	3.63(0.47)	4.05(0.42)	−4.03	0.000**

were no statistically significant differences found between job roles or level of remoteness on overall rate of webinar access in the current sample (synchronous and asynchronous). On average, those participating in individual online sessions accessed more webinars (M = 15.14, SD = 4.36) than group webinars alone (M = 11.08, SD = 5.31). See Figure 1 for webinar viewing rate and modality.

Individual online support sessions

Eight participants engaged in one or more individual online support sessions from mid-way through the 12-month program. These participants included three speech pathologists, two occupational therapists, two psychologists and two educators. No social and community workers opted to engage in the individual online support sessions. All individual online support sessions involved case discussion and five participants requested assistance in Positive Behaviour Support. Other requests for support included toilet training, social skills and discipline specific support (e.g. speech pathologist or occupational therapist). Figure 2 outlines the reported outcomes of the individual online sessions for the participants who did engage.

Participants who declined the offer of individual online sessions were asked to provide comments in the survey as to why they did not engage. The majority of responses indicated they were unable to fit it into their work schedule.

> I was offered the opportunity but due to work commitments and schedules I could not use them. But in the future, would like further opportunities to seek 1:1 sessions. (Community Worker.)
>
> With lead in to NDIS, workload changed and could not get to . . . sessions. (Case Manager).
>
> Difficulties in finding time with the roll out of the NDIS and dealing with all the changes in the work demands. (Educator).

Other reasons included changing jobs, no current clients to discuss and already having supervision in place.

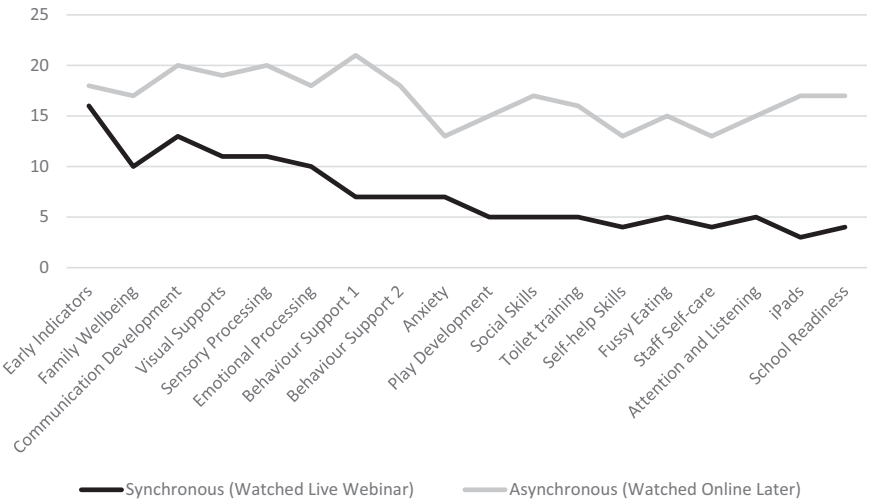

Figure 1.
Webinar viewing rates

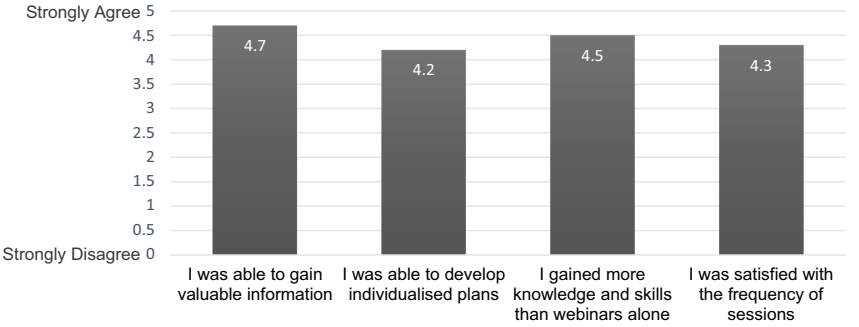

Figure 2.
Outcomes of the 1:1 online support sessions

Access and support via technology

In terms of technology, 85% ($N = 28$) of participants agreed that they found the process for logging onto the webinar simple and easy to do, and 82% ($N = 27$) of participants also agreed that they found the audio quality was acceptable when attending or watching the webinars. Finally, 94% ($N = 31$) agreed that they were able to gain valuable information from the presenters and 90% ($N = 28$) of participants agreed that this information was useful to them in their role.

Discussion

The current study aimed to evaluate an online group webinar and individual online support program designed to educate and build capacity in regional and remote staff to support children with autism. Overall, the program was reported to be beneficial in increasing the reported knowledge, skills and confidence of a diverse range of staff in regional and remote communities who were supporting children with autism. Pre-program data in the study indicated that the respondents did not agree nor disagree that they had the skills and knowledge, and confidence to support young children on the autism spectrum and their families. By post-program, however, the respondents reported increased self-reported "knowledge and skills" and "confidence", in working with children with autism in their care across a range of support areas. It was also found that higher rates of participation in the program were related to greater gains in perceived "knowledge and skills" and "confidence". The program was found to be beneficial for a range of staff who participated, with backgrounds in allied health, social and community work, and education. These positive results indicate that there is a potential for increased access to staff in regional and remote areas who feel confident and knowledgeable in supporting children on the autism spectrum during the crucial early intervention years when specialist support may be limited.

Another promising result was that the program was reported to be beneficial across all study conditions of remoteness. All participants, from inner regional to very remote locations reportedly participated similarly in the program and increased in their self-reported "knowledge and skills" and "confidence" at a similar rate regardless of their location.

Overall, webinar participants predominantly used an asynchronous learning mode (watching webinar recordings) rather than synchronous (watching webinars live). While Vismara *et al.* (2009) recommended the synchronous component as necessary in learning outcomes, in our study sample where the majority of participants accessed an asynchronous mode of delivery, we found positive results were still able to be achieved. Some of the challenges in working in regional and remote areas often surround being time poor due to

driving long distances, heavy caseloads and staff shortages (Dew *et al.*, 2012; Veitch *et al.*, 2012). The program was based on a needs analysis indicating a need for autism-specific education and support to be accessible for participants and potentially delivered via technology (Johnsson *et al.*, 2016). Further, with the increasing demands of the NDIS, the prioritisation and ability to fit in training programs by staff remains an issue that will need to be explored. However, as our study found that access to the asynchronous component of the program was effective for regional and remote staff who may be experiencing high caseloads and limited time to devote to professional development activities, this may help to address these challenges in delivering training and support to regional and remote areas.

Professional development is a choice made by many professionals; however, managers and school principals are also in a position to encourage prioritisation of training and support programs which are designed to improve their staff's practice with clients and students in their setting. Therefore, rather than targeting individual staff members, programs that are endorsed by managers and school principals may have a more significant effect on registration and participation rates. The implementation of staff training entitlements funded as part of the NDIS (Parliament of Australia, 2018) may also go some way to mediate issues of prioritisation as demand continues to increase, and as a way to ease the burden on managers and principals in releasing staff from work duties to attend.

Synchronous learning was also offered via individual online support sessions. Despite the reported benefits from those who chose to participate, these sessions were accessed by a small number of individuals, of which 75% were allied health professionals. Allied health services have seen the most consistent growth under the NDIS (National Disability Insurance Agency, 2018), and therefore, the individualised support component of the program may be most beneficial for this sub-group of regional and remote staff. We also reported that two of the participants who engaged in the individual sessions used this time to seek support from a therapist within their own discipline. As suggested by Dew *et al.* (2012), this may be useful in reducing levels of professional isolation in remote areas. It may be suggested that the lack of community support workers engaging in individual sessions could be due to a more varied caseload of individuals with, and without, a diagnosed disability. The individual session content was consistent with findings from the needs analysis by Johnsson *et al.* (2016) in that support for managing behaviours of concern was the most prevalent request for support. Unsurprisingly, busy work schedules were reported as a barrier to accessing individual online sessions across all disciplines. As funding and demand for services increase, alternative methods of individual consultation should be considered to fit in with these schedules such as supporting the staff member live during face-to-face client sessions or during staff meetings. Future implementation of the program may also include varying the delivery of the program to include an audio version while travelling, and varying the time of day in which the webinars and individual online sessions are offered including an after-work hours option.

Research delivered in real world settings often comes with its own set of limitations. The current evaluation is based on a subset of the overall group of participants enrolled in the program, whose experience of working with children on the autism spectrum was unknown. While the current study aimed to minimise the impact of participant attrition through a missing data analysis, final results should be interpreted with caution due to the sample size and difficulties experienced with following up the total sample at post-program. Additionally, as the current study could not exercise control over participants' access to other information via the Internet, their peers or other professional development, we cannot entirely attribute positive outcomes to the program alone. Self-report measures on skills, knowledge and confidence may also be limited in their measurement of the translation of participant learning to behaviour. Future studies based on the application of the Kirkpatrick Model

(Kirkpatrick, 1994) which evaluates the reaction, learning, behaviour and results of a training program may be a way to effectively bridge this gap.

Regarding technology, we found the online platform was considered both accessible and valuable. Participants indicated that they were able to access the technology with ease and found the audio quality acceptable. While certain barriers such as local access to equipment and reliable Internet could not be solved by the program staff (Moffatt and Eley, 2011), the current program offered technology training and troubleshooting, as suggested by Tipton *et al.* (2011), prior to starting in order to reduce these barriers. With such a diverse group of staff in many different roles in the community, it was promising to see that the majority of participants found the information valuable and useful in their current role.

Conclusions

Overall, these findings suggest that the use of technology is an acceptable and beneficial method of delivering autism-specific professional education and development for the diverse range of staff in regional and remote areas. While past research has indicated that both synchronous and asynchronous learning modes are vital in its success, the current study found success with a predominantly asynchronous learning mode. Targeting allied health staff for individual support sessions may also make the best use of this resource. The impact of such a program will contribute to greater capacity in local educators, social workers and allied health professionals to provide timely autism-specific early intervention support at a time when it is most critical. Especially at a time when the full implementation of the NDIS is driving up demands for existing services. Future researchers should consider further comparison of delivery modes, measuring the translation of learning to behaviour and results, as well as innovative ways in which to deliver individual support sessions to fit in with busy workload schedules. Finally, further investigation may be warranted on delivering online synchronous Positive Behaviour Support services.

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Corresponding author
Genevieve Johnsson can be contacted at: genevieve.johnsson@sydney.edu.au

Appendix

Confidence
I handle meeting new clients and families with relative comfort and ease
I feel confident when helping children with autism and developmental delays, and their families
I can answer most families' questions about their child's autism and other developmental delays
I can help families bring about positive change in theirs and their child's life
I can achieve the professional goals I set for myself
I feel confident when helping children with autism and developmental delays
I have contact with people of similar skills and experience who I would call successful
Knowledge and Skills
I have a good understanding of autism
I can identify the early indicators of autism
I have good knowledge and skills on helping children and families manage their child's anxiety
I have good knowledge and skills in helping children with challenging behaviours
I have good knowledge and skills in teaching and helping a child develop their social skills
I have good knowledge and skills in developing and implementing strategies for emotional regulation for a child
I have good knowledge and skills about sensory processing and promoting sensory regulation in children with autism
I have good knowledge and skills in supporting children in the development of their play skills
I have good knowledge and skills in supporting a child's development of self-help skills (dressing, feeding, bathing and grooming)
I have good knowledge and skills in helping families where the children have feeding difficulties and fussy eating
I have good knowledge and skills in developing effective toilet training programs and supporting families to implement them for their child
I can identify early indicators of speech difficulties in a child
I have good knowledge and skills in supporting families to develop their child's speech development
I have good knowledge and skills in supporting children's development of social language. e.g. conversation and social interaction with others
I have good knowledge and skills in developing and implementing effective visual supports to help with expressive and receptive communication
I have good knowledge and skills in supporting children's ability to attend, listen to instructions and complete tasks in a variety of environments
I have good knowledge and skills in using an iPad or similar device for educating and supporting development in children
I have good knowledge and skills in how to help families and children so they are ready for school

Table A1.
Survey questions

Received 6 October 2020
Revised 3 November 2020
Accepted 21 November 2020

Co-designing multidisciplinary telehealth education for online learning

Jennifer L. Cox
Three Rivers Department of Health, Charles Sturt University, Orange, Australia
Claire Ellen Seaman
Three Rivers University Department of Rural Health, Charles Sturt University, Albury, Australia
Sarah Hyde
School of Rural Medicine, Charles Sturt University CSU, Albury, Australia
Katharine M. Freire
Three Rivers University Department of Rural Health, Albury, Australia, and
Jacqueline Mansfield
Three Rivers University Department of Rural Health, Charles Sturt University, Albury, Australia

Abstract

Purpose – There are growing expectations that students graduating from health courses and current health professionals have some proficiency in using telehealth. However, there is limited accessibility to multidisciplinary-based material to meet this need. This paper describes the development of an online telehealth education resource using a co-design approach and the strengths and challenges of embedding authentic learning principles in an open-access online course with a broad target audience.

Design/methodology/approach – The authors first describe the co-design process of the course and discuss the pedagogy underpinning the course design. Then learner enrolment data is discussed to evidence uptake across key characteristics. Finally, the authors assess the efficacy of the co-design approach by analysing feedback collected from learners at the end of the course.

Findings – The course is structured across four modules and comprises interactive content, reflective tasks, case studies and purposefully developed digital material. Responses from the working group and from learner feedback indicate that the course is an authentic and relevant introduction to telehealth practice for both health students and current health professionals, despite some limitations.

Originality/value – This case study demonstrates the value of a co-design process and key learning design choices in online course development to meet the educational needs of learners from broad disciplinary backgrounds, in various stages of learning/understanding of telehealth and/or requiring a practice-based resource in the context of a rapidly changing policy environment.

Keywords Information technology, Health education, Telehealth, Co-design

Paper type Case study

Introduction

Australia covers an extensive landmass, has low population density, but a substantial proportion of the population is dispersed in rural areas (those areas outside the major cities) (Bradford *et al.*, 2016). Consistent with many other nations, increasing distance from major city areas has been found to increase difficulty in accessing healthcare services leading to poorer overall health outcomes (AIHW, 2019).

Health Education
Vol. 122 No. 2, 2022
pp. 164-179

0965-4283
DOI 10.1108/HE-10-2020-0098

This study was supported by Three Rivers University Department of Rural Health, funded by the Australian Government under the Rural Health Multidisciplinary Training Program.

Health workforce issues negatively impact equity and accessibility of health service delivery in the Australian context, and the need for innovative solutions is well recognised (Department of Health, 2020). The use of telehealth is one such innovation that has a long history of use in Australia in varied forms. Telehealth is an important component of health service delivery and accessibility for rural and other underserved communities (Fronczek *et al.*, 2017) but has had ad hoc embedment in Australian health practice (Wade *et al.*, 2014) and training (Edirippulige and Armfield, 2017; Edirippulige *et al.*, 2020). Economic, social and physical changes associated with the impact of the COVID-19 pandemic have seen telehealth move from rural periphery to the centre of health service policy and delivery in Australia (Marshall *et al.*, 2020) and globally (Fisk, 2020).

Telehealth delivery in the Australian context

The term "telehealth" broadly refers to health service delivery using mediated information and communication technologies, including telephone and video conference (Edirippulige and Senanayake, 2020). Healthcare delivered via telehealth is shown to be experienced as equally satisfactory by health care users and as equally effective by clinicians as face-to-face care (Polinski *et al.*, 2016; Kruse *et al.*, 2017). As an adjunct to face-to-face health service delivery, telehealth has emerged as a means to potentially provide improved access to healthcare for residents in more rural and remote settings (Fronczek *et al.*, 2017); a recent systematic review confirming satisfaction with videoconferencing by people living in rural and remote areas accessing outpatient health appointments (Orlando *et al.*, 2019). Access to education and training, however, has been varied and sporadic, dependent on the organisation, the sparse number of trainers with experience in telehealth and health professionals who are sceptical about the value of telehealth in their practice (Kayyali *et al.*, 2017).

The advantages of efficiency and the geographically boundless potential of telehealth for health service delivery make it very appealing. There have, however, been a range of barriers to realising these benefits and to achieving high-quality outcomes in current health service delivery. At the state level, a key factor in the uptake of telehealth in Australia is the funding models for telehealth service delivery (Wade *et al.*, 2014; Bradford *et al.*, 2016; Fisk *et al.*, 2020); serving as an enabler when funding is available and subsequently as a barrier when and where it is not. Digital literacy and access remain issues (Van der Kleij *et al.*, 2019; Anita and Julie, 2020), particularly among older Australians and Australians living with disabilities who could most benefit from the "anywhere" potential of telehealth (Fisk *et al.*, 2020). Even in circumstances where an individual is ready and able to engage in telehealth for consultations or other health resource use, provider infrastructure, coordination, confidence, familiarity and training can either hinder the quality of the experience or inhibit the potential altogether (Bradford *et al.*, 2016). Education and continuing professional development relevant to the local context are therefore key solutions for workforce telehealth readiness (Senanayake *et al.*, 2020).

Despite these challenges, digital innovation in healthcare delivery has evolved and grown at accelerated rates during the global SARS-CoV2 (COVID-19) pandemic due to the need to maintain health and well-being throughout these unprecedented times. The outbreak of COVID-19 changed the inclusion of telehealth from selected services to the only form of service delivery for many healthcare professionals. Thus, many healthcare professionals were left with no option but to transform their service into a virtual clinic despite a lack of knowledge and experience in this mode of delivery. This led to an increased number of clinicians and students seeking out online courses in telehealth to inform and upskill them during this time.

Telehealth education/training in Australia

Training and ongoing support are key facilitators for the uptake of telehealth services (Helleman *et al.*, 2019; Traube *et al.*, 2020). To date, however, there has been no systematic design or delivery of telehealth education, generally, nor has the existing telehealth education

been readily accessible, a fact noted to have possibly impacted the uptake of telehealth prior to the COVID-19 pandemic (Edirippulige and Armfield, 2017). The review conducted by Edirippulige and Armfield (2017) found just nine studies from five nations and reported a mix of classroom and e-learning modalities with content ranging from terminology, clinical applications, the evidence base to technological aspects. The duration of these courses, comprising a mix of university level and CPD courses, also varied from one week through to six months, and seven of the nine studies had fewer than 100 students enrolled. A second review of telehealth education integrated into the health curricula of medicine and nursing degrees found no consistency, wide variation in breadth and depth of content and little to no evaluation about the effectiveness (Chike-Harris *et al.*, 2020).

We note that, in 2015, there was a publication related specifically to the development of a self-paced, short modular, online learning Telehealth Facilitator Certificate Training programme designed and delivered by Thomas Jefferson University in Pennsylvania (Papanagnou *et al.*, 2015). This was only available to learners at that institution. A similar study reported on an inter-professional inter-institutional telehealth course delivered in a blended mode over 9 h of undergraduate course time (Jonas *et al.*, 2019).

As telehealth is recognised as an important part of rural health service delivery, telehealth education and training at a tertiary level are increasingly acknowledged as an important component of achieving rural-ready graduates in Australia (Pit and Bailey, 2018) and elsewhere (Camhi *et al.*, 2020). Although the Australian Centre for Rural and Remote Medicine (ACRRM) has been providing online telehealth modules for clinicians and practice managers since 2012, this is not readily accessible to students or non-members and has not been updated since 2015.

Thus, there is a need to provide open access, easily accessible education which will encourage the use of telehealth technologies and that is relevant in rural practice. Moreover, with the heightened importance of interdisciplinary work in smaller, rural sites (Fertman *et al.*, 2005; Hays, 2008), a rurally relevant telehealth pedagogy should take an interdisciplinary approach as well as incorporate learning design best practices such as authenticity and accessibility. Such best practice includes delivery in an easily updatable format that enables the content to remain relevant to current practice, particularly in the context of telehealth practice as a digital solution in healthcare service delivery.

Institutional context for the development of an online, introductory telehealth course

Aligned with the growing importance of telehealth in rural health service delivery, telehealth training has been a strategic key area of activity for the Three Rivers University Department of Rural Health ("Three Rivers"). As a University Department of Rural Health (UDRH), Three Rivers is funded by the Australian Government under the Rural Health Multidisciplinary Training (RHMT) Programme. The RHMT Programme emphasises engagement and collaboration with the local health workforce and community towards innovative solutions for both student training and workforce recruitment and retention. Three Rivers is a part of Charles Sturt University, a regional university with relatively high proportions of students from regional and remote backgrounds (Department of Education, Skills and Employment, 2020).

Digital literacy is a key graduate learning outcome of Charles Sturt University and increasingly recognised by accrediting agencies. Despite this, the specificity of digital health itself, including telehealth service delivery, and digital data, has not been clearly described or prescribed as a necessary skill set; reflective of the broader national and international issue (Edirippulige and Armfield, 2017; Fronczek *et al.*, 2017). As a result, there was little curriculum space nor available expertise within most individual health courses at Charles Sturt to teach and design key learning activities around telehealth.

With this in mind, an open-access telehealth course consisting of four self-paced modules, specifically tailored to meet the needs of students and clinicians working in rural settings,

was developed. The key strategy underpinning this resource was the development of a flexible approach which would support students to gain training in telehealth to prepare them for placement and future practice, as well as for clinicians to enhance their current understanding and use of telehealth. Through training both students and clinicians, it is expected that the course will also increase the best practice use of telehealth for student placement supervision, during placement experiences and in practice more broadly.

Course co-design process

Initially, Three Rivers undertook a formal consultation with an Australian higher education (HE) research agency specialising in digital health to provide subject matter expertise in curriculum scoping. Recruitment of a Telehealth Service Coordinator ("Service Coordinator") was completed in August 2018. The Service Coordinator role brought the knowledge and experience in operational design, development of services and the practical clinical application of telehealth, having worked on several telehealth projects in regional and remote Australia. The Three Rivers Telehealth Curriculum Working Group (the "Working Group") consisted of Charles Sturt academics from health disciplines including Occupational Therapy, Speech Pathology, Podiatry, Physiotherapy, Nursing, Pharmacy, Dentistry and telehealth experts including service providers from Local Health Districts and Primary Health Networks of the Murrumbidgee and Western NSW. The primary steps in developing the course purpose, content and design are detailed in the flowchart in Figure 1.

The final agreement from the group was to create four modules for the course: Telehealth Overview, Telehealth Technology, Telehealth in Practice and Sustainable Telehealth. Achievement of all individual module learning outcomes (see Appendix Table A1) leads to achievement of the following course learning outcomes:

(1) Define telehealth and explain how it can be an effective means of health service delivery in rural and regional healthcare.

(2) Outline the benefits, challenges, barriers and enablers of telehealth for rural and regional healthcare.

(3) Recognise and evaluate various telehealth applications across clinical contexts and scenarios.

(4) Demonstrate interpersonal and professional skills in consulting with a patient to achieve a successful telehealth consult via case studies.

(5) Evaluate the feasibility of implementing telehealth consults in your own context.

Overall, the course aims to support learners to familiarise themselves with telehealth essentials and learn how they can incorporate it into their current or future clinical practice.

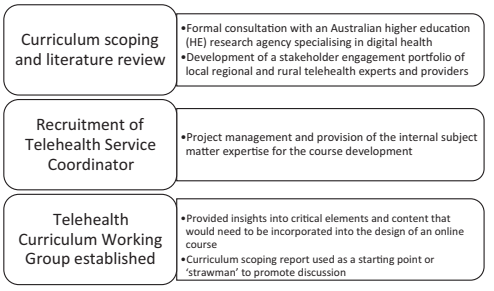

Figure 1.
Co-design process flowchart

This stage took six months and focussed on the development of the multidisciplinary content, patient scenarios, resources and guides included for each module, ensuring they were based on current best evidence with a high focus on telehealth in practice in a rural context. A range of user perspectives were embedded across the four modules – rural consumers, rural healthcare providers, students, families of the consumer and ensuring considerations for different population groups such as children, Aboriginal and Torres Strait Islander persons, elderly persons and those with decreased mobility. The Curriculum Working Group helped to inform this content and ensure the content was both practical and suited to use in classroom and clinical practice contexts.

The production of purpose-designed digital media content comprising interviews with practitioners in the field was outsourced to a rurally based media production company in the Three Rivers footprint. This process involved a degree of scripting of four, 3-min videos, identification of key informants and locations and careful scheduling to ensure access to the talent and the site. Media recordings were arranged and filmed at each location with telehealth experts and service providers that provide telehealth as part of their service delivery, as well as with consumers of telehealth who recounted personal stories of the benefits of having access to this form of service delivery. Service providers included in the media content included nursing and medical staff, as well as physiotherapists, podiatrists, virtual care managers in the local health district and the mental health emergency care team in the local health district.

The course was opened to members of the Working Group in July 2019 for pilot testing and identification of any corrections, clarifications or additional information required. Feedback was received from five members. From this initial feedback, several minor changes and corrections were made before the course was reviewed by the Faculty of Science Associate Dean (Academic) and Sub-Dean Learning and Teaching. With approval received, the course officially launched in August 2019.

Learning design

This introductory course was designed to meet the scope and needs identified by the Working Group in concert with best practice online pedagogical design. The course had to be accessible and engaging for the diverse intended audience of pre-registration and registered health professionals with varying clinical practice experiences. A focus on the contemporary rural NSW context provided an overarching schema to shape the design of case studies and identify professionals to feature throughout the content.

Learner access to the course

It was decided that the course should be open access so that any prospective learner could enrol. This is because our stated broad scope as a UDRH is to upskill local, rural clinicians, those servicing rural communities, as well as students from all universities to ensure they have "rural-ready" capabilities.

Choosing the online platform

Once it was decided to make the course open access, a suitable online platform was sought. *OpenLearning* was chosen, in part, because of pre-existing organisational affiliations with the platform that would better support its use and any potential troubleshooting.

As with many online learning platforms, the OpenLearning platform has a number of authoring tools and widgets to promote active learning and engagement as a community of learners (Brimo, 2019). This enabled the course designers to embed key design features that would facilitate higher-level learning to be achieved given the constraints of the intended administration and ongoing resourcing of the course (online-only, with nominal educator

facilitation). This platform also enables learners to self-enrol and the administrator to create set cohorts if desired.

Providing relevant and up-to-date course content

The course aimed to provide practical, introductory telehealth information suitable across a broad range of health disciplines. The scoping work at the beginning of the project recognised issues in existing courses where content was out of date or redundant. These issues are pronounced in telehealth education as its use is informed from a nexus of several constantly changing fields; technology, health provision and policy. The course administrator (author JM) responds to these identified issues through her regular oversight of the course. At present, the course administrator completes all daily enrolments, review of comments and posts from learners, answers any learner queries, awards the certificate of completion and collates the feedback received. On a monthly basis, the course administrator completes a full course review – this includes checking if all links, resource download, video and podcast are still working correctly. These tasks required up to 2 h each month in the first few months due to troubleshooting and refining the platform. This includes ongoing reflexive changes made to each page given insights garnered from learners either as a comment on the course or in the final feedback form that learners provide on completion of the course. The course design is responsive to identified learner needs and can be readily adapted to meet new demands or promote new information that becomes available as more evidence is published about this method of health service delivery.

Asynchronous and module-based

Course characteristics are aligned with an andragogical approach, as with most open-access courses. Andragogy assumes adult learners are self-driven (Anders, 2015), and so the course is asynchronous and self-paced. The course is designed to be an immersive experience that can be completed in stages or in one sitting (of 4–5 h) and can be accessed on a variety of devices. Asynchronous, self-paced, modular and multi-modal learning activities are common features of high-quality online courses (Panigrahi *et al.*, 2018), including telehealth (Jonas *et al.*, 2019; Papanagnou *et al.*, 2015).

For tertiary educators using this course in their academic programmes, this design enables them to select modules or activities for their students to focus on and complete as best fits in their curricula. This "wrapped or blended" approach has been used in a made-for-purpose, closed, online telehealth course previously (Gustin, 2020). In light of the broad potential offered by this introductory course, after the first stage of implementation and stakeholder feedback, senior staff within the university suggested there might be improved uptake within courses if an assessment was provided alongside of the course material. Authors JM and SH collaborated with an educational designer to develop two exemplars which are available to accompany the course. The assessment rubric is based on application of knowledge to one of the case studies embedded in the modules. This exemplar could be applied to any discipline area. The second assessment exemplar was developed in relation to a master's level subject in speech therapy, together with the subject matter expert, the service coordinator (author JM) and the educational designer. Two assessment exemplars are therefore available to accompany use of the modules and to further enhance and leverage the degree to which the course is embedded within different disciplines. The exemplars are available on request.

Sufficient scaffolding to facilitate the needs of novice through to experienced learners

Each module has clearly articulated learning outcomes at the beginning of each module. The scaffolds for each module contain a description of the topic, why it is important and has been

included in the course, practical applications related to the topic and evidence of the utility of the content in everyday practice. There are opportunities for learners to interact with one another or with the content on each page using reflections, widgets such as Padlet and Mentimeter, posting of one's own images in relation to the content to talk about experience, short quizzes and other interactive learning activities to ensure application of content and understanding. Further, the course is embedded with opportunities for learners to "dive-deeper" beyond the course and access additional resources based on their area of interest (Figure 2).

Opportunities for authentic learning

The course is designed to provide an authentic learning experience, within the limits of the open-access design of the course and the use of an administrator rather than educator. Oliver and Herrington (2003) posit that forms of learning that have an authentic context, authentic activities (with real-world relevance) and authentic assessment provide a sound framework for learning environments that encourage knowledge construction. Imagery, purposefully designed graphics, video production and podcasts have been utilised throughout each module to provide an authentic active learning experiences and to emphasise the contexts in which telehealth can be implemented whilst valuing the contribution of local rural experts in the field who are the learners. Case study problems support authentic learning through providing real-life examples (Lyons, 2020). Course case studies include videos of rural health staff from different disciplines and prompt learners to find solutions with multiple "correct" answers. The variety of disciplines represented in the videos and the consistent setting in real-life rural health contexts ensure that the broader intention of the course is retained. For instance, while the learning outcomes refer to rural and regional Australia and enable learning of broader telehealth practice principles in Australia, the videos support upskilling among learners most specifically to multidisciplinary telehealth practice in the Central and South-Western NSW context. It is designed to best meet the needs of current, local health professionals and to exhibit the quality, opportunities and limitation of practice in these locales for future health professionals.

This addition of digital media means that there is not a single facilitator or "expert" delivering the content, learners are able to construct meaning for themselves by relating to

Figure 2.
Scaffolding learner engagement for those who want to extend their understanding and application further

the presentation of content from various experts, who are local, and a mix of health professional disciplines. Given the course is convened by an administrator rather than teacher or education professional, and that it is open-access, the potential to fully incorporate authentic learning design is more restricted than in typical online classroom contexts (for instance, the mixed-mode model of Jonas *et al.* (2019)). However, learners are prompted to reflect at regular intervals and engage in case-based online discussion. Learner can post their answers openly on case study problems and can then view other learners' responses using the Padlet tool. Unless otherwise disclosed, learners do not know if the qualification of the other is a student or a health professional. This provides opportunities for mixed interactions across levels of experience as well as health professions.

Learners in the course are expected to complete the required tasks and respond based on their own understanding to facilitate deeper learning of the course content because of the self-driven expectation of the course. Learners can then extend their understanding by seeing others' viewpoints on the same problem, as opposed to copying existing responses. Achievement of deeper-level learning towards each module's learning outcomes is not directly assessed in this format, although there are opportunities for learners to test their knowledge and self-reflect on their learning. The course utilises *OpenLearning's* progress bar that collates learner completion progress by page and through the course overall. On each page of the course, learners must engage with all learning activities and associated multimedia in order to achieve 100% page completion and must complete all pages to complete the course. At the end of the course, learners are asked to provide some short feedback on their course experience and indicate their interest in receiving a Certificate of Completion. Certificates are administered via a separate platform that enables learner name and date of certificate request to be merged with a Certificate template. Course completion is recognised with a certificate from Three Rivers and Charles Sturt University; this can be used for continuing professional development purposes if relevant. The intention is that the accessibility and availability of the course also align with the lifelong learning ethos expected of all health professionals and students. These features of course design which have worked for us are summarised in Table 1.

Course uptake and learner feedback

We have so far detailed the identified need for, and subsequent design of, this online introductory telehealth course. Here we describe the first year of course enrolments and then use learner feedback to assess the efficacy of the co-design approach in building a course that meets the identified need for telehealth training in Australia.

Method

Prior to enrolling in the course, learners are directed to fill out a "course enquiry" form in order to gain access to the course, as approved by the course administrator. The requested information was designed to assess the reach of the course from the expectation that Charles Sturt staff and students were the primary audience. Learners were asked to indicate their discipline area; whether they were applying for access as student, health professional, technician, health academic or educator or other; as well as whether they were from Charles Sturt University. Charles Sturt students were additionally asked for their campus location and student number. Those learners from outside Charles Sturt were asked to name their current role, organisation and postcode. For analysis, postcodes are coded into Remoteness Area categories of the Australian Statistical Geographic Standard (ASGS-RA) 2016. At the end of the course, learners are prompted to provide online feedback as part of a request for a certificate of completion, including open-ended responses to the question "what aspects of the

Element of design	What was implemented
Accessibility	(1) Free and open
	(2) Platform readily available on all browsers
	(3) Platform promotes accessibility options for vision or hearing impaired
	(4) Videos used can be watched with sub-titles if needed
	(5) Platform has readily available and responsive help for users and educators
Flexibility	(1) Modular nature of course design
	(2) Modules can be completed independently and in any sequence
	(3) Users can monitor and track own progress towards completion
	(4) Material is accessible anytime anywhere
	(5) Users can enrol in the course at any time
	(6) Course is always "open"
	(7) Users can access the course even after completion to review or revise material
	(8) Clear signposts throughout each module to indicate where the user is up to and how much of the course is left to complete
	(9) Course is readily adaptable for use within classroom settings with a facilitator driving the navigation or by users in their own time
Engagement	(1) Content has been informed by key stakeholders with expertise
	(2) Key stakeholders actively co-designed the entire course
	(3) Multimedia is used throughout – with first-person accounts, narratives, case studies and promotion of reflective dialogue with users
	(4) Self-assessment tasks are in-built
	(5) Learner–content engagement promoted through authentic and up-to-date material relevant across most health profession contexts
	(6) Learner–learner engagement prompted through Padlet
	(7) There is opportunity for learners to provide feedback
	(8) Course is regularly monitored (at least weekly at a minimum) to ensure there are no issues
	(9) Material is continually updated as needed to reflect new policy development, tools, link to additional content
	(10) Course is promoted through various social media, at conferences, presentations to professional and peak bodies and word of mouth
	(11) There is opportunity for learners to provide feedback, and feedback is readily acted on where relevant and/or needed
Completion	(1) Certification is available
	(2) Learners are required to complete all learning activities and engage with resources in order to receive certification
	(3) Course can be completed in as long or short a timeframe as the learner needs
	(4) Completion is feasible with four modules that take 1–1.5 h each to complete
	(5) Task requirements are not onerous and require reflection and thoughts and strategies about adaptation to one's own context
Motivation	(1) Material is up to date and authentic
	(2) Locally produced
	(3) Evidenced high levels of collaboration with key stakeholders – government, various health professionals, private providers and links to best practice initiatives nationally and internationally
	(4) Suited for students and health professionals wanting to learn more about the foundations for providing telehealth service delivery
	(5) Contributes to achieving key competencies of a registered health professional
	(6) Practically oriented
	(7) Free, open, accessible and flexible
	(8) Digital badging and credentialing will be the next consideration and may enhance motivation and completion

Table 1.
Recommendations to drive telehealth education: key design features/what has worked

course did you find most beneficial?" and to respond how much they disagreed or agreed with the statement "Overall, I am satisfied with this online course".

Additionally, all participants from the Telehealth Curriculum Working Group (n = 19) were invited to participate in a short survey. The survey asked participants about their contribution to the course design, their view on the value of the final product for themselves personally or others, their reflection on what aspects of the co-design process worked well and what could be improved for future projects. To encourage honest participation and mitigate response bias, surveys were distributed and returned, via email, to one of the authors (JC) who had not been involved in the Working Group. Although it was acknowledged that there was potential for respondents to be identified because of the small population of interest, this risk was communicated to participants in the participant information sheet.

Learner and working group member responses were anonymised prior to analysis, and content analysis, as described by Hsich and Shannon (2005), was undertaken by two of the authors (CS, KF). Their responses were coded inductively to generate an orderly catalogue of phrases and concepts leading to identification of central themes.

Ethics approval

The use of all data in this study has been approved by the Charles Sturt University Human Research Ethics Committee, protocol number H20200.

Analysis of learner demographics

In the first year of opening (August 2019–August 2020), 3,105 learners from more than 20 health disciplines had enrolled in the course. The cohort consisted primarily of students (70.8%) and health professionals (19.3%) with the discipline most highly represented being Occupational Therapy (26.5% of learners) followed by Physiotherapy (16.9%). The majority of learners were from Australian universities. Almost one in five learners was from Australian health or non-university organisation.

There are at least 12 health discipline courses (nine bachelor-level courses and three master's level) from six universities (two regional and four metropolitan) that have embedded the telehealth modules into either a subject or course curricula. Students from four of these courses were requested to complete the telehealth modules prior to commencing clinical placements. In addition, one non-government organisation which provides early parenting support and guidance has used the module as part of staff professional development, with 69 staff enrolling in the course. We suspect that the number of health courses where this course (or part thereof) has formed a formal or informal part of the learning material to be much higher; identifying 24 instances where 20 or more students from the same university discipline have enrolled in the online course.

There was a large increase in uptake of the course in metropolitan areas which may be attributed to COVID-19-associated changes of the delivery of telehealth in Australia. From August 2019 to February 2020, 79% of the 330 course enrolments came from rural areas, while from March 2020 to August 2020, course demand escalated, with 2,775 new enrolment enquiries. Of these, only 27% came from rural-based learners. This is potentially driven by high national demand for telehealth services in this period as well as the uptake in courses.

Learner feedback about the course

As of end of August 2020, 1,455 learners submitted end-of-course feedback. Of these, 94% agreed or strongly agreed they were satisfied with the course. Selected responses to the end-of-course feedback question, "what aspect of this online course did you find most beneficial" are provided in Table 2, which also shows themes identified from the responses received.

Practical and authentic	(1)	"*Watching videos and listening to excerpts of interviews and podcasts to see and hear about how telehealth has been practically implemented to help people [was most beneficial]. Also the opportunity to apply the learnt knowledge to case studies*"
	(2)	"*Use of case studies made learning more relevant and relatable to real-life situations*"
Modular	(1)	"*The layout of it was helpful and easy to follow*"
	(2)	"*Being able to share thoughts and the mini activities embedded in the modules to help check my understanding [was most beneficial].*"
Open access	(1)	"*This course was absolutely amazing! Thank you to the staff for collating all these resources and putting them in one place!*"
	(2)	"*The availability of resources provided to us as students is greatly appreciated*"
Interdisciplinary	(1)	"*I have only really looked at telehealth from a speech pathology perspective so seeing the videos of it being applied to real-life medical scenarios in rural NSW was really interesting*"

Table 2.
Learner feedback on the value of the telehealth resource

Some similar themes were also identified in the content analysis of the members of the curriculum working group ($n = 7$; 36.8%). For example, the expertise and input from a variety of practitioners were noted as a key aspect of the design process, ensuring the modules were authentic and based in a real-world context:

> Having input from different disciplines/professions was valuable as it brought varied perspectives. Having it accessible to clinicians and others increased the exposure and feedback for the modules

> The engagement of providers who deliver care via telehealth in practice was a key success of the project. This was invaluable as they could bring their real-life experiences to the discussions. It also validates the material as being much more than academic.

> [The modules] have a strong relationship to real-world practice and thus form a firm foundation for our students in telehealth as they enter clinical placements and practice, as graduates.

Additionally, Curriculum Working Group members highlighted the importance of having a dedicated course convenor to oversee the content collation and design in the co-design process.

> Having Jackie lead the process and do much of the groundwork behind the scenes with just a few meetings and inputs from us was a good approach and made the process/goals achievable.

> Knowledge and Skills of the Telehealth Coordinator as well as the network of outside stakeholders was a major contributor to the success of this project.

Discussion

As we have witnessed in 2020, it has taken a pandemic for telehealth to reach higher levels of telehealth use and create a need for education and training. Fortuitously, our telehealth course was completed for delivery in August 2019 with the design and implementation pre-dating the COVID-19 pandemic. Our results find learners have a high level of satisfaction with the course and report the content to be applicable to their everyday practice. Learner demographics suggest that there has been considerable uptake among regional and city health professionals and students, including several tertiary institutions in addition to Charles Sturt University. It is also interesting to note the impact that COVID-19 and the associated changes in healthcare delivery and funding may have had on metropolitan uptake of the course reflecting the high national demand for telehealth services during this period.

Whilst motivation to enrol in our course was potentially high due to the current pandemic and applicability and recent upscaled use of telehealth across a broad range of health professionals, we suggest it was the learning design which ensured broad uptake and integration of this open learning course within curricula at several tertiary and health institutions. This indicates that the course addressed a demand within these sectors. Further, the widespread uptake of the course by other universities also indicates that health education staff view the material as relevant and appropriate for prospective health professionals – suggesting that it has effectively met the "Introductory" level at which it is targeted. The course offers a way to promote achievement of the digital literacy competencies of graduates and to meet similar associated accreditation criteria for registration of health professionals.

Although research in this area of open education is still emerging, it is known that flexibility of the course and quality of the materials are key features important to learners and for retention in the course. Likewise, the interface is as important as the course design features to ensure learner success (Liu *et al.*, 2015). Qualitative feedback from learners affirmed the value of the scaffolded, modular design of the course for learners. The inclusion of purposefully designed, high-quality, rich media learning resources including videos from several disciplines set in real-life rural health contexts was found to enhance the authenticity of the case studies and supported upskilling among learners in a multidisciplinary, rural context. We suggest that co-designing this material with health academics and clinicians has ensured that it is a practical introduction that meets student and clinician needs. Additional considerations for using an open platform for education include – identifying who you want to have access, moderation, permissions sought for all material not your own, certification requirements, evaluation, interactivity, identification of users, enrolment processes, advertising, navigation between different courses and within the course, invite-only classes or public and ways to embed videos. The requirement to watch each video and engage fully with each module was a key to success, that is, learners couldn't just "gloss over" parts of modules. Finally, having a dedicated service coordinator to maintain oversight and currency of an online resource in such a rapidly evolving field is also a significant consideration and can prove central to the ongoing success of such a resource.

In recent years, availability and attainment of microcredentials have been gaining momentum in the HE sector (Young *et al.*, 2019). This has also received increased recognition as a result of COVID and the restrictions on international student enrolments, alongside economic impacts of the pandemic requiring many in the community to re-skill and look towards education for alternate career paths. The impetus on universities to create a number of micro-credentialled subjects as a way to "taste" learning in HE and forge a pathway to a degree programme may have important implications for open learning courses such as ours. Additionally, there is evidence of movement locally and internationally to establish discipline specific and interprofessional telehealth competencies (see e.g. Chike-Harris *et al.*, 2020; Edirippulige and Armfield, 2017; Jonas *et al.*, 2019; Meheu *et al.*, 2018), and some disciplines such as nursing are already on track with this (e.g. van Houwelingen *et al.*, 2016). Completion of an online self-paced course such as the one described in this paper could contribute to micro-credentialing or "introductory" competency development in telehealth.

Conclusion

Telehealth, and digital health more broadly, is undoubtedly here to stay and will form a part of clinical practice for most health professionals (Wijesooriya *et al.*, 2020). As telehealth and other digital health technologies gain momentum clinically, it will almost certainly have more prominent inclusion in health curricula and clinical placements. So too, there will be

increasing expectations that health profession students graduate with sufficient competency to adapt and provide care using new mediums of service delivery. The education and training needs of new learners, therefore, need to be considered. We posit that our telehealth course provides the foundational building blocks and initial scaffolding for learners to progress from. The fact this course has had rapid uptake and completion from both students and clinicians alike suggests this is so and is meeting a need in the current climate, which we attribute to the co-designed approach. The modular nature ensures it can be easily adapted to maintain currency as new evidence and practices come to light, and the open-access platform ensures it can be provided as a useful adjunct to traditional teaching, can stand alone as a resource for health professionals or consumers and can also be embedded and used as course material within subjects or courses.

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Appendix

Table A1. Learning outcomes of the four course modules

Module 1: Telehealth overview
(1) Define the term telehealth in relation to Australian and International healthcare contexts
(2) Outline the benefits of using telehealth in clinical practice and non-clinical settings in rural and regional Australia
(3) Articulate the benefits, enablers and challenges of telehealth for both patients and health professionals in rural and regional healthcare, with examples, for specific cases
Module 2: Telehealth technology
(1) Identify and explain technology and terminology commonly used in global telehealth practice
(2) Outline strategies to establish shared understanding of terminology commonly used in global telehealth practice
(3) Examine and choose modalities and technologies of telehealth that are suited to your own clinical specialisation and to rural and regional healthcare settings
(4) Recognise and evaluate appropriate and optimal practical requirements for telehealth consultations in various settings and specific cases

(*continued*)

Module 3: Telehealth in practice
(1) Utilise your professional and interpersonal skills for a successful telehealth consult within the patient journey in case studies
(2) Identify when and how it might be most appropriate to use telehealth in rural and regional healthcare
(3) Apply your understanding of telehealth technologies and practice to implement a telehealth consult based on given case studies
Module 4: Sustainable telehealth
(1) Explain the importance of factors relating to telehealth governance and practice in rural and regional healthcare settings
(2) Assess the feasibility of implementing telehealth consults in your own context
(3) Identify the typical measures or outcomes used to evaluate telehealth practices
(4) Explain the importance of keeping up to date with research in global telehealth practice, for rural and regional health professionals

Table A1.

Corresponding author
Jennifer L. Cox can be contacted at: jcox@csu.edu.au

Received 22 December 2020
Revised 5 March 2021
31 May 2021
30 July 2021
22 August 2021
Accepted 29 August 2021

"Through their eyes, I can work" – rural physicians' perceptions about mobile phone use among community health workers – a qualitative analysis

Manjula Venkataraghavan and Padma Rani
Manipal Institute of Communication, Manipal Academy of Higher Education, Manipal, India
Lena Ashok
Social Work Programme, Prasanna School of Public Health, Manipal Academy of Higher Education, Manipal, India
Chythra R. Rao
Community Medicine, Kasturba Medical College, Manipal Academy of Higher Education, Manipal, India
Varalakshmi Chandra Sekaran
Department of Community Medicine, Melaka Manipal Medical College, Manipal Academy of Higher Education, Manipal, India, and
T.K. Krishnapriya
Manipal Institute of Communication, Manipal Academy of Higher Education, Manipal, India

Abstract

Purpose – Physicians who are primary care providers in rural communities form an essential stakeholder group in rural mobile health (mHealth) delivery. This study was exploratory in nature and was conducted in Udupi district of Karnataka, India. The purpose of this study is to examine the perceptions of rural medical officers (MOs) (rural physicians) regarding the benefits and challenges of mobile phone use by community health workers (CHWs).

Design/methodology/approach – In-depth interviews were conducted among 15 MOs belonging to different primary health centers of the district. Only MOs with a minimum five years of experience were recruited in the study using purposive and snowball sampling. This was followed by thematic analysis of the data collected.

Findings – The perceptions of MOs regarding the CHWs' use of mobile phones were largely positive. However, they reported the existence of some challenges that limits the potential of its full use. The findings were categorized under four themes namely, benefits of mobile phone use to CHWs, benefits of mobile phone-equipped CHWs, current mobile phone use by CHWs and barriers to CHWs' mobile phone use. The significant barriers reported in the CHWs' mobile phone use were poor mobile network coverage, technical illiteracy, lack of consistent technical training and call and data expense of the CHWs. The participants recommend an increased number of mobile towers, frequent training in mobile phone use and basic English language for the CHWs as possible solutions to the barriers.

Originality/value – Studies examining the perceptions of doctors who are a primary stakeholder group in mHealth as well as in the public health system scenario are limited. To the authors' knowledge, this is one of the first studies to examine the perception of rural doctors regarding CHWs' mobile phone use for work in India.

Keywords mHealth, Mobile phones, Rural physicians, CHWs, Rural healthcare

Paper type Research paper

Health Education
Vol. 122 No. 2, 2022
pp. 180-201

0965-4283
DOI 10.1108/HE-12-2020-0123

The authors would like to extend their gratitude to Transdisciplinary Centre for Qualitative Methods (TCQM), MAHE, Manipal, for permitting us to use their lab and resources for data analysis.

Declarations of interest: The authors declare no conflict of interest.

Introduction

Approximately 5.87 million deaths occur annually in India due to noncommunicable diseases (NCDs), which is nearly two-third of total NCD mortality in the South-East Asia Region (National Health Portal, 2019). As per the Indian Ministry of Health and Family Welfare (2018), the maternal mortality rates have come down significantly over the years, yet, it still contributes to about 15% of the total global maternal deaths. The Sustainable Development Goal (SDG) target in several Indian districts to reduce death in under five-year-old children to 25 or less per 1,000 and 12 or less per 1,000 in live births seems unlikely by 2030. Further, health infrastructure issues such as scarcity of health professionals in rural areas, distribution of Public Health Centers (PHCs) and dearth of paramedical personnel continue to be challenging in many districts of the country (Kasthuri, 2018). Currently, the doctor to patient ratio in rural India is 1:30,000 (Nair, 2019). Hence, it is the community health workers (CHWs) who help bridge the gap between thousands of India's rural remote populace and the health systems.

The three major cadres of CHWs in India are the Accredited Social Health Activists (ASHAs), Anganwadi Workers (AWWs) and Auxiliary Nurses and Midwives (ANMs). ASHAs are voluntary women workers typically between the age group 25–45 years, with a minimum eight years of formal education. This cadre was launched under the National Rural Health Mission (NRHM) in the year 2005, to supplement the work of ANMs and AWWs (Koehn *et al.*, 2020). Drawn from the community they live, the ASHAs help connect people from the community to the public health systems by improving health awareness and access to primary healthcare services (Abdel-All *et al.*, 2018). They report to ANMs and are expected to meet them every week at the PHC. They are paid a small honorarium and receive incentives for tasks such as registering pregnant women, persuading and encouraging women to access antenatal care, postnatal care and opt for institutional delivery (Paul and Pandey, 2020). ANMs or the junior health assistants are senior-level workers who have been a constant part of all maternal and child health programs. They are salaried, multipurpose workers with minimum 10 years of education plus an additional 18-month diploma in ANM nursing program (Tiwari *et al.*, 2013). They are either attached to the PHC, Sub-Center, Community Health Center (CHC) or the Urban Health Center (UHC). The ANMs monitor ASHAs and dispense their remuneration (Scott and Shanker, 2010). The AWWs cadre under the Integrated Child Development Services (ICDS) scheme was launched by the Government of India for improving health and nutritional status of children, pregnant and lactating women.

mHealth and CHWs

Categorized under the broad umbrella of eHealth by the World Health Organization, Mobile Health or mHealth involves the use of mobile phone technology such as mobile phones, personal digital assistants for delivering healthcare services and information (World Health Organization, 2011). mHealth holds the potential to provide much-needed support to CHWs (Strachan *et al.*, 2012; Henry *et al.*, 2016). This is important given that it is vital to ensure that the CHWs have the required tools, training and support structures for garnering optimal performance (Lehmann and Sanders, 2007; Tulenko *et al.*, 2013).

The ubiquity of mobile phones has pushed many low-resource countries to examine the potential of this technology to serve as a support tool for the CHWs. Chib (2010) reported that mobile phone use within primary healthcare settings can provide substantial advantages with its ability to enable and increase access to communication and information; between remotely located CHWs and physicians (Chib, 2010). Several other studies have reported that mHealth can aid the CHWs in better outreach, efficient data collection, improved workflow and healthcare delivery to the community (Schuttner, 2014; Feroz *et al.*, 2020; Early *et al.*, 2019; Braun *et al.*, 2013). Mobile phones enable the CHWs to reach out to community members

during an emergency or when there are specific health concerns or queries about medications (DeKoekkoek *et al.*, 2015). This technology helps them in planning better, making efficient use of time, in accessing and networking with peers and other health professionals and in reducing the need to travel (Saif-Ur-Rahman *et al.*, 2019). This leads to improved performance, motivation and credibility of these workers within the community (Thondoo *et al.*, 2015; Chib *et al.*, 2008). A recent review of mHealth studies revealed that incorporation of mHealth into existing maternal health programs could lead to positive outcomes among poor rural women such as perceptions of better care, changed behaviors, active engagement with health systems and better understanding of the indicative signs of danger (Early *et al.*, 2019). Further, studies suggest that CHWs themselves feel empowered with the use of mHealth tools and perceive them as tools that augment their service delivery (Agarwal *et al.*, 2015; Feroz *et al.*, 2020).

Though the benefits of mHealth are significant, especially in rural areas (Xiao *et al.*, 2013), and are increasingly being implemented to counter the dearth of health professionals in limited resource contexts (Watkins, 2018), the fact is that the success of mHealth programs depends on the capability of the existing health system infrastructure to integrate and implement these solutions (Odendaal *et al.*, 2020) cannot be overlooked.

Increased significance of mHealth

The ongoing COVID-19 pandemic further tested the capability of the existing health systems world over. Studies from across the world suggest that mHealth can be of immense support during epidemic or pandemic outbreaks. Data management, educational programs, patient identification, diagnosis and treatment are some significant areas in which mHealth tools can be of use during such times (Aslani *et al.*, 2020). Further, plenty of studies have reported the advantages of applying mHealth tools in the field of maternal and child health (Coleman *et al.*, 2020; Ward *et al.*, 2020), communicable diseases such as malaria (Rassi *et al.*, 2018), HIV/AIDS, tuberculosis (TB) (Devi *et al.*, 2015; Catalani *et al.*, 2013), and NCDs such as asthma, cardiovascular diseases (CVDs) and diabetes (Liu *et al.*, 2011; Feinberg *et al.*, 2017; Krishna *et al.*, 2009 Kitsiou *et al.*, 2017; Shahid *et al.*, 2015; Debong *et al.*, 2019).

The mobile technology environment in India presently seems to be conducive to securing the advantages that this technology can offer to the healthcare services and healthcare delivery sector. According to the Telecom Regulatory Authority of India (TRAI), the total telephone subscribers in the country in year 2020, was 1173.83 million out of which 1153.77 million were wireless subscribers. The reduction in device price and call rates could be factors contributing to this. The prices of smartphones witnessed a drop of 11% (Nair, 2019). The average outgoing call rate witnessed a drop to 19 Paise in December 2017 (PTI, 2018) (One Indian Rupee is equal to one hundred Paise. One Indian rupee is equal to USD0.014). Mobile data charges saw a higher drop of 90% during the same time period. Further, the Indian Government is working on various projects to increase broadband connectivity by linking 250,000 local self-government systems (Gram Panchayats) with high-speed broadband networks in a phased manner.

Nevertheless, for successful implementation of mHealth programs and interventions, the acceptance and adoption of this technology among various parties in a health ecosystem plays a significant role (Meyers *et al.*, 2017) and requires in-depth perusal. While studies from some countries have reported CHWs' acceptance of mobile technology as a support tool (Prinja *et al.*, 2017; Pimmer *et al.*, 2017), there is a dearth of studies that scrutinize the views about mHealth from a qualified health professional's perspective, especially the CHWs' use of mobile phone for work. As physicians are essential participants in the mHealth scenario, their views and perspectives require careful examination. Further, the dynamics of doctor–patient and doctor–CHW communication through mobile phones requires careful perusal as a lack of

physician support has been reported to hinder the extensive use of mHealth in clinical systems (The Economist Intelligence Unit, 2012; Barkman and Weinehal, 2017; Kong *et al.*, 2020).

In the Indian rural health systems, the medical officer (MO) assigned to the PHC is responsible for managing its day-to-day affairs and are burdened with administrative functions along with their curative and preventive roles (Vallikkunu *et al.*, 2014). Hence, the MOs manage and monitor the health issues of the rural underserved populace through the CHWs (Saprii *et al.*, 2015). It is pertinent then to examine how the mobile phone technology has augmented this process of remote healthcare delivery management; in particular, it is useful to understand the benefits and barriers of mobile phone use by CHWs. This study examines MOs' perspective of mobile phone use by female CHWs, especially the ASHAs and ANMs, in the Udupi district of Karnataka (India).

Framework for the study

The Information Communications Technology for Healthcare (ICT4H) development model (Chib *et al.*, 2008) was used as a framework for examining MOs' perceptions of mobile phone use by CHWs. In addition to four benefits, this model posits four interconnected barriers that may hinder ICT use for healthcare delivery. This model has been employed as a theoretical framework in several mHealth studies conducted in different countries (Watson *et al.*, 2015).

The benefits postulated by this model are "opportunity producer", where the use of ICT may enhance work productivity by increasing the number of people attended to; "capability enhancer", where the use of ICT may increase the ability of the workers to make timely referrals or take skilled actions based on access to quick information and clarifications from higher-ups, "social enabler", as it would aid in the construction of social networks that would enable social and professional engagement between workers and finally, that of "knowledge generator" through better access to information (Chib *et al.*, 2008). The barriers that pose impediment to effective use of ICTs include infrastructural barriers such as lack of ample mobile technology framework especially in rural areas, economic barriers to employ or utilize ICTs, technological barriers due to lack of skills or inexperience and sociocultural barriers due to established conventions and customs (Watson *et al.*, 2015).

Methods

Study area

This study was conducted in Udupi district of Karnataka, in the Indian subcontinent. The district has a total of 59 PHCs, six CHCs, two Taluk [1] hospitals and one district-level hospital.

Approach

This study adopted a qualitative approach with exploratory design to understand the MOs' perspectives.

Recruitment

In-depth interviews were conducted among 15 MOs belonging to different PHCs of the district. Only MOs with a minimum of five years' experience were included in the study. Purposive and snowball sampling were employed to identify and collect the sample. All the participants interviewed were 30–45 years of age. Seven participants out of the total 15 MOs were women. Each MO interviewed was requested to recommend their peers from other PHCs for the study.

Interviews

Individual face-to-face in-depth interviews took place over four weeks between January and March 2020 and were held at the PHC. With the onset of the pandemic, further data were collected through telephonic interviews from May to July 2020. The ICT4H development model was used to develop the interview guide. Permission to conduct the interviews among the MOs was obtained from the District Health Officer (DHO). Oral consent was obtained from the participants, and the interviews were audio recorded. Each interview lasted for 30–45 min and was stopped with the saturation of data. The interviews were conducted in English by the lead author and transcribed by a member of the research team.

Analysis

The data were subjected to thematic analysis, as it enhances the rigor of data by allowing close examination of the data through reading and rereading to identify emerging themes (Kumar and Mishra, 2016). The software Atlas.ti was used for coding and categorizing the data.

Findings

The overall findings of this study are arranged under four themes (see Table 1). These are benefits of MP use to CHWs, benefits of mobile phone-equipped CHWs, current MP use by CHWs and barriers to CHWs' MP use. Theme 1 captures the MOs' perceptions about the advantages of the CHWs' device use as a job tool. Theme 2 is about the benefits of the CHWs equipped with MPs for the MOs and the community. Perceptions regarding the types of devices owned (feature phones/smartphones/Android tablets) by the CHWs and their current use are placed under Theme 3. All the barriers faced by the CHWs with regard to their MP use were categorized under Theme 4.

Benefits of MP use to CHWs

The MOs stated that mobile phones assist the CHWs in swift communications with the health system, health professionals, peers and community members. Mobile phones enable quick collection of data, transfer of video clips or photographs as evidence of tasks completed (it could be a video of a surveyed site or a photograph of an unclean site) or of a patient with visible symptoms for diagnosis. This was seen to save time as well as the expenses of the CHWs. Not only does the mobile phone equip the CHWs to deliver a quick response, it also helps them organize and document pertinent data.

> Suppose there is an infection that is spreading or there is some water logging or there are too many mosquitoes, they can take photos and also send it to the higher authority as evidence for such issues. Because if she just tells the panchayat that such a situation exists, they may deny it, but now she will have proof [. . .] Whatever work they have done will be documented. (Participant 5)

As the ASHAs are mostly from low-income households, many of them look for additional work that could supplement their income. Time saved could mean more time to focus on other

Table 1. Major themes of the MOs' perspective of CHWs' MP use

Sl. No	Themes
1	Benefits of MP use to CHWs
2	Benefits of mobile phone-equipped CHWs
3	Current MP use by CHWs
4	Barriers to CHWs' MP use

revenue generating activities such as beedi rolling (tobacco wrapped into Tendu leaves to make a thin cigarette), tailoring, small business units, etc.

> There is this ASHA [. . .] She is a widow, and more like a social worker [. . .] She has now been an ASHA for 10 years. She also drives the auto in her spare time. (Participant 9)

Additionally, mobile phones augment CHWs' ability to convince rural people through use of pictures, audio and video to inform, educate and persuade. "They can show videos to the community people to explain" (Participant 5). It also helps them show test reports and government guidelines to the patients especially during pandemic and epidemic situations.

Further, the MOs opined that mobile phones also help the CHWs develop and foster professional and personal networks, by letting them connect, work and consult with each other. As one participant stated, "They are conversing with other patients, health workers and other friends also through their mobile phones" (Participant 12). Further, the device connects them with MOs themselves, enabling access to health related information and knowledge. "I will also share many articles, pictures with them[ANMs, ASHAs]. I will also be enriching them with knowledge" (Participant 5). This network helps them clarify their doubts and queries whenever the need arises. "It plays an important role, during an emergency, they [ASHAs and ANMs] even call us and ask us what to do" (Participant 3). Further, it was reported that some CHWs with smartphones also access Internet for acquiring information. This way the devices aid them in accumulating knowledge and experience over time.

The access that the technology provides the CHWs, to MOs, ANMs, peers and the community members helps them take precise and timely actions. "If they see any worry causing signs or symptoms, they call me to inform and check for actions to be taken" (Participant 4).

> Suddenly, we may need Aadhar [2] card number [. . .] we may need some relative's number [. . .] age [patient's] [. . .] Whatever [. . .] such situation they can make a single call. They will get all the information. (Participant 13)

Further, the MOs opined that this access to health professionals helps them clarify any concerns regarding the myriad health conditions they may witness during their work leading to an enhanced understanding of the various symptoms and conditions, equipping them to become better healthcare givers.

> For example, during the immunization of a child in a remote area, they can call us as soon as possible and inform the MO in charge that the child who has come for immunization has fever and find out what needs to be done. (Participant 5)

They also felt that the mobile phone technology can get the CHWs recognized for the amount of work completed by them, as the data collected get updated onto various portals. These data can then be accessed by the medical and public health systems professionals from any part of the country.

> Because of these mobile phones her work will be highlighted in the government files and she will be appreciated [. . .] it is not just only in a book [. . .] it is online and transparent [. . .] it can be utilized by every department [. . .] every official [. . .] It will be a record for her. (Participant 9)

Caste is a unique social stratification system practiced in India, which still plays an important role in the socioeconomic inequities in the country (Baru *et al.*, 2010). The MOs informed that this aspect along with their gender also tend to affect the acceptance of the information imparted by the CHWs and also their relationship with the community.

> If the ASHA who is visiting is from lower caste and if the house, she is visiting is from the upper caste then the people of the house ask her, who she is, to advise them [. . .] Acceptance of women is very less. Even with medical officers it is the same. In villages what happens is if you are a lady medical

> officer, all of these things will certainly happen [. . .] People look at the age of the medical officer and ask who is she. Even the ladies do that. If the Asha Worker advices the people not to drink, they will ask in the panchayat who is she to ask us not to drink, we will do what we want with our money. Age matters, so does caste and gender. This applies to Asha workers, ANM and new medical officers. (Participant 5).

Mobile phone technology, according to the MOs, can help these workers overcome the barriers that they face due to their age, caste and gender. They felt that with mobile phones, the CHWs may not be required to go to individual houses at all times, especially when the task at hand is to remind counsel, guide or persuade them. For example, to persuade a young mother to come to the PHC for family planning consultation, to remind her about vaccination schedule of her baby, an upcoming clinic visit or to inform the family about a health camp. However, this would require them to be trained and equipped with good communication skills.

> Instead of going to individual houses, communication can happen through the phone but it all depends on how good the ASHA worker is in communication. (Participant 5)

Further, the MOs indicated that the coming of the COVID-19 pandemic accelerated the need for the CHWs' use of the MPs to send reports and data back to the health system. They reported that MPs can aid CHWs report real-time pandemic data and reports to health systems.

> Now a days because of COVID-19, even from mobile phones, they can access the data ma'am. They can call a person, they can ask them about ILI SARI [. . .] these details. They can in turn call us. (Participant 9)

Additionally, ASHAs with smartphones can use their devices to show reluctant rural villagers their COVID-positive status or COVID-related guidelines,

> Instead of coming to PHC and getting the report, we could send it through [. . .] even for them, it is easy to communicate any documents which they require in the field. (Participant 11)

Benefits of mobile phone-equipped CHWs

The primary health centers in remote areas are often in places where transport facilities are very scarce. Further, the MOs reported that as most PHCs face a shortage of staff, the MO in charge often has to multitask and perform duties beyond the curative and preventive roles.

> I do not have a staff nurse. There is a contract staff nurse under me, but she is under maternity leave right now [. . .] There is no clerk here. The lab technician is on maternity leave too. (Participant 2)

Further, the MOs are also expected to enter a very large amount of data in numerous databases regularly.

> We have about 10–15 sites to enter the data of all the national programs like that of immunization or pregnancy or stock of medicines [. . .] that is the most challenging part as you do not even have a clerical or data entry position operators [. . .] So, the doctors end up doing the clerical works. (Participant 5)

Given the existing challenges and responsibilities, the MOs informed that they cannot always be present in the community, and the MP armed CHWs can be extremely useful in bridging the gap.

> If we must follow up on any case, say communicable diseases, antenatal (ANC) or pre-natal (PNC) we are expected to go and examine. In case if the day is hectic for me, she (CHW) will go to the field, examine her, and call to inform me. If there is any problem, she will take a photo. This is done not by

> the ASHA but by my ANM who has an Android phone. So, I do not have to go to the field every time because she will go check and give me the information. (Participant 2)

According to the participants, the CHWs with smartphones have become an advantage to the community because of their increased ability to provide initial and appropriate medical care at the rural patients' doorstep.

> They can call the patients to enquire if they have any problem. If there is any problem where the patient has to go to the hospital all of a sudden, they (CHWs) can tell (identify) the danger signs. (Participant 4)

In the process, the rural patients get the required timely medical assistance, while they (CHWs) get the exposure to a variety of cases, resulting in increased learning and development of skills, which in turn leads to their increased efficiency. The MOs, meanwhile, are able to be of service to the assigned population effectively through these mobile armed CHWs.

> Right now, we have a Dengue case. I called up the sister (ANM) and informed her that she and an ASHA worker will be going to the field. So, through their eyes, I can work. (Participant 11)

The MOs also informed the researcher that the mobile phone technology enables remote monitoring of CHWs and their work. The ASHAs are asked to send selfies from the field or photographs of the data collected or of the site they visited as proofs of completed field visits. In case of ANMs, the GPS tool in their tabs enables the MOs to monitor ANMs' field visits as the data of patients that need to be collected and entered through the ANMOL app can be entered only from the site once the GPS mode is switched on to conduct a real-time data entry.

> For example, if there is stagnant water or plastic wastes near a house, we can ask them to send the picture of the same area again, after it has been cleaned. (Participant 11)

> For ANMs, we will consider their work, only when it is recorded, it gets recorded only when they go to that place and switch on the GPS mode. Only then location will get logged [. . .] It is really a tracker for them. It is actually a headache for the old ANMs, because they have made the application in such a way that they cannot enter the ANC patients' data at their (ANM's) home or somewhere else. They have to go the concerned ANC's house and there only they have to drop the pin in the app and enter it. Otherwise it will not take the entries. Then we will understand if she has visited the ANC or not. That means, that headache, that one extra burden of the medical officer is gone. (Participant 9)

It was informed that WhatsApp as a platform for passing information and instructions by the MOs to the CHWs was very convenient. One MO revealed that he persuades ASHAs and others in the PHC to buy smartphones and install WhatsApp on the device as he felt that he could easily pass on work-related instructions easily.

> If I put any information on WhatsApp group, they cannot say the information has not reached me. Information is put up in Kannada and gets communicated very fast. (Participant 5)

Some divergent views also came from the interviews. Few MOs pointed out that some CHWs avoid field visits altogether and just call up the ANCs or other patients, instead of actually visiting them. This they felt may lead to missing certain crucial symptoms.

> Often instead of visiting and collecting the information, they sit at home and collect information [. . .] but sometimes the physical presence of ASHA is important [. . .] symptoms which they can see as a health worker is different from the mother seeing it in the child, right? (Participant 11)

Some also felt that the CHWs may simply use their mobile phones for chatting with friends rather than follow-up patients. "Around 30% of them may be using it for unnecessary purposes" (Participant 1). Some MOs reported that calls from CHWs interrupt them during

their consultation times. "Sometimes it is irritating. When I am at work they keep on calling and it disturbs me especially when I am with patients" (Participant 2).

Current MP use by CHWs

The MOs informed that most ANMs owned and used smartphones for work. They were also recently supplied with android tablets as a job tool by the government. The tabs were preinstalled with ANMOL app which is a tab-based version of the reproductive and child health (RCH) portal. The ANMs were also provided training to use the tab to enter different categories of healthcare data and service records of the beneficiaries.

The ASHAs, on the other hand, being honorarium workers and from very low socioeconomic backgrounds mostly use basic feature phones. Feature phones are mobile phones that have nontouch display, limited basic functions such as text messaging, Bluetooth, FM radio, calculator, voice calling, Internet, torch, etc. and have buttons as input. "We have 11 ASHAs [. . .] I think only three to four ASHA's have the smartphones. Others have keypad phones (feature phones)" (Participant 7). The devices help them in following up and monitoring expectant and young mothers as well as other patients in the community. They use it to reach out to the community to remind them about immunization camps, follow-up visits to the clinic, especially the antenatal care (ANC) and prenatal care (PNC) patients and for checking on other community members with ailing health conditions.

> When the due date for the immunization comes, our ANM will inform the ASHAs. The ASHA will remind the mother by phone or sometimes they may visit. If a visit is not possible, then they might inform through phone. (Participant 13)

Mobile phones help CHWs in conducting tasks such as registering pregnant women from the community at the PHC (ANC registrations) and recording vaccination and immunization data of newborn infants in a quick and organized manner.

> Even if the patient is away from a district they (ASHA/ANM) will call and arrange for the delivery date. ANMs would message about immunization dates through MCTS. (Participant 4)

Some ASHAs who own smartphones, use them to capture pictures of their field visits or surveyed area (for cleanliness related issues) in the community to be sent to the Gram Panchayat office [3] through WhatsApp. "They [ASHAs] use it for sending the reports [. . .] even the larvae survey report, the COVID-19 field visit report" (Participant 8). These as well as other pertinent health-related information or data from the community are sent through WhatsApp to the MOs or to the Panchayat or taluk office by both the cadres of the CHWs.

> When Healthcare workers go for the screening of skin diseases they may take a photograph of it and send it to us or if there are issues such as stagnant water around houses in community, they can send us those photos, audio, information, and statistics etc. (Participant 5)

The MOs stated that "The ANMs, they are better than the ASHAs in using mobile phones" (Participant 7). This they felt may be the case because the ANMs are more qualified workers with usually more experience and formal education than ASHAs. They also receive more training to use technology than the ASHAs. For instance, this cadre of workers was given training (through the Zoom platform) for contact tracing using a mobile application during the ongoing COVID pandemic.

> ANMs are using multiple apps already. Now even Contact tracing apps and other government sponsored apps [. . .] They are using it all. But ASHAs only use mobile phones for the purpose of communication. (Participant 13)

Later on, as the pandemic advanced, even ASHAs with smartphones were involved in conducting contact tracing through the contact tracing app.

Barriers to CHWs' MP use

Barriers identified were placed under four separate subthemes namely *poor network coverage, technical illiteracy, lack of sufficient training*, and *call and data expense* (see Table 2).

Poor network coverage. Almost all the MOs spoke about the lack of network coverage in the rural remote areas.

> They face network problems mostly. Even if we have good networks, ASHA workers in the field will not have a good one and it is difficult to connect to them. Network coverage is poor. (Participant 3)

To overcome the network challenge, the CHWs sometimes walk or travel back to the point where they can receive signals or "they come back to the PHC in the afternoon and tell us" (Participant 3). Additionally, they cannot consult their peers or MOs from poor network areas. Further, the use of GPS tools for tracking patients as well for supervision of the ASHAs through MP will not be possible in those areas. Some MOs suggested "We need to get more towers because in the periphery there is no signal at all" (Participant 3).

> In our area, I work in a PHC hours away. There is no proper Network also. Some of the areas we do not get network where the geolocation of the patient is required. After coming back to the PHC or after coming back home they have to do this thing called geo-tagging [4]. (Participant 8)

Technical illiteracy. Technical illiteracy is the lack of knowledge to make use of a mechanical or scientific subject (Shaikh and Kinange, 2018). Digital literacy is defined by the American Library Association (ALA) as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills". Based on the above definitions, we define "technical illiteracy" as the lack of typing/computing skills to operate their mobile phones and the inability to use the device to access Internet to read, watch and gather information from online platforms.

Technical illiteracy was reported to be present among most ASHAs as well as the older ANMs. This, as some MOs felt, was not surprising as "The background from which they come, the economic status, the education, their interest in learning new things [. . .] depends on that" (Participant 9). The older CHWs, according to the MOs, were uncomfortable with technology and found it tedious and difficult to use. "The ANMs have smartphones but the older ones find it difficult to use" (Participant 6).

"There are 11 ASHAs working under me. Four of them are above 40–45 years of age [. . .] they are not very comfortable using mobile phones" (Participant 7). Most participants reiterated that the mobile phone use among these older CHWs, especially the ASHAs, was mostly to make or receive calls. They stated that these workers found it difficult to use even basic features such as the short messaging service (SMS) facility for sending or receiving messages.

> With this feature phone they (ASHAs) can only use calling facility and do not know how to use SMS facility. Even if they do, spacing and English language is a big problem [. . .]. (Participant 5)

The cause for this was attributed to low educational status and a general lack of English language proficiency. Additionally, the inability to understand, type and reply in English

Table 2. Barriers to CHWs' mobile phone use as a support tool

Sl. No	Sub-themes
1	Poor network coverage
2	Technical illiteracy
3	Lack of sufficient training
4	Call and data expense

forces the workers to ignore text messages. Some MOs suggested that the ASHAs should be provided with smart phones to overcome the typing, literacy and comprehension issues. Further, it was felt that even the instructions to them can be given through video calls or simply through instructional videos, instead of texting it to them.

> Proper education is a requirement. If you tell them something now, they just listen and forget it tomorrow, so we need to repeatedly tell them. (Participant 3)

> It's better to give the ASHAs Android phones so that we can at least talk to them through video calls rather than sending them text messages. (Participant 2)

Most MOs informed that the younger ASHAs, under 35 years age, tended to use smartphones and were better in terms of the mobile technology use. They used some applications such as WhatsApp, YouTube, Facebook and also used the Internet to search for information. Few however felt that, "Most of them (ASHAs) do not know how to use smartphones [. . .]." (Participant 6)

Lack of sufficient training. Almost all the participants spoke about the need for training the CHWs in mobile technology use.

> No proper training is given to these workers [. . .] on what to use and how to use, no training in English language for beginners, no training on sending messages. (Participant 1)

> They need to be given training to make the best use of mobile phones. If you can create some apps for them to reach us better it would be better. Like WhatsApp we already have a hospital group but they do not use it so it is not very much useful for them. (Participant 3)

This, according to the MOs, reduces the potential of the device to become a support tool to them. "Only in the beginning when the tabs were provided (to ANMs), training was given. After that regular training was not given" (Participant 12). The MOs opined that the CHWs need to be given frequent and consistent hands-on training on mobile technology use. Many reported that the CHWs tend to forget the training given about technology use by the time the program is implemented.

> For example, if there is a scenario[training] where they have to enter data on hand then it is more effective. What happens is they are given a lecture or a one-day orientation at the district level. And then take at least one month for implementation, when that happens everything is forgotten and they (ANMs) will have so many doubts. (Participant 5)

Additionally, the MOs felt that since most ANMs were above 40 years, they find it difficult to use and apply technology and hence would require training until they get comfortable with the technology. The MOs also pointed out the need for these workers to be trained in communication as well as basic English language proficiency. "They require training in English language at least for understanding English SMS messages" (Participant 2). One MO went on to suggest that English language literacy is essential for effective use of computers, mobile phones and Internet.

> If we give our staff proper training then we can bring change. eVin [an app that monitors the temperature of vaccine stocks through smartphone application] is a new initiative by the government for proper maintaining of the RCH[Reproductive and Child Health programs]. For us it is difficult, for them it is more difficult because they cannot even spell. (Participant 3)

Call and data expense. The participants informed the researchers that the Government has provided all the ASHAs, ANMs and MOs with closed users group (CUG) SIMs with 25 min of free talk time per month. These SIMs facilitate calls between ASHAs, ANMs and MOs and enable quick communication and coordination. "Any calls made between any Government practitioners and me within Karnataka is free of cost. And the same is true with ASHA workers" (Participant 11).

This CUG facility, however, does not extend to calls made to patients or others in the community. They get charged for these calls. Further, if calls to CUG users exceed a period of one minute, then it is charged as well. "Beyond this one minute, even if it is for professional or personal use it is charged" (Participant 5). This additional expense needs to be borne by the CUG users and may become burdensome for the ASHAs. Further, the ASHAs with smartphones also need to buy data packs for using WhatsApp and Internet unlike the ANMs. "ANMs are provided for by the government. For ASHAs they have to use their own data pack" (Participant 12).

Discussion and conclusion

This study examined MOs' perspective of female CHWs' usage of mobile phones as a support tool for their work. It also examined the challenges and constraints faced by them in terms of their usage. The study reports positive perceptions among the MOs regarding CHWs' mobile phone use, contrary to the reports from earlier studies (Barkman and Weinehal, 2017; Kong *et al.*, 2020; The Economist Intelligence Unit, 2012). While findings of this study corroborate with the study conducted by Chib *et al.* (2008), it also suggests that the technology can help the CHWs overcome certain inherent issues such as those related to caste and gender.

Oppression due to caste and other related issues are more evident within rural Indian communities (Gang *et al.*, 2008; Baru *et al.*, 2010). Adding complexities to this condition is the gender differences intertwined with social and cultural hierarchies (Chaudhuri *et al.*, 2018; Ramachandran *et al.*, 2010). The participants of this study highlighted the presence of these innate issues which hinder with the performance of CHWs duties. Their suggestion echoed with the larger scholarship about ICTs and development (Ramachandran *et al.*, 2010; Venkatesh *et al.*, 2016, 2020), in that, the mobile phones could be used as a tool to overcome such issues, provided they are equipped with good communications skills to counter, persuade and overcome these barriers. For instance, a study conducted in rural Odisha (formerly, Orissa, an east Indian state) reported CHWs' use of self-made videos on mobile phones which were effective in persuading pregnant women to use health services (Ramachandran *et al.*, 2010).

The salience of mobile phone technology in the healthcare context has increased manifold in the ongoing COVID-19 pandemic situation. The technology helped health personnel of all cadres to communicate and respond rapidly to the emerging public health crisis across the world (Kondylakis *et al.*, 2020; Hong *et al.*, 2020; Linz *et al.*, 2020). As reported from other parts of the world, this technology aided in constant surveillance of new infections in the community (Wang *et al.*, 2020; Leslie, 2020; Singh *et al.*, 2020). In the primary healthcare context, it assisted the CHWs in sending real-time pandemic reports and data to the health systems as well as for showing patients their test results or guidelines issued by health systems and government. These findings corroborate several other mHealth studies conducted in the COVID-19 context (Verhagen *et al.*, 2020; Aslani *et al.*, 2020; Pai *et al.*, 2020).

The MOs corroborated that conducting certain tasks through the mobile phones leave them with enough time to pursue activities that could supplement their income (Chib *et al.*, 2008; Tran *et al.*, 2011). This advantage is especially significant to the ASHAs, as many belong to low socioeconomic backgrounds and take up the CHW work to support their household expense burden (Paul and Pandey, 2020). Further, the "flexi-time" that a mobile phone use allows (Bal, 2020) adds to their sense of efficacy in managing tasks at home and work (Chib *et al.*, 2008), while providing a certain amount of economic independence (Bal, 2020). Additionally, the MOs felt that mobile phones enable knowledge to be assimilated through discussions; sharing of pictures, videos and reports on various networks (Chib *et al.*, 2008; Ramachadran *et al.*, 2010) and bolster the retention and efficacy of the accumulated knowledge (Jain *et al.*, 2019).

Motivation is crucial for CHWs' performance, retention and well-being (Gottert *et al.*, 2021). A significant advantage that comes with mobile phone use as pointed out by the MOs is that all the reports and data updated by the CHWs serve as a record of their performance or of tasks completed. This may lead to appreciation and recognition at work which in turn could motivate them to work better (Thondoo *et al.*, 2015). CHWs have been envisioned to act as bridge between health systems and community and are expected to empower them with access to health systems as well as with health education and awareness. However, to empower the community, they themselves need to be empowered (Kane *et al.*, 2016). Thus, this study corroborates that benefits of mobile technology use may enable a sense of empowerment in these workers by contributing to increased self-efficacy, knowledge and economic independence (Chib and Chen, 2011; Lee *et al.*, 2011; Chib *et al.*, 2014).

The mobile phone armed CHWs were informed to be extremely useful to the MOs as they enable remote yet timely patient healthcare service delivery (Lemay *et al.*, 2012). Further, monitoring and supervision of these workers was informed to have become easier with this technology (Biemba *et al.*, 2017). Some MOs reported that they encouraged their ASHAs and staff to buy smartphones and be present on the PHC's WhatsApp groups to ensure smooth communication between the MOs, CHWs and other staff (Early *et al.*, 2019; Thondoo *et al.*, 2015). The seamless communication thus enabled would result in better workflow due to timely dissemination of information and instructions or directives to action (Chib *et al.*, 2012, 2014).

However, as found in rural areas across the world, one of the biggest challenges highlighted by all the participants of this study was the poor mobile coverage and Internet connectivity (Zaidi *et al.*, 2020; Mishra *et al.*, 2019; Schuttner *et al.*, 2014; Thondoo *et al.*, 2015). As on March 2020, the broadband coverage in rural areas was 29.2% (Sharma, 2020). Poor network coverage may lessen or reduce the advantages of the technology to the CHWs, health systems and the community as a whole. Lack of network coverage requires these workers to walk back from the peripheries to the PHCs to submit report and data (Ilozumba *et al.*, 2018). They are also unable to contact the MOs for any clarifications or conduct referrals effectively (Zaidi *et al.*, 2020). WhatsApp and GPS enabled real-time data entry may not be optimally functional due to the poor network. Further, as GPS-linked data entry among ANMs and submission of selfies or photographs and videos of field visits conducted by ASHAs, double-up as tools of monitoring, the challenge of poor network would add to stress and anxiety among them. This in turn may lead to demotivation and attrition (Strachan *et al.*, 2012). A significant cause for poor signal in the study area may be due to the terrain of the district. Being hilly and covered with forests, these hinder the signals coming from mobile towers. Further, monsoon season in the region worsens the problem (Express Web Desk, 2021; ET Bureau, 2021). Some MOs suggested that the number of mobile towers in rural areas requires to be increased to counter this challenge. The service provider of the CUG SIM given to the ASHAs, ANMs and MOs is the government-owned Bharat Sanchar Nigam Limited (BSNL). This study found that during times when health workers including the MOs are in areas that do not receive signal from BSNL, they use SIMs belonging to other networks, incurring personal call expense. This may be an additional burden for the ASHAs. Provision of dual SIMs (belonging to two different service providers) by the government to CHWs may also be a solution to the network issue (Thondoo *et al.*, 2015). Further, ensuring sufficient free talk time which could also be used to a limited number of out-of CUG calls will cut the call expense for these lower paid workers (Steege *et al.*, 2018).

The issues of technical illiteracy are another significant challenge that requires addressing among both the cadres of CHWs. Only a small number of ASHAs own smartphones and mostly use it just to make calls. Nominal few make use of the camera feature to take photos or videos of field surveys as reports to be sent through WhatsApp or access the Internet for information. Though most ANMs use smartphones or tabs, are present on

WhatsApp groups and access Internet for information and health related videos, the older ones find technology use cumbersome and difficult to use. This variance in the use of technology between the two cadres was attributed to the different levels of education as well as to their digital literacy. This finding clearly aligns with the findings from another study which found that nurses were unable to exploit the use of mobile phones as much as the doctors because they had poorer technical competence compared to the doctors (Watkins *et al.*, 2018). Lack of English language proficiency also adds to the technical illiteracy, for to comprehend and use mobile phones and other technologies, a basic knowledge of this global language is a key requirement (Khan, 2018; Emmanuel and Emmanuel, 2018). Further, the adoption and better use of Internet is reported to be connected to English proficiency (Pearce and Rice, 2014). Training programs to equip these workers, with basic English language skills coupled with persistent technical training on mobile phone use, supported with back end technical support at the PHC level, may be the solutions to these challenges (White *et al.*, 2016; Feroz *et al.*, 2020).

It is clear from this study that issues of caste, gender and low literacy still plague rural health systems in India, and mobile phone technology seems to be a viable solution to counter the same. However, focused efforts from the government are required to address the existing impediments which may steer the country toward better and universal healthcare.

Recommendations

It is evident from the study that mobile phone technology has the capability to be a potent support tool for the CHWs. However, poor network, technical illiteracy and insufficient training are the challenges that need to be addressed (see Table 3). By increasing the number of mobile towers in rural areas, the problem of poor network can be addressed to some extent. Additionally, dual SIMs from two different service providers may be provided to CHWs working in poor network areas. Smartphones help in voice messaging, and the camera in the device allows for effortless communication through photos and videos. This can be an excellent tool that can support the illiterate ASHAs, and hence, they should be provided with smartphones or tabs by the government. Provision of sufficient talk time and data pack to ASHAs will reduce call and data related expenses for them. Finally, policy changes to effect frequent technical as well as basic English language training of the CHWs at the CHC/PHC level will ensure the conduct of such sessions at designated intervals. Such changes at the policy level would help CHWs in overcoming technical illiteracy to reap full benefits of the technology. Further research is required to gather the perspectives of all the stakeholders involved in the primary health system including the beneficiaries.

Strengths and limitations

This was a qualitative study conducted to understand the perceptions of MOs regarding mobile phone use by CHWs. Efforts were directed to gather a deep insight into the

Stakeholders	Recommendations
Government	(1) Increase the number of mobile towers to widen mobile network coverage
	(2) Provide CHWs with dual SIMs to counter network issues in remote areas
	(3) Supply ASHAs with smartphones or android tablets to overcome illiteracy issues
	(4) Power the CUG SIMs with unlimited talk-time and a small data pack to reduce call and data expenses
	(5) Policy changes to ensure frequent training of the CHWs

Table 3.
A summary of recommendations

perceptions of MOs. Confidentiality was assured to the participants to alleviate any reservations that they may have pertaining to the subject of research. While we applied the ICT4H development model to comprehend the MO perceptions regarding the benefits and challenges of MP use among CHWs, we did not extend its use to fathom the consequences of CHWs' MP use on the health delivery systems. Another limitation was that some in-depth interviews could not be conducted face to face due to the onset of the pandemic and instead had to be carried out over the phone.

Notes

1. "Taluk" is a term used for an administrative district, comprising of several villages.
2. Aadhar card is the unique identification number issued by Government of India and can be used as a proof of identity and residence (https://uidai.gov.in/what-is-aadhaar.html).
3. The Gram Panchayat and Taluk office are part of the Panchayati Raj Systems, which is a three-tier rural local self-government system, brought into existence to encourage community-level participation in all developmental activities including rural healthcare. Under this system, the Gram Panchayat is in charge of health, nutrition and sanitation management of a village or groups of villages and hence supervise and monitor related activities at the village level (Kumar and Mishra, 2016), while the taluk panchayat oversees healthcare and sanitation functions at the Block (subdistrict) level (https://www.niti.gov.in/writereaddata/files/document_publication/IDMPS-Book_0.pdf).
4. Geotagging involves the assigning of geographic coordinate information such as latitude and longitude coordinates, altitude etc., to images, video and other media recorded by GPS-enabled electronic devices (https://www.caliper.com/glossary/what-is-geotagging.html).

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Further reading

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About the authors

Manjula Venkataraghavan is an Assistant Professor, Selection Grade, at the Manipal Institute of Communication, Manipal Academy of Higher Education, Manipal, India. She has a work experience of over twelve years, with research interests in the field of technology and development, public relations and Health communication. Manjula Venkataraghavan is the corresponding author and can be contacted at: manjula.v@manipal.edu

Dr. Padma Rani is Professor and Director at the Manipal Institute of Communication, Manipal Academy of Higher Education, Manipal, India. She has been in the academic arena for over 15 years. Over the years, she has mentored innumerable students and has been part of several research projects. Her research interests lie in New Media, Gender and communication, International relations and political communication.

Dr Lena Ashok is an Associate Professor and Coordinator of the Social Work program at the Prasanna School of Public Health, Manipal Academy of Higher Education (MAHE). With over 18 years in academics, she has been part of several public health projects and has several research papers to her credit. Her interest areas in research include adolescent health, Mother and Child Health, Mental health and well-being.

Dr Chythra R. Rao M.B.B.S., M.D., D.N.B is an Associate Professor in the Department of Community Medicine, Kasturba Medical College, Manipal Academy of Higher Education, Manipal, India. Apart from teaching and mentoring undergraduate medical students, she also trains the postgraduates and faculty members of Kasturba Medical College in Research methodology, Epidemiology and Bio-statistics. She is also a member of the Institutional Ethics Committee of Kasturba Medical College and Hospital, Manipal from 2016 and a registered PhD Supervisor. She has several papers to her credit and is part of several completed and ongoing research projects.

Dr. Varalakshmi Chandra Sekaran M.B.B.S., M.PH, Ph.D, is an Assistant Professor at the Department of Community Medicine, Melaka Manipal Medical College, Manipal Academy of Higher Education (MAHE). She has a work experience of 15 years with research interests in parenting, child and adolescent mental health and mental health literacy. She has mentored several master's theses and has been the Principal Investigator with several projects including a recent one sponsored by the Indian Council of Medical Research (ICMR), Government of India. She has several publications in national and international journals.

T.K. Krishnapriya is a Junior Research Fellow (UGC) at Manipal Institute of Communication, MAHE. Her areas of interest include Gender Studies and Indian English Literature.

Received 18 July 2021
Revised 20 September 2021
Accepted 20 September 2021

Online multidisciplinary integrated rural healthcare education programs during the COVID-19 pandemic for students from different universities: experiences and guidelines

Frances Barraclough
Faculty of Medicine and Health, University Centre for Rural Health, The University of Sydney, Sydney, Australia, and
Sabrina Pit
School of Medicine, University Centre for Rural Health, Western Sydney University, Sydney, Australia;
Faculty of Medicine and Health, University Centre for Rural Health, The University of Sydney, Sydney, Australia and
Knowledge Mobilisation Unit, NSW Rural Doctors Network, Newcastle, Australia

Abstract

Purpose – The COVID-19 pandemic has led to "forced innovation" in the health education industry. High-quality training of the future rural health workforce is crucial to ensure a pipeline of rural health practitioners to meet the needs of rural communities. This paper describes the implementation of an online multidisciplinary teaching program focusing on integrated care and the needs of rural communities.

Design/methodology/approach – A multidisciplinary teaching program was adapted to allow students from various disciplines and universities to learn together during the COVID-19 pandemic. Contemporary issues such as the National Aged Care Advocacy Program for Residential Aged Care COVID-19 Project were explored during the program.

Findings – This case study describes how the program was adopted, how learning needs were met, practical examples (e.g. the Hand Hygiene Advocacy within a Rural School Setting Project), the challenges faced and solutions developed to address these challenges. Guidelines are proposed for remote multidisciplinary learning among health professional students, including those in medical, nursing, pharmacy, dentistry, and allied health disciplines.

Originality/value – The originality of this program centers around students from multiple universities and disciplines and various year levels learning together in a rural area over an extended period of time. Collaboration among universities assists educators in rural areas to achieve critical mass to teach students. In addition it provides experiences and guidance for the work integrated learning sector, rural health workforce practitioners, rural clinical schools, universities, policy makers, and educators who wish to expand rural online multidisciplinary learning.

Keywords Allied health, Multidisciplinary, Rural health, COVID-19, Rural medical education, Remote learning, Workforce, Workforce planning, Rural placement, Australia, Videoconferencing

Paper type Case study

Ethical approval: Ethics approval was not sought as the paper was considered a quality assurance project.

Health Education
Vol. 122 No. 2, 2022
pp. 202-216
Emerald Publishing Limited
0965-4283
DOI 10.1108/HE-06-2021-0096

Abbreviations

RCS –	Rural clinical school
NSW –	New South Wales
MD –	Multidisciplinary
RHMT –	Rural Health Multidisciplinary Training

Introduction

Context

There is increasing evidence that a positive rural placement experience for health professionals has a positive impact on practice intention and actual practice uptake in rural areas (Smith, 2018a, b). The Rural Health Multidisciplinary Training (RHMT) program was established in 2016 to expand rural health placements in medicine, allied health, dentistry and nursing. The government allocates placements based on rural classifications (Rural Area (RA) 2–RA5) defined by the Australian Statistical Geography Standard (ASGS), consisting of RA1–RA5 (Major City, Inner Regional, Outer Regional, Remote, Very Remote) (KBC, 2020). The three objectives of the RHMT Program in 2016–2018 are to (1) "provide effective rural training experiences for health students," (2) "maintain well-supported academic networks to enhance the delivery of training to students, junior doctors and specialist trainees in rural, remote and regional areas" and (3) "develop the evidence base for the efficacy of rural training strategies in delivering rural health workforce outcomes." The COVID-19 pandemic has brought about challenges to achieve these three objectives. These challenges have led to forced innovation and the rapid development of online education for health professional students enrolled in undergraduate and postgraduate university programs. The University Center for Rural Health (UCRH) has addressed some of these challenges in delivering a multidisciplinary education program to health professional students who were due to be on rural placements during the COVID-19 pandemic. The program provides an opportunity for students to learn with and from each other, with a focus on the specific needs of rural populations, integrated care and multidisciplinary learning to improve their work-readiness.

This paper aims to:

(1) Describe the experiences of an online multidisciplinary education programs on rural health and integrated care for professional students during COVID-19; and

(2) Based on these experiences, propose guidelines for others wishing to implement online multidisciplinary education.

Theoretical approach

Interdisciplinary learning strengthens students' ability to work in a team, communicate effectively and provide better patient-centered healthcare solutions (Mackenzie *et al.*, 2007). The program is based on a combination of key theoretical approaches a practice-development approach (McCormack *et al.*, 2009), task-based learning (TBL) (Harden *et al.*, 2000), a mainly student-focused approach (Trigwell *et al.*, 2005) and *adaptive expertise* (Sockalingam *et al.*, 2016).

Firstly, the program uses a *practice–development approach* enabling the students to situate themselves within their own practice while taking into account their own and other disciplines, to integrate their learning and develop new knowledge and skills (McCormack *et al.*, 2009). Specifically, the program adopts the practice–development approach where the students learn new knowledge focused on the needs of rural communities and integrated care and develop an understanding of and solutions for COVID-19 within these communities. The program supports and enables students to think beyond their own discipline focused tasks, build deeper relationships with clients and carers, and develop more functional relationships with other disciplines and service providers. Students can also acquire

extensive integrated knowledge of the systems of rural health care and social determinants of health. The program allows for creativity and working in teams to solve contemporary issues, such as the COVID-19 outbreak and its effects on rural communities.

Secondly, the program uses TBL, which centers around a set of activities that are related to practice and learning results. The students need to comprehend the multidisciplinary tasks but also the core concepts and mechanisms underlying the tasks (Harden *et al.*, 2000). TBL is used because it has the potential to improve workforce readiness.

Thirdly, the program's teaching approach is both teacher- and student-focused, with the major focus being on students (Trigwell *et al.*, 2005):

(1) The teachers conduct an information transfer of the components of the task to the students (teacher-focused); and

(2) Activities are designed in such a way that the components of the task are taught as a whole, which will lead to conceptual change for the student in relation to rural health, integrated care and other disciplines (student-focused).

Lastly, from the teacher's perspective, an *adaptive expertise approach* (Sockalingam *et al.*, 2016) is used, whereby the expert is able to distill the complexity of integrated care through continually refining and increasingly describing and discussing patient and system complexity with the students based on their expertise. This assists students in not feeling overwhelmed.

Multidisciplinary education program

A multidisciplinary education program (the program) has been in place at the UCRH since 2016. Students come from a variety of disciplines and universities across New South Wales (NSW) and Queensland. The program is aimed at students studying health-related degrees, including medicine, nursing, pharmacy, dentistry and allied health (e.g. dietetics, speech therapy, physiotherapy and occupational therapy (Pit *et al.*, 2020).

Students have the opportunity to learn about integrated care within the multidisciplinary program through working with students from other disciplines on joint projects, workshops and academic days and addressing system limitations and developing solutions for complex interplay of patient and system problems.

Curricula for healthcare workers in training do not always promote the attainment of skills and experience in rural communities, primary care settings and integrated care. In many training programs, students learn primary care principles but are then placed in clinical environments often in discipline silos in which it is difficult to implement and practice these principles. This program aims to address this gap and provide an opportunity for students to learn with and from each other, with a focus on the specific needs of rural populations, integrated care and multidisciplinary learning.

The program consists of several structured multidisciplinary programs, including the following:

(1) a weekly full-day face-to-face (or online during COVID-19) workshop on Wednesdays (known as the "Wednesday Program"); and

(2) a weekly 1-h face-to-face student-led patient-based case discussion, which is attended by medical students, nursing, pharmacy and allied health students, UCRH teaching staff and academics and educator clinicians from the local regional hospital and community services (known as the "Friday Student Led Case Discussion").

The students are mostly in their final years of study and are allocated a placement within the Northern Rivers Area of NSW footprint. This footprint includes a variety of small rural towns. Many students are placed in a primary healthcare setting within community organizations such

as schools or residential aged care facilities. The exception is students studying medical degrees who are predominantly based within the hospital and general practice settings. However, medical students undertake a community research project to become engaged in community-based health and solving inequity issues in rural communities. To address service gaps and community needs, UCRH rural placements sites were selected based on a local rural population needs assessment conducted by the North Coast Primary Health Network (Longman *et al.*, 2020). Students who were on an acute hospital placement were also invited to participate in the program.

COVID-19 opportunities – scaling up

When the COVID-19 restrictions were introduced, the education program continued and thrived rapidly moving online via the Zoom platform, unexpectedly broadening our capacity to provide multidisciplinary learning opportunities. Two examples of capacity expansion are provided.

Firstly, new university arrangements were established with three universities, allowing an additional 30 undergraduate occupational therapy, nutrition and dietetics, pharmacy and occupational therapy students to participate in the program. Therefore, in addition to students who were already allocated a rural placement within the UCRH, the program was able to provide extra support to partner universities, allowing students who were not allocated an official rural placement to participate in the online program. This enabled these students not only to complete mandatory interprofessional curriculum requirements but also to learn and experience rural health care. COVID-19 has, therefore, incidentally had the benefit of extending the potential for health professional students to be remotely exposed to rural health. Indeed, we postulate that pre-COVID-19, it would not have been thought possible or considered as an option to expand multidisciplinary rural health learning.

Secondly, the Wednesday Program and student-led case discussions could now be recorded on Zoom. This led to sharing the recorded session with two other universities who now use these during their training.

The benefits of the program going online due to COVID-19 were:

(1) An increased capacity to allow students from other disciplines and other universities to participate;

(2) The ability to engage and improved communications with university academics regarding meeting student curriculum requirements;

(3) The ability to record and share lectures across different universities; and

(4) COVID-19 has led to unexpected efficiencies in delivering rural health training.

Table 1 provides an overview of targeted workforce ready skills, learning areas and examples of a typical Online Wednesday Program and online case discussion since COVID-19 started.

COVID-19 adapted real-world rural health projects

The program had to create new projects that could be developed remotely and presented back to multidisciplinary student groups. Early on COVID-19-related topics were chosen in line with existing rural-based placements sites such as schools and aged care facilities. Two projects are presented here. The first project focused on Hand Hygiene Advocacy within a rural school setting and the second one on National Aged Care Advocacy Program for Residential Aged Care during COVID-19.

To increase student understanding of real-world issues around integrated care such as systems limitations and to learn to think beyond the biomedical model for patients but also to think in terms of real-world solutions, students are exposed practically to current national policy guidelines and directives. For example, the National Aged Care

UCRH graduate workforce-ready skills
Rural specific
• Graduates have confidence and skills in working in autonomous environment in rural and remote workplaces • Graduates are socially accountable • Graduates are able to improve healthcare equity in rural areas through system and practice change
Healthcare specific
• Graduates are able to provide holistic patient-centred care • Graduates look after their own well-being (self-care)
General
• Leadership skills • Innovation ability • The ability to work in a team • Ability to work in multidisciplinary settings
Learning areas during the Wednesday Program education sessions
Systems approach
• Focus on an integrated approach between health care and other sectors • Establish familiarity with local and national programs and services to support health and social needs • Ability to connect community-based partners, patients and caregivers to local and national programs and services to support their health and social needs • Emphasizing an integrated knowledge of person-centred, preventative and community-based care, based on the biopsychosocial aspects of disease, systems of care and social determinants of care
Integrated care knowledge and skills
• Skills to construct a comprehensive understanding of individual patients' complex needs and how these can be met within their health and social systems • In-depth understanding of other disciplines, including referral processes • Understanding how care is provided in rural areas • Knowledge of services in small rural towns • In-depth understanding of early intervention and prevention • Adaptive expertise is used by the facilitator to encourage students to proactively understand the interaction between patient and system complexity (Sockalingam *et al.*, 2016) • Management of chronic conditions and improving quality of life for older people
Workforce-ready skills
• Work effectively as a member of a multidisciplinary team • Work autonomously and self-directed • Generate new ideas and solutions to complex problems
Examples of topics covered
Multidisciplinary Wednesday Program
National disability insurance scheme, my aged care, national digital health strategies, role of the cancer council, trauma informed care
Friday multidisciplinary clinical case discussion
Management of back pain in the elderly, management of depression in the elderly, management of Type 1 diabetes

Table 1.
Example of content of the Online Wednesday Program and online clinical case discussions

Advocacy Program (Department of Health, 2020a), focusing on the implementation of the Aged Care Standards in Residential Aged Care Facilities was used, as well as ideas to implement the recommendations from the recently released Australian Government National Rural Health Commissioner Report (June 2020) on the Improvement of Access, Quality and Distribution of Allied Health Services in Regional, Rural and Remote Australia (Department of Health, 2020b). The content of the sessions included a group session to encourage the students to work in teams to generate novel ideas and solutions based on national policies and directives. Key outcomes were that all students complete

their university requirements while learning about rural health in a multidisciplinary learning environment.

Hand Hygiene Advocacy within a Rural School Setting project

For this multidisciplinary project, students were advised that the Department of Education (DOE) has set up a rural consultation group to advise schools on strategies and to implement resources to deal with the COVID-19 outbreak. The DOE has tasked several organizations to provide evidence-based recommendations and resources for schools to adopt now and into the future. Students were asked as a multidisciplinary group, to represent small rural schools in considering the topic of hand hygiene. In line with *TBL*, several tasks and assessments were developed.

Firstly, students were asked to produce a report for the department, based on current evidence as well as their experience of placement within the school environment, to guide approaches to hand hygiene and reducing rates of infection, considering:

(1) Gaps in the school community's knowledge;

(2) Strategies to implement long term;

(3) Identification of international or national guidelines, policies and procedures; and

(4) Any resources or capital works that may be required.

A formative assessment task involved a 500-word summary report, including key priorities. The students presented the project back to a larger group of students from other disciplines and had to seek feedback to further refine the project. This was concluded with the compilation of the group suggestions into a 500-word reflection of the task.

Secondly, students were tasked to work together in a multidisciplinary team to develop a hand hygiene program, including resources for their placement site (small rural school) that could be adopted nationally. They were asked to (1) identify the target population such as a classroom, a specific age group, teaching staff, volunteers or parents/carers for the home environment; (2) apply and incorporate the five steps of hand hygiene within the chosen setting. A similar formative assessment task as above was developed, including an online presentation of the resources developed, incorporating feedback from the MD online group and including the group suggestions into a 500-word reflection of the task.

National Aged Care Advocacy Program for Residential Aged Care COVID-19 project

For this MD project, initially, a *teacher-focused approach* was used to ensure *information transfer*. Students were taught about the National Aged Care Advocacy Program for Residential Aged Care to ensure they understood the mechanisms and concepts underlying the learning task. Students were advised that the Federal Government Budget funded several initiatives to help aged care providers to:

(1) Adapt to the proposed new aged care standards;

(2) Improve palliative care in residential aged care;

(3) Support aged care capital works in rural and regional Australia;

(4) Develop technological solutions for people living with dementia; and

(5) Encourage healthy aging and improve the mental health of older people.

Students were informed that as part of the budget, they could apply for a national grant to establish a consultancy service to support residential aged care facilities to implement the new aged care standards. Several tasks and assessments were developed.

Firstly, students were told that the program should assist aged care facilities to understand and apply practical person-centered care and provide examples of how to do this. The grant money could be used to deliver education sessions to aged care providers promoting the new standards. Students were asked to design in a multidisciplinary team a program and resources and present them back to a wider multidisciplinary student group for input. The formative assessment took place by incorporating the group suggestions into a 500-word reflection of the task.

Secondly, similar projects, tasks and assessments were conducted based on establishing a consultancy service to (1) improve palliative care in residential aged care and (2) support aged care capital works in rural and regional Australia. The latter is particularly significant, because students are often not taught about capital works and the influence this can have on rural communities and future service delivery.

Thirdly, given the increased difficulties during the COVID-19 pandemic for older people and the opportunities that digital solutions provide (Fisk *et al.*, 2020), students were also asked as part of the budget and in a multidisciplinary team to apply for a national grant to establish a consultancy service to develop technological solutions for people living with dementia.

Lastly, due to increased mental health problems due to COVID-19 (Fisk *et al.*, 2020), students were asked as part of the budget to apply for a national grant to establish a consultancy service to encourage healthy ageing and improve the mental health of older people. The task assist students in a *conceptual change* about other disciplines, systems change and integrated care.

Patient-based clinical case discussion during COVID-19: social work and mental health

A social work student on rural placement was invited to deliver a 30-min presentation to their fellow students. The presentation focused on the scope of social work practice within a rural mental health setting and illustrated appropriate social work assessments and interventions. This was also an opportunity to promote the potential outcomes for people at risk, when a strengths-based and person-centered approach is applied. This opportunity gave the student the experience of collaborating with students across medical and allied health disciplines and extending their knowledge of allied health care beyond the scope of social work. However, it also shows for example medical students the knowledge that other disciplines bring to the table.

Program impact

As part of quality assurance activities to ensure learning objectives are met and continuous improvement of the program occurs, students are asked to reflect on their UCRH placements. Students comment on improved multidisciplinary learning, increased understanding of other professions, health systems and rural health inequity.

The program aims to increase social accountability and a positive attitude toward working with disadvantaged rural populations. Students have gained a deeper understanding of system limitations and practices within medical and allied health spaces. Students develop confidence in navigating health systems and service delivery. They also improve their capacity to identify and support those who are marginalized and at risk of poorer health outcomes.

Upscaling of the program has occurred, signaling further recognition of the importance of the program.

Firstly, discussions are occurring with urban clinical educators who are considering the potential expansion of the multidisciplinary student-led patient-based clinical case discussions into urban areas, recognizing the collective wisdom of the multidisciplinary team. It is unlikely that this intention would have crystallized without the expansion of online learning due to the COVID-19 pandemic as the webinars were previously not recorded, and hence, knowledge translation did not occur as rapidly. Secondly, several students have expressed the wish to continue to participate in the multidisciplinary learning sessions after completion of their rural

placements. This has resulted in UCRH alumni now having the opportunity to stay on the email list to allow them to partake in further online multidisciplinary activities.

The program allows for learning from other disciplines and increased understanding of each other's role as students from different disciplines teach other students through the lens of their own professions. This is important to break down current silos in health service delivery and to improve multidisciplinary team work when entering the workforce. This learning complements students' acute care placements. The Zoom platform allows for a flexible mode of learning of workshops and case discussions.

The program, through providing academic support, also assists students to feel part of a community. This is important as research has demonstrated that social isolation during a rural clinical placement is common and reduces rural career intent (Isaac *et al.*, 2018) and is associated with reduced well-being on rural placements, while academic support contributes to student well-being (Saikal *et al.*, 2020). While social isolation has increased during COVID-19, students reported feeling connected. The importance of online debriefing at the start of each Wednesday Program among the students proved to play an important role to feel connected so that they can freely discuss the high and lows of their online placements and any challenges they were facing and find potential solutions together.

Lastly, the program aims to make students more work-ready to assist them in their future careers as the setup of integrating different professions in a safe environment allows for a unique opportunity to individually seek help across the professional spectrum and ultimately trial their future career's work in regard to multidisciplinary work environment.

Challenges

The challenges for the educators when establishing the program online were:

(1) Knowing in advance the audience and who the participants and disciplines would be for each session, as this changes weekly;

(2) The educators had to learn about the Zoom platform;

(3) There were interoperability and policy differences between organizations. Not all organizations had access and were able to use Zoom. For example, the state-based NSW health policy does not allow staff to use Zoom due to privacy concerns, whereas many universities use Zoom as their main online platform. This led to reduced communication abilities between the hospital environment, universities and students during the training program;

(4) It was felt that breakout sessions were hard to manage without administrative support and that information technology (IT) support was needed to ensure high quality online education; and

(5) Partnership agreements and engagement agreements.

Table 2 list some examples of communication methods that were implemented to overcome these challenges that can be used by other programs. For example, challenges were overcome by establishing an online registration system for each of the sessions. This allowed the presenter to know the disciplines and target groups so that the program could be tailored to the needs of the students. An additional benefit was that the organization (the UCRH) now has a record of participants for monitoring purposes. Zoom sessions were accessed securely via passwords. It is recommended for breakout sessions to have an admin support to assist in managing the break out groups and monitor when participants have technical difficulties that need to be sorted in real time so that the educator can concentrate on the learning.

Student-focused content of the program
• Student presentations, examples of remote placement outcomes, including the application of telehealth
• Participation on the Zoom platform allowed presentations from organisations such as the Australian Digital Health Agency informing students about new and existing digital health strategies
• Multidisciplinary patient-based student-led case discussions
• Multidisciplinary student debriefing sessions to allow students to discuss challenges in a safe space and provide solutions to each other
• Shared case studies to enhance the students' application of graduate qualities including creativity, innovation, communication and working as a multidisciplinary team
Rural educator focused
• Structured and *ad hoc* email communications with urban and rural educators
• An online registration process for weekly sessions of health professional student attendees
• Students complete a reflexive formative assessment to identify what they have learnt and to assist the educator to continuously improve the program
• University educators have and are invited to participate in and lead components of the program
Organizational level
• Partnership agreements and engagement agreements with multiple universities
• After the COVID-19 restrictions have been lifted, it is intended that the program will still be offered both face-to-face and via Zoom to allow students from other universities or students who are on a placement in a rural location away from the UCRH to still be able to access the program
• The program will be promoted with other universities

Table 2.
Examples of communication methods used to increase multidisciplinary learning during COVID-19.

While not implemented at this stage due to time constraints when transforming the program to online delivery, it is envisaged that in the future, student projects will be used to develop grant applications to improve rural health care, such as the grants that were developed for aged care.

Proposed guidelines for developing and implementing a multidisciplinary online learning environment

An online learning environment allows rural students to be engaged and participate and learn from the knowledge and experiences of other disciplines while being remote. An integrative literature review (Moehead *et al.*, 2020) identified key factors that most likely create an effective online dementia learning environment (Table 3). These factors align with the principles of the *practice–development approach* in fostering collaboration, inclusion and participation. The program culture allows students to flourish and creates opportunities for active learning and creativity. The program utilizes skilled facilitation through *adaptive expertise* to direct learning to contemporary issues relevant to the current environment and the needs of a variety of disciplines and rural populations. Therefore, these key factors have been translated and applied to the online multidisciplinary learning environment to assist practitioners when designing online multidisciplinary training courses and to increase workforce readiness among health professional students. Extra factors for consideration were identified based on the practical learnings from the authors, including multidisciplinary learning, good facilitation skills, cyber security, organizational support structures, strong partnerships and the health needs of the community.

Discussion

This paper described the experiences and upscaling of an online multidisciplinary education program on rural health and integrated care for health professional students during the COVID-19 pandemic, and guidance for others wishing to implement online multidisciplinary education.

Factors[1]	Guidelines
1. Self-directed/self-paced learning[1]	• Students are self-directed through completing and leading multidisciplinary case discussions at their own pace and within set timeframes • Students choose their own integrated care topics and develop and complete multidisciplinary team-based projects at their own pace within a set timeframe
2. Individualized, based on learner's profile and background[1]	• Students present patient-based student-led case discussions from the perspective of their own discipline to students from other disciplines
3. Interactive[1]	• An online collaboration platform allows the multidisciplinary education program to be interactive. Students can ask questions or use the chat functions
4. Multimodal[1]	• Students read various types of resources, watch videos, attend online meetings and write reflections on their own work based on other students' feedback
5. Flexibility[1]	• Students pick a topic that interests them to increase engagement • Students can jump into real-time multidisciplinary learning sessions or watch the recordings later
6. Accessible[1]	• Students can participate no matter where they are located
7. Consistency of information, repetition, and reinforcement[1]	• Learning is repeated and reinforced through the following processes: (1) Students are informed about national policies or policy directives (information-transfer), (2) students are asked to complete a project in relation to the national policies or directives, (3) students present their project back to other students and receive feedback, (4) students incorporate feedback from their peers and write a 500-word reflection on their learnings
8. Cost-effective and good value for investment both for the learner and system[1]	• The online program allows for increased efficiencies. Consider new partnerships so that the program can be expanded to other rural or urban areas and promote multidisciplinary learning at new universities
9. Measures using questionnaires/feedback/ surveys of satisfaction[1]	• At the end of their placement students complete a survey that will assist in further improving the program • Identify existing data sources to ensure formal feedback about the education program from internal and external sources • Identify informal feedback from students, peers, university partners and the community partners about the program *Example: Student placement quality surveys, peer observation, ad hoc feedback and internal sources such as the Australian Rural Health Education Network Survey*
10. Provides equitable engagement[1]	• Students from anywhere can participate
11. Access to the lecturer who facilitates the program[1]	• An academic lecturer facilitates the program. Students can access the lecturer to ask questions online, email and face-to-face
12. Nurtures critical thinking, reflection and applicability[1]	• Use real-world applications to allow critical thinking about multidisciplinary learning and reflect on the effect on (rural) communities *Example: The School Hand Hygiene Project*

(*continued*)

Table 3.
Proposed guidelines for developing and implementing a multidisciplinary online learning environment

Factors[1]	Guidelines
13. Establishment of a learning community[1]	• Debrief sessions and multidisciplinary project team-based learning creates a sense of a learning community among students from different disciplines
14. Ability for translation into practice[1]	• Projects are marked on application to (rural) practice and are based on real-world problems. This assists students to think of system-based as well as individual patient-level solutions • Community partners join online sessions to provide real-world context *Example, the impact of COVID-19 on older people and social isolation*
15. Multidisciplinary expertise	• Multidisciplinary facilitators require in-depth knowledge of a wide range of disciplines and health systems to allow students to communicate across various disciplines and understand integrated care solutions • The expert has adaptive expertise, whereby the expert is able to distill the complexity of integrated care through continually refining and increasingly sharing patient and system complexity with the students based on their expertise
16. Multidisciplinary learning	• Students identify the top three health priority issues in an area based on local needs assessments • Students identify which interventions are implemented in their placements to improve the priority health issues
16. Good facilitation skills	• Multidisciplinary facilitators need to have good facilitation skills
17. Cyber security	• Online meetings are recorded in accordance with university policies • Recordings are saved to a local drive, not a USB or external hard drive, which is nominated in the online platform recording settings • The local drive is encrypted. The recording is moved to an approved data storage platform and deleted from the local drive
18. Organizational support structures	• Strong administrative and IT support structures are in place to ensure seamless integration of online education
19. Strong partnerships	• Have strong partnerships with a variety of community-based organizations • Have strong partnerships with clinicians from multiple disciplines • Have strong partnerships with multiple universities
20. Health needs of the community	• Provide resources on the health needs of the community • Ensure students share their knowledge and skills to solve the community needs across disciplines

Table 3. **Source(s):** [1]Moehead *et al.* (2020)

The program included the following features previously identified for improving online education (Moehead *et al.*, 2020): self-directed/self-paced learning, individualized approach, based on learner's profile and background, interactive, multimodal, flexibility, accessible, consistency of information/repetition/reinforcement, cost-effective and good value for investment both for the learner and the system, measures using questionnaires/feedback/surveys of satisfaction, equitable engagement, facilitated/access to instructor/mentored, nurtures critical thinking/reflection and applicability, establishment of a learning community and the ability for translation into practice. Other factors identified as important were multidisciplinary expertise,

multidisciplinary learning, good facilitation skills, cyber security, organizational support structures, strong partnerships and meeting the health needs of the community. We propose that programs could use these features as a guide when developing their own courses.

To our knowledge, there is limited information currently available about multidisciplinary rural health learning online. Yet, understanding this form of learning is crucial to inform the development and training of the future rural health professional workforce so that individuals are comfortable to work in multidisciplinary settings and to safeguard a pipeline of rural health professionals to meet rural communities' needs. Salter *et al.* (2020) described how they changed rural-based placements to online due to the COVID-19 pandemic and concluded that their placements were responsive, individualized and supported by strong partnerships. Similarly, for our program, partnerships are key to multidisciplinary education, especially because we need to deal with multiple disciplines, multiple universities and a wide variety of community-based organizations.

Because of the COVID-19 pandemic, we will need to increase the delivery of online learning to ensure sustainability of learning for students. Border restrictions, other movement restrictions, placement cancellations in aged facilities and rural schools, school closures and family commitments such as children not being able to go to school or daycare have severely impacted academics and student' ability to be physically present. This means that students need to have a choice of learning online, independent of time or location, and new solutions need to be offered during disasters. Indeed, other disasters such as bush-fires, flooding and drought also need to be considered when designing future rural placements. Rural Australia will continue to experience natural disasters and emergencies, which will have a continued impact on rural health education and service delivery (NSW RDN, 2021). We have demonstrated that it is possible to continue to offer multidisciplinary learning through a pandemic, and that this form of learning can be applied during other national disasters as well.

Humphreys *et al.* (2018) conducted an evaluation of the university departments of rural health networks across Australia and found that cross-cultural, interprofessional, and simulation training were available across all departments. In addition, it is important to note that a 2020 evaluation of the RHMT Program recommended an increase placements in rural, remote and very remote locations (RA3–5) because 73% of long-term medical rural placements currently take place in regional areas (RA2), as do 56% of allied health and nursing placements and 80% of dentistry placements. Therefore, it is recommended to increase rural placements in more rural and remote regions (KBC, 2020). Our learnings have demonstrated that upscaling and expanding rural placements to more rural areas while still supporting the students is possible.

TBL (Harden *et al.*, 2000) forms an important element of the program to allow students to apply and share their discipline knowledge with other students from other disciplines pertaining to the rural setting and integrated care. *Adaptive expertise* plays a critical role in multidisciplinary education programs as it encourages students to increase their understanding of the interplay between system and patient complexity (Sockalingam *et al.*, 2016) while learning to solve complex problems. The experts increasingly share their knowledge and expertise with the students as students become more comfortable and experienced. We also believe that a *practice-development approach* is ideal in this learning environment to increase understanding and skills in rural health and integrated care, and could be embedded in the curricula for our future health workforce. This will assist in the development of more work-ready students.

Limitations

It is acknowledged that an official evaluation needs to be conducted to measure the sentiment among all students and key stakeholders, but our informal and initial quality assurance feedback cycles demonstrate promising results. Formal evaluations are underway to further improve the program.

Implications

The main implication is that our learnings and the program can be translated to other rural areas to increase multidisciplinary learning among students from multiple universities, different disciplines, and year levels. Collaboration between universities assist rural areas in achieving critical mass to teach students. A rural multidisciplinary online education program can assist in reducing some of the perceived barriers to uptake of rural practice, including lack of knowledge around rural training, limited research opportunities, fear of the unknown and a limited rural training pipeline (Bailey and Pit, 2020). For example, the NSW Rural Doctors Network can provide online education sessions during the program about current and future rural workforce-funded opportunities for students attending online education sessions. Through the program, the students also learn that they can easily undertake (research) projects remotely and away from an urban setting and become familiar with rural communities.

The independent Review into Regional Rural and Remote Education (Halsey, 2018, in KBC, 2020) recommended that regional university centers be created to provide tertiary students based in rural areas online education access and support so that they can complete their studies while remaining in their rural communities. Our program can also assist those students to learn remotely about multidisciplinary rural health training, regardless of their location. Our program can also support the establishment of new student placements within community settings in other small rural towns. We argue that multidisciplinary learning should also be embedded more visibly in university curricula. High-quality multidisciplinary education can still be maintained with the use of online technology.

Conclusion

This paper has provided insight and potential guidelines for the work-integrated learning sector, rural health workforce practitioners, rural clinical schools, universities, policy-makers, and educators who wish to increase rural online multidisciplinary learning and integrated care for tertiary health professional students.

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Corresponding author

Frances Barraclough can be contacted at: frances.barraclough@sydney.edu.au

The effect of COVID-19 prevention methods training given through distance learning on state anxiety level: the case of private sector

Sultan Ucuk
Midwifery Department, Faculty of Health Sciences, Sivas Cumhuriyet University, Sivas, Turkey, and
Gulay Yildirim
Medical Ethics and the History of Medicine Department, Faculty of Medicine, Sivas Cumhuriyet University, Sivas, Turkey

Received 22 February 2021
Revised 3 May 2021
Accepted 28 May 2021

Abstract

Purpose – The aim of this study was to determine the effect of coronavirus disease 2019 (COVID-19) prevention methods training given by distance learning technique on the state anxiety level of the workers of a company serving in the communication sector.

Design/methodology/approach – The sample of this experimental and cross-sectional study consisted of 52 people working in the communication sector. Data were collected using a questionnaire and the state anxiety inventory. Data were analyzed using descriptive statistics, *t*-test, variance analysis, Kruskal–Wallis, Mann–Whitney U and Tukey's test.

Findings – While the state anxiety scores of the workers working in the communication sector were 47.94 ± 4.90 before the training, they were found to be 43.98 ± 5.20 after the training.

Research limitations/implications – As in every study, this study has some limitations. Although a homogeneous sample is tried to be formed since it only covers this group, it should be considered that there is a limitation in terms of generalizability. In addition, the fact that the knowledge score is not measured and the relationship between the knowledge score and the anxiety score is not evaluated should be considered as a limitation. Finally, it is also a limitation that the questionnaire form, which includes measurement tools, is applied online. It is thought that measuring errors can be minimized if questionnaires are applied face to face.

Practical implications – The results of the study showed that the training given to the workers in the communication sector contributed positively to the reduction of anxiety levels. It is important to provide training and support to those with high anxiety levels. After providing effective protection for nurses/midwives under pandemic conditions and preventing their uncertainties, they can contribute to the reduction of anxiety levels by providing training to individuals who serve the society. It is recommended to plan health trainings for the anxiety of other sector workers serving the society and to focus on these groups. Thus, the effective protection of individuals and their service quality will increase and their anxiety may decrease.

Originality/value – Informative support from nurses/midwives can make it easier to control anxiety arising from the COVID-19 pandemic. The results are important in order to draw attention to the anxiety of other sector workers serving the society and the importance of informative roles of nurses. In order to reduce the anxiety levels of workers in different sectors, it is recommended to conduct more supportive training activities and to draw attention to the workers serving the society.

Keywords Anxiety, COVID-19, Nursing, Training

Paper type Research paper

Introduction

Developments in information technologies provide rapid access to information for societies. Health education, which was limited to face-to-face education in the past, has also been transferred to the web environment with the developments in information technologies. Today, developments in satellite, fiber optic, television, radio, computer, Internet and in other information technologies affect the structure and form of education, and lay the groundwork for educators to develop new educational programs and teaching-learning models.

Health Education
Vol. 122 No. 2, 2022
pp. 217-231

0965-4283
DOI 10.1108/HE-02-2021-0030

The tendency to search for health information on the Internet has brought web-based health education to the agenda (Demir and Gozum, 2011). Web-based health trainings have been conducted on many health problems, such as stroke, diabetes, obesity, hypertension, exercises, headache, breastfeeding, breast cancer, and there are studies showing that education and counseling have a positive effect on health outcomes (Avci and Sebahat Gozum, 2018; Chee *et al.*, 2017; Stephen *et al.*, 2017; Hansel *et al.*, 2017; Mumcu and Inkaya, 2020). Demirel *et al.* (2008) in a study on the use of health websites by Internet users within the scope of E-Health found that 94.9% of individuals in their study sought information about health on the Internet, and 30.4% of them made health decisions with the information they obtained and used this information in their interviews with their physicians. In recent years, Turkish studies have reported that web-based health education and counseling provided by nurses have been effective in the participation of pregnant women in regular follow-ups (Genc Rollas, 2019), the glycemic control of patients with type 2 diabetes (Avdal *et al.*, 2011) and the participation of adult men in prostate cancer screenings (Capik and Gozum, 2011).

In the meantime, the epidemic that emerged on December 31, 2019, in the seafood market workers in Wuhan city of China, was diagnosed as "new coronavirus (COVID-19)" (COVID Guideline of Ministry of Health), and was declared as pandemic on March 11, 2020, by the World Health Organization (WHO, 2020a, b). Within the scope of combating the pandemic, face-to-face education was suspended on 16 March 2020 in Turkey, and distance education was started in this process. Prevention plans and community trainings for protection were put into practice in Turkey. Coronavirus Scientific Advisory Board was established by the Ministry of Health in Turkey to combat COVID-19 disease during the coronavirus pandemic. This board prepared posters, brochures, billboards, videos and radio spots for the public. Online training activities and television channels were created to ensure the continuity of training suitable for the development levels of individuals. The spreading rate of the virus was tried to be controlled by making partial or full-time shutdowns at appropriate periods, taking into account the recommendations of the scientific board of the government. Health education is the combination of learning experiences that protect health and help develop behavior change in individuals. The aim of health education is to improve patients' health-related behaviors, to help them cope with diseases and to increase their ability to make decisions about their health (Mayer, 2017; Dekkers *et al.*, 2018; Pinar Boluktas *et al.*, 2019).

In a study conducted on private sector executives, it was stated that only 4% were not anxious about the COVID-19 pandemic, while 68% of professionals were quite anxious. It is emphasized that the biggest reason for this anxiety is uncertainty and not knowing when the virus will fully lose its effect (Prime, 2020).

Anxiety according to the literature is divided into two parts as state anxiety and trait anxiety. State anxiety is defined as "a form of anxiety that arises due to stress arising from environmental conditions, mostly based on logical reasons, can be understood by others and usually depends on the temporary situation experienced by individuals" (Ergin *et al.*, 2016). In these pandemic days, it is thought that there is a significant increase in anxiety and adaptation problems, especially due to the high number of uncertainties (Colgecen and Colgecen, 2020). In addition, the WHO reported that the main psychological impact of this pandemic was increased stress or anxiety to reduce anxiety (WHO, 2020c) and published guidelines containing biomedical and psychological approaches (WHO Regional Office for Europe, 2020). The pandemic is primarily a trauma that threatens the lives and existence of individuals and is distressing for everyone. Epidemic diseases, which are one of the serious stress factors, can cause serious changes in both the lifestyles, behaviors, roles and responsibilities of individuals and the psychology of the societies they live in. With this epidemic process, employees who had to serve the society became more risky than other individuals in the society in terms of the risk of transmitting the disease. In addition, many businesses have been closed to reduce social distancing. Therefore, the private sector switched from full-time to part-time working as a way

of increasing protection from pandemic. According to our observations, it is seen that the workers show signs of anxiety due to uncertainty (Thornhill and Fincher, 2014). The trauma, disaster and crisis unit of the Psychiatric Association of Turkey stated that in order for health policymakers to guide the society, there is a need to produce urgent evidence about the transmission routes of COVID-19, effective prevention methods and the physical and mental effects of the disease (The Psychiatric Association of Turkey, 2020). In this context, our study was planned to determine the effect of COVID-19 prevention methods training given by distance learning technique on the state anxiety level of the workers of a company serving in the communication sector. Further, it is thought that our study will contribute to the literature because it is a guide for the content of psychological intervention methods to be applied in the future, and it is among the first studies carried out during the pandemic.

Methods

Design and sample

The population of this experimental and cross-sectional study consists of 57 people. The sample, on the other hand, consisted of 52 employees from a company serving in the communications sector between May 15 and May 25, 2020, and agreed to participate in the study.

Knowledge

The research data were obtained using the information form and the state anxiety part of the state-trait anxiety inventory.

Personal information form

It was developed by the researcher to gather information about research variables related to workers (Rubin *et al.*, 2009; Jalloh *et al.*, 2018; Sakaoğlu *et al.*, 2020). In addition to socio-demographic characteristics, such as age, gender, family type, there are 27 items in this form that contain questions about COVID-19 protective measures published by Republic of Turkey Ministry of Health.

State anxiety inventory (SAI)

The inventory was developed by Spielberger in 1983 to determine the state anxiety levels of individuals. The validity and reliability study of the inventory was done by Oner and Lecompte (1985) in Turkey. The SAI consists of 20 items and requires an individual to describe how he/she feels at a certain time and under certain conditions. Responses for the inventory assess frequency of feelings "in general": (1) almost never, (2) sometimes, (3) often and (4) almost always. There are 10 reversed items in the inventory. These are items 1, 2, 5, 8, 10, 11, 15, 16, 19 and 20. State anxiety score is calculated by adding 50 points to the difference between the total weighted scores of direct and reversed statements. The scores obtained from the inventory theoretically vary between 20–80 points. It is accepted that there is no anxiety in those who score below 36, mild anxiety between 37–42 points and severe anxiety in those who score 42 and above. The Cronbach alpha coefficient of the scale was determined as 0.83. In this study, the Cronbach alpha coefficient was calculated as 0.77.

Data analysis

Before starting the research, the company managers were contacted and the lists of the company workers and the lists of the dealers they work with were obtained for the preliminary work. The first session consisted of an introduction to the study, obtaining informed consent and sharing the flow chart of the training. Individuals were asked to fill in the information form and SAI which were sent to e-mail addresses of participants. The distance training was carried

out on a day and hour jointly decided with company officials outside of working hours. The training was held in sessions of 40 min each, connecting through the Zoom Video Communications program. In the second and third sessions, training was carried out using both narrative and demonstration methods. In the fourth session, the training was ended by discussing the questions and contributions of the participants and receiving their feedback. The SAI was applied again one week after the distance training ended in line with the expert opinion from educational sciences.

The training content was created by the researchers using the information guides about COVID-19 from the official site of the WHO and the Ministry of Health. Basic headlines of the training content consisted of COVID-19 definition, its prevalence in Turkey and in the world, symptoms, transmission routes, preventive measures, measures to be taken in working life, rules for entering and exiting the house, handwashing techniques, gloves using techniques, mask usage, visor mask usage and sterilization processes, surface cleaning and ventilation.

Ethical considerations

Ethical approval was obtained from Sivas Cumhuriyet University (decision no. 2020–05/04) Non-Interventional Clinical Research Ethics Board, and written permission was obtained from the company where the study was conducted. Informed consent was obtained from the participants. The study was conducted in accordance with the principles of the Declaration of Helsinki. Data collection forms were applied after the informed consent of the participants was obtained.

Evaluation of the data

Data of the study were evaluated by using SPSS program (Statistical Package for Social Sciences/14.0 for Windows). In the data analysis, the percentage distribution for socio-demographic factors, student *t*-test for comparing the averages of two continuous data groups determined by measurement with parametric analysis conditions, Kruskall Wallis variance analysis to evaluate one-way analysis of variance without parametric analysis conditions, Mann–Whitney for data that fulfill parametric conditions for two independent groups and one-way analysis of variance (ANOVA) test were used to determine whether there is a difference between the averages of more than two groups of data and data groups, and to find out where the difference originated from. The chi-square test was used to analyze qualitatively specified data whether the difference between observed and expected frequencies was significant. Tukey's test was used to compare the difference between group averages. In the significance assessment, $p \leq 0.05$ was considered significant.

Findings

In Table 1, it was found that there was a significant decrease in the state anxiety mean scores of private sector workers after COVID-19 training compared to pre-training ($p < 0.01$). While the state anxiety scores of the communication sector were 47.94 ± 4.90 before the training, their state anxiety mean scores decreased to 43.98 ± 5.20 after the training.

Table 2 shows that the pre-training state anxiety mean scores of female workers who attended the COVID-19 training was 47.06 ± 4.81, while it was 42.85 ± 5.69 after the training.

Table 1.
Distribution of state anxiety mean scores of private sector workers before and after the training

	Number	$X \pm$ SD	t	p
Pre-training state anxiety mean scores	52	47.94 ± 4.90	6.578	0.000
Post-training state anxiety mean scores	52	43.98 ± 5.20		

State anxiety mean scores were 49.04 ± 4.89 and 45.34 ± 4.11 for male workers, respectively. Regardless of gender, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 42.521$, $p = 0.000$). While the state anxiety mean score of participants who were middle school graduates was 49.50 ± 1.00 before the training, it was 45.50 ± 0.57 after the training. State anxiety mean scores of high school graduates were 47.25 ± 4.86 and 44.50 ± 5.21, respectively. While that of university graduates was 48.21 ± 5.27 before the training, it was found to be 43.94 ± 5.16 after the training. Regardless of the educational level, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 21.973$, $p = 0.000$). While the state anxiety mean score of the married workers was 48.77 ± 4.91 before the training, it was 46.11 ± 4.01 after the training. State anxiety mean scores of single workers were 47.76 ± 4.93 and 43.48 ± 5.30, respectively. Regardless of marital status, the difference between the pre-training and post-training state anxiety scores of the participants was found to be statistically significant ($F = 19.207$, $p = 0.000$). While the state anxiety mean score of workers with nuclear families was 47.53 ± 4.73 before the training, it was 43.86 ± 5.02 after the training. The same scores of workers with extended families were 50.57 ± 5.53 and 44.42 ± 6.47, respectively. Regardless of family type, the difference between the pre-training and post-training state anxiety scores of the participants was found to be statistically significant ($F = 31.789$, $p = 0.000$). While the state anxiety mean score of workers without children was 48.04 ± 4.94 before the training, it was 43.77 ± 5.31 after the training. State anxiety mean scores of workers with children were 47.28 ± 4.88 and 45.00 ± 4.32, respectively. Regardless of having children or not, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 13.979$, $p = 0.000$). While the state anxiety mean score of participants with chronic disease was 44.80 ± 4.65 before the training, it was 40.60 ± 6.34 after the training. State anxiety mean scores of participants without any chronic disease were 48.27 ± 4.85 and 44.29 ± 4.97, respectively. Regardless of the chronic disease status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 15.847$, $p = 0.000$). The state anxiety mean score of participants who applied to the hospital for any reason in the last month was 49.46 ± 5.37, while it was 44.23 ± 5.32 after the training. State anxiety mean scores of those who did not apply to hospital were 47.43 ± 4.69 and 43.84 ± 5.18, respectively. Regardless of hospital admission status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 40.882$, $p = 0.000$). While the state anxiety mean score of participants who had a positive diagnosis of COVID-19 in one of their relatives was 53.00 ± 1.73 before the training, it was 46.00 ± 2.64 after the training. State anxiety mean scores of workers whose relatives did not have a positive COVID-19 diagnosis were 47.43 ± 4.69 and 43.84 ± 5.18, respectively. Regardless of positive COVID-19 diagnosis status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 40.882$, $p = 0.000$).

Table 3 shows the distribution of state anxiety mean scores of private sector workers according to the sources of information they have about COVID-19. Accordingly, the state anxiety mean score of participants following the news on television was 48.11 ± 3.88 before the training, while it was 42.88 ± 5.61 after the training. State anxiety mean scores of workers following on social media were 50.60 ± 5.01 and 47.40 ± 4.40, respectively. The state anxiety mean score of those following COVID-19 news from the official website of the Ministry of Health was 46.76 ± 5.20, while it was 43.28 ± 4.72 after the training. Regardless of the sources of information about COVID-19, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 38.244$, $p = 0.000$).

Table 2.
Distribution of state anxiety mean scores of private sector workers according to their socio-demographic characteristics and COVID-19 status

	number	%	Pre-training state anxiety mean scores	Post-training state anxiety mean scores	ANOVA results of pre-training and post-training scores
Female	29	55.8	47.06 ± 4.81	42.85 ± 5.69	$F = 42.521$
Male	23	44.2	49.04 ± 4.89	45.34 ± 4.11	$p = 0.000$
			MWU = 277.50	MWU = 253.00	
			$p = 0.300$	$p = 0.137$	
Secondary school graduate	4	7.7	49.50 ± 1.00	45.50 ± 0.57	$F = 21.973$
High school graduate	20	38.5	47.25 ± 4.86	44.50 ± 5.21	$p = 0.000$
University graduate	28	53.8	48.21 ± 5.27	43.94 ± 5.16	
			KW = 1.659	KW = 0.006	
			$p = 0.198$	$p = 0.938$	
Married	9	17.3	48.77 ± 4.91	46.11 ± 4.01	$F = 19.207$
Single	43	82.7	47.76 ± 4.93	43.48 ± 5.30	$p = 0.000$
			MWU = 160.50	MWU = 116.50	
			$p = 0.422$	$p = 0.062$	
Nuclear family	45	86.5	47.53 ± 4.73	43.86 ± 5.02	$F = 31.789$
Extended family	7	13.5	50.57 ± 5.53	44.42 ± 6.47	$p = 0.000$
			MWU = 130.50	MWU = 153.50	
			$p = 0.467$	$p = 0.914$	
Not having a child	45	86.5	48.04 ± 4.94	43.77 ± 5.31	$F = 13.979$
Having a child	7	13.5	47.28 ± 4.88	45.00 ± 4.32	$p = 0.000$
			MWU = 146.00	MWU = 130.00	
			$p = 0.757$	$p = 0.459$	
Having a chronic disease	5	9.6	44.80 ± 4.65	40.60 ± 6.34	$F = 15.847$
Not having a chronic disease	47	90.4	48.27 ± 4.85	44.29 ± 4.97	$p = 0.000$
			MWU = 63.50	MWU = 79.50	
			$p = 0.092$	$p = 0.236$	
Applying to the hospital in the last month	13	25.0	49.46 ± 5.37	44.23 ± 5.32	$F = 40.882$
Not applying to the hospital in the last month	39	75.0	47.43 ± 4.69	43.84 ± 5.18	$p = 0.000$
			MWU = 182.00	MWU = 253.00	
			$p = 0.129$	$p = 0.992$	
Having someone familiar with COVİD-19 positive	3	5.8	53.00 ± 1.73	46.00 ± 2.64	$F = 17.871$
					$p = 0.000$
Not having someone familiar with covid-19 positive	49	94.2	47.63 ± 4.86	43.81 ± 5.27	
			MWU = 16.50	MWU = 56.00	
			$p = 0.025$	$p = 0.491$	

	Number	%	Pre-training state anxiety mean scores	Post-training state anxiety mean scores	ANOVA results of pre-training and post-training scores
Following COVID-19 news on TV	17	32.7	48.11 ± 3.88	42.88 ± 5.61	$F = 38.244$ $p = 0.000$
Following COVID-19 news on social media	10	19.2	50.60 ± 5.01	47.40 ± 4.40	
Following COVID-19 news from official website of ministry of health	25	48.1	46.76 ± 5.20	43.28 ± 4.72	
			KW = 0.657 $p = 0.418$	KW = 2.286 $p = 0.131$	

Table 3.
Distribution of state anxiety mean scores of private sector workers according to having information about COVID-19

Table 4 shows that the state anxiety mean score of participants who followed proper handwashing steps was 47.54 ± 4.88 before the training, while it was 43.86 ± 5.12 after the training. State anxiety mean scores of participants who did not follow proper handwashing steps were 51.00 ± 4.19 and 44.50 ± 5.99, respectively. Regardless of handwashing status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 30.133$, $p = 0.000$). The state anxiety mean score of participants who washed clothes at temperatures more than 60 °C was 47.77 ± 4.74 before the training, while it was 44.50 ± 4.39 after the training. State anxiety mean scores of participants who sometimes washed clothes at temperatures more than 60 °C were 49.85 ± 4.94 and 46.00 ± 4.16, respectively. The state anxiety mean score of those who did not wash clothes at temperatures more than 60 °C were 47.40 ± 6.54 before the training, it was found to be 36.60 ± 6.98 after the training. Regardless of the precautions regarding laundry rules, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 60.907$, $p = 0.000$). When asked whether or not participants shared their personal belongings, the state anxiety mean score of those who did not share was found to be 48.04 ± 4.96 before the training and 43.94 ± 5.27 after the training. State anxiety mean scores of those who sometimes shared their personal belongings were 45.50 ± 2.12 and 44.00 ± 2.12, respectively. Regardless of sharing the personal belongings status, the difference between the pre-training and post-training state anxiety mean score of the participants in the study was not found to be statistically significant ($F = 3.204$, $p = 0.079$). The state anxiety mean score of those who maintained social distancing was 47.79 ± 4.87 before the training, while it was 44.15 ± 5.23 after the training. State anxiety mean scores of those who sometimes maintained social distancing were 48.385.15 and 43.30 ± 5.10, respectively. Regardless of the status of obeying the social distancing rule, the difference between the pre-training and post-training state anxiety scores of the workers was found to be statistically significant ($F = 39.674$, $p = 0.000$). While the state anxiety mean score of those who ventilated the environment frequently was 47.65 ± 4.89 before the training, it was 44.00 ± 5.12 after the training. State anxiety mean scores of the workers who sometimes ventilated their environment were 50.60 ± 4.61 and 43.40 ± 6.18, respectively. Regardless of the ventilation status, the difference between the pre-training and

Table 4.
Distribution of state anxiety mean scores of private sector workers according to measures taken against COVID-19

	Number	%	Pre-training state anxiety mean scores	Post-training state anxiety mean scores	ANOVA results of pre-training and post-training scores
Following proper handwashing steps	46	88.5	47.54 ± 4.88	43.86 ± 5.12	$F = 30.133$ $p = 0.000$
Not following proper handwashing steps	6	11.5	51.00 ± 4.19	44.50 ± 5.99	
			MWU = 76.00 $p = 0.074$	MWU = 115.00 $p = 0.508$	
Washing clothes at temperatures more than 60 °C	40	76.9	47.67 ± 4.74	44.50 ± 4.39	$F = 60.907$ $p = 0.000$
Sometimes washing clothes at temperatures more than 60 °C	7	13.5	49.85 ± 4.94	46.00 ± 4.16	
Not washing clothes at temperatures more than 60 °C	5	9.6	47.40 ± 6.54	36.60 ± 6.98	
			KW = 1.027 $p = 0.599$	KW = 5.701 $p = 0.058$	
Not sharing personal belongings	50	96.2	48.04 ± 4.96	43.94 ± 5.27	$F = 3.204$ $p = 0.079$
Sharing personal belongings sometimes	2	3.8	45.50 ± 2.12	44.00 ± 0.00	
			MWU = 27.00 $p = 0.271$	MWU = 42.00 $p = 0.702$	
Maintaining social distancing	39	75.0	47.79 ± 4.87	44.15 ± 5.23	$F = 39.674$ $p = 0.000$
Maintaining social distancing sometimes	13	23.1	48.38 ± 5.15	43.30 ± 5.10	
			MWU = 224.000 $p = 0.531$	MWU = 230.500 $p = 0.626$	
Ventilating the room at frequent intervals	47	90.4	47.65 ± 4.89	44.00 ± 5.12	$F = 29.696$ $p = 0.000$
Ventilating the room sometimes	5	9.6	50.60 ± 4.61	43.40 ± 6.18	
			MWU = 74.50 $p = 0.180$	MWU = 115.00 $p = 0.938$	
Wearing mask	49	94.2	47.91 ± 5.032	44.10 ± 5.06	$F = 17.871$ $p = 0.000$
Wearing mask sometimes	3	5.8	48.33 ± 2.08	41.33 ± 7.37	
			MWU = 72.50 $p = 0.969$	MWU = 55.50 $p = 0.478$	
Wearing gloves	37	71.2	47.59 ± 5.19	44.43 ± 5.24	$F = 38.255$ $p = 0.000$
Wearing gloves sometimes	4	7.7	49.25 ± 4.92	42.50 ± 3.87	
Not wearing gloves	11	21.2	48.63 ± 4.05	42.81 ± 5.43	
			KW = 0.562 $p = 0.755$	KW = 1.318 $p = 0.517$	

(*continued*)

Table 4.

	Number	%	Pre-training state anxiety mean scores	Post-training state anxiety mean scores	ANOVA results of pre-training and post-training scores
Increasing water consumption	31	59.6	47.00 ± 5.30	43.74 ± 4.97	$F = 47.906$ $p = 0.000$
Increasing water consumption slightly	21	38.5	49.55 ± 3.92	44.30 ± 5.69	
			MWU = 224.50 $p = 0.058$	MWU = 305.00 $p = 0.701$	
Taking vitamin supplements	21	40.4	48.76 ± 4.94	44.38 ± 5.80	$F = 38.887$ $p = 0.000$
Taking vitamin supplements sometimes	12	23.1	47.41 ± 5.56	44.00 ± 5.08	
Not taking vitamin supplements	19	36.5	47.36 ± 4.53	43.42 ± 4.69	
			KW = 0.269 $p = 0.874$	KW = 0.862 $p = 0.650$	
Getting sufficient sleep	24	46.2	48.00 ± 4.52	45.45 ± 4.38	$F = 59.250$ $p = 0.000$
Getting little sleep	18	34.6	48.38 ± 5.67	44.16 ± 4.88	
Getting insufficient sleep	10	19.2	47.00 ± 4.64	39.90 ± 5.72	
			KW = 0.612 $p = 0.737$	KW = 7.617 $p = 0.022$	
Increasing fruit and vegetable consumption	23	44.2	48.13 ± 5.06	45.17 ± 4.62	$F = 48.801$ $p = 0.000$
Increasing fruit and vegetable consumption slightly	15	28.8	47.66 ± 4.59	43.66 ± 5.66	
Not increasing fruit and vegetable consumption	14	26.9	47.92 ± 4.90	42.21 ± 5.29	
			KW = 0.450 $p = 0.798$	KW = 3.27 $p = 0.195$	
Doing exercise	11	21.2	49.09 ± 4.88	46.63 ± 4.61	$F = 34.188$ $p = 0.000$
Doing exercise sometimes	16	30.8	47.37 ± 5.04	44.68 ± 4.61	
Not doing exercise	25	48.1	47.80 ± 4.93	42.28 ± 5.29	
			KW = 0.310 $p = 0.856$	KW = 5.056 $p = 0.080$	

post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 29.696$, $p = 0.000$). While the state anxiety mean score of those who stated that they were wearing a mask was 47.91 ± 5.032 before the training, it was 44.10 ± 5.06 after the training. State anxiety mean scores of the workers who were sometimes wearing a mask were 48.33 ± 2.08 and 41.33 ± 7.37, respectively. Regardless of wearing a mask or not, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 17.871$, $p = 0.000$). While the state anxiety mean score of those wearing gloves was 47.59 ± 5.19 before the training, it was 44.43 ± 5.24 after the training. State anxiety mean scores of workers who sometimes wore gloves were 49.25 ± 4.92 and 42.50 ± 3.87, respectively. The state anxiety mean score of the workers who did not wear gloves was 48.63 ± 4.05 before the training, while it was 42.81 ± 5.43 after the training. Regardless of wearing gloves status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 38.255$, $p = 0.000$). While the state anxiety mean score of those who increased their water consumption was 47.00 ± 5.30 before the training, it was 43.74 ± 4.97 after the training. State anxiety mean scores of the workers who sometimes increased their water consumption were 49.33 ± 3.95 and 44.23 ± 5.55, respectively. Regardless of water consumption status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 47.906$, $p = 0.000$). While the state anxiety mean score of those who took vitamin supplements was 48.76 ± 4.94 before the training, it was 44.38 ± 5.80 after the training. State anxiety mean scores of the workers who sometimes took vitamin supplements were 47.41 ± 5.56 and 44.00 ± 5.08, respectively. The state anxiety mean score of the workers who did not take vitamin supplements was 47.36 ± 4.53 before the training, while it was 43.42 ± 4.69 after the training. Regardless of taking vitamin supplements status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 38.887$, $p = 0.000$). While the state anxiety mean score of the participants who got enough sleep was 48.00 ± 4.52 before the training, it was 45.45 ± 4.38 after the training. State anxiety mean scores of the workers who got enough sleep sometimes were 48.38 ± 5.67 and 44.16 ± 4.88, respectively. The state anxiety mean score of the workers who did not get enough sleep was 47.00 ± 4.64 before the training, while it was 39.90 ± 5.72 after the training. Regardless of getting sufficient sleep status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 59.250$, $p = 0.000$). While the state anxiety mean score of the participants who increased their fruit and vegetable consumption was 48.13 ± 5.06 before the training, it was 45.17 ± 4.62 after the training. State anxiety mean scores of the workers who slightly increased their consumption of fruit and vegetable were 47.66 ± 4.59 and 43.66 ± 5.66, respectively. While the state anxiety mean score of the workers who did not increase their consumption of fruit and vegetable was 47.92 ± 4.90 before the training, it was 42.21 ± 5.29 after the training. Regardless of fruit and vegetable consumption status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 48.801$, $p = 0.000$). While the state anxiety mean score of the participants who increased doing exercise was 49.09 ± 4.88 before the training, it was 46.63 ± 4.61 after the training. State anxiety mean scores of the workers who exercised sometimes were 47.37 ± 5.04 and 44.68 ± 4.61, respectively. The state anxiety mean score of the workers who did not exercise was 47.80 ± 4.93 before the training, it was 42.28 ± 5.29 after the training. Regardless of the exercise status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 34.188$, $p = 0.000$).

Discussion

This study was carried out to determine the effect of COVİD-19 prevention methods training given by distance learning technique on the state anxiety level of the workers of a company serving in the communication sector. It is seen that anxiety behavior against the health threat that caused deaths in the world so far has increased. According to the parasite-stress theory, outbreaks that can cause deaths due to a health threat increase the behavior of "introversion" and "keeping distance from outside communities" (Thornhill and Fincher, 2014).

While the state anxiety scores of the workers were 47.94 ± 4.90 before the training, these scores decreased to 43.98 ± 5.20 after the training. As WHO (2020a) stated, learning the facts, avoiding rumors and misinformation may have decreased the anxiety level. According to the literature, anxiety level is considered high for scores above 42 (Spielberger, 1983; Oner and Le Compte, 1985). Even though COVİD-19 training had a significant effect on reducing the state anxiety level of the workers, it was seen that the anxiety levels of the workers still remained slightly higher. The reason for this is thought to be due to the uncertainty created by the pandemic period. In our study, the anxiety levels of female workers were found to be lower than that of male workers, and the difference between the pre-training and post-training state anxiety mean scores of the workers in the study was statistically significant, regardless of gender ($F = 42.521$, $p = 0.000$). In the study by Wang *et al.* in which they examined the immediate psychological responses in coronavirus disease, they found that women experienced higher anxiety due to more negative experiences of psychological processes, which differs from our study results (Wang *et al.*, 2020). The reason why female participants had lower anxiety mean scores in the present study can be explained by the fact that women are more likely to engage in self-protective behaviors than men, and consequently, their anxiety decreases as they learn anti-virus methods and begin to act in accordance with the rules (Cowling *et al.*, 2020; Lee *et al.*, 2020). Women can benefit more from the training and the impact of training on anxiety by keeping their anxiety more under control.

It was found in the study that after the training, university graduates had the lowest anxiety score, followed by high school and middle school graduates. Results of many studies carried out on anxiety levels also support this finding (Atici and Deveci, 2019). The reason for this is thought to be that the awareness and consciousness level, which increases with education, differentiates the perspectives and expectations of individuals regarding control practices against the pandemic. Those with a high level of education may have better controlled their anxiety by making better sense of the training given.

Regardless of marital status, the difference between the pre-training and post-training state anxiety scores of the workers in the study was found to be statistically significant ($F = 19.207$, $p = 0.000$). Our study results are similar to other study results (Sakaoglu *et al.*, 2020; Tutku *et al.*, 2020).

In the study, the anxiety scores of participants who obtained information about COVID-19 from social media and television were found to be high. In the study of Wheaton *et al.* (2012), it was stated that the constant coverage of the pandemic in the media (social, visual, written) could potentially lead to mass fear, and excessive television watching was associated with fear and anxiety due to this disease. In this context, only obtaining information that provides uncertain predictions about viral threats can serve to increase perceptions of uncertainty and thus anxiety (Jalloh *et al.*, 2018). The level of anxiety may have decreased as the training given reduced these uncertainties.

When the findings regarding the COVID-19 protection measures were evaluated, it was seen that the highest anxiety mean scores of the participants were related to the personal control dimension, that is, the adoption of personal hygiene rules. It can be said that the emphasis on personal hygiene, social distancing and handwashing, which are frequently circulated in the media and social networks, contributes to the formation of this awareness in individuals. In a study conducted by Bostan *et al.* (2020) in Turkey, it was found that

individuals had sensitivity about the COVID-19 pandemic, were not indifferent to the issue, gave importance to the implementation of the decisions taken and the information provided by the media channels, and paid attention to measures such as hand hygiene. In a study by Rubin *et al.* (2009) on whether the swine flu epidemic has caused behavioral changes among individuals in England, Scotland and Wales, 28% of respondents stated that they washed their hands more often than usual with soap and water, 17% started to disinfect the places more where the frequency of touching was high, such as door handle, and 35% of them stayed away from crowded places. In the study conducted by Kwok *et al.* (2020) in Hong Kong, it was seen that the most effective method to protect from the COVID-19 pandemic was to increase personal hygiene practices. It is likely that the importance of individual attitudes and behaviors in such pandemics is understood.

Having knowledge contributes to positive attitude and lower anxiety levels (Mishra *et al.*, 2016). In a pandemic like COVID-19, people's rejection of the seriousness of the situation to avoid anxiety poses a danger in terms of increasing negative consequences in dealing with the pandemic. For this reason, it is important to comply with the recommendations of health professionals and to act consciously. Some suggestions can be made as a result of the study findings. In particular, information about the disease that is constantly coming from social media and other channels may cause more concern. Therefore, informative actions made through official channels should contain anxiety-relieving messages rather than just negative data. Access to medical resources and health services should be further strengthened and improved. Thus, the anxiety of accessing equipments such as masks can be eliminated in the minds of individuals. Therefore, the existence of effective and robust social support and education during pandemic period will reduce the anxiety levels of people and affect their well-being levels positively (Cao *et al.*, 2020). For this reason, the existence of effective and robust social support or training during pandemic periods will positively affect the welfare levels of people. From this point of view, it is seen that it is necessary to fight the virus not only physiologically but also in the context of social psychology.

Conclusion

As a result of the study findings, it was seen that the training contributed positively to the reduction of anxiety in personnel working in the communication sector. Anxiety status is affected by the characteristics of gender, educational status, marital status, family type, presence of chronic disease and having positive for the COVID-19 test in their relatives. In this context, by organizing training programs, individuals' level of anxiety can be reduced by preventing uncertainty. In addition, it is recommended to use the knowledge score as a variable in future studies and to examine the effect of pandemic anxiety on work stress.

Limitations of the study

As in every study, this study has some limitations. Although a homogeneous sample is tried to be created, it should be taken into account that there is a limitation in terms of generalizability of the information obtained. In addition, the fact that the knowledge score is not measured and the relationship between the knowledge score and the anxiety score is not evaluated, should be considered as a limitation. Finally, it is also a limitation that the questionnaire form, which includes measurement tools, is applied online. It is thought that measuring errors can be minimized if questionnaires are applied face to face.

Implications for nursing practice

The results of the study showed that the training given to the workers in the communication sector contributed positively to the reduction of anxiety levels. It is important to provide training and support to those with high anxiety levels. After providing effective protection

for nurses/midwives under pandemic conditions and preventing their uncertainties, they can contribute to the reduction of anxiety levels by providing training to individuals who serve the society. It is recommended to plan health trainings designed to reduce the anxiety levels of workers in other sectors' workers serving the society and to focus on these groups. Thus, this is likely to provide effective protection for individuals, causing their anxiety levels to decrease and their service quality to improve.

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Corresponding author
Sultan Ucuk can be contacted at: sultangercek@gmail.com

Received 5 March 2021
Revised 15 June 2021
16 July 2021
Accepted 19 July 2021

Digital solutions to facilitate education, training and professional support for paediatric oncology and other health professionals in rural and other low-resource settings

Alexandra Martiniuk
The University of Sydney, Sydney, Australia
Julia Challinor
University of California San Francisco, San Francisco, California, USA
Ramandeep S. Arora
Paediatric Oncology Disease Management Group, Max Super Speciality Hospital Saket, New Delhi, India
Sri Andini Handayani
St Jude Children's Research Hospital, Jakarta, Indonesia, and
Catherine Lam
St Jude Children's Research Hospital, WHO Collaborating Center for Childhood Cancer, Memphis, Tennessee, USA

Abstract

Purpose – Globally, cancer represents an increasing proportion of child mortality as progress against infectious causes is made. Approximately 400,000 children will develop cancer, each year, around the world. Only about half of these cancers will ever be diagnosed. In high-resource settings, 80% of children will survive, but only about 30% will survive in low-resource settings. Digital solutions have a valuable role in increasing health professional knowledge, skills and empowerment to diagnose, treat and otherwise care for children and adolescents with cancer. This review sought to identify digital resources that support the training and development of the paediatric oncology workforce in resource -poor settings.

Design/methodology/approach – This paper presents a narrative descriptive review of peer-reviewed publications and digital platforms that contribute to health professionals' education and training regarding paediatric oncology, particularly in rural and other low-resource settings.

Findings – Digital solutions were identified for building communities of practice, facilitating access to information and support and providing access to training, education and supervision specifically for paediatric oncology health professionals. A total of 33 resources are discussed in depth. A quality assessment of the digital resources is provided using the Currency, Relevance, Authority, Accuracy and Purpose (CRAAP) tool and suggestions to improve the quality of resources are discussed.

Practical implications – The authors anticipate that this summary of digital resources for the global paediatric oncology professional community will inform digital health investments and design of digital innovations to meet emerging needs and will have an impact on the workforce in the real world. Ultimately, this work will contribute to an improvement in the diagnosis and treatment of children and adolescents with cancer in resource-poor settings.

Originality/value – This is the first discussion and summary of digital education platforms which educate, train and offer support to health professionals with respect to paediatric oncology. These digital

Health Education
Vol. 122 No. 2, 2022
pp. 232-259

0965-4283
DOI 10.1108/HE-02-2021-0035

platforms are often aimed at, and are essential for, health professionals in rural and other low-resource settings.

Keywords Paediatric, Oncology, Digital, eHealth, Rural, Education, Training, Support, Low-resource settings, Websites, Online, Equity

Paper type General review

Introduction

Childhood cancer in resource-poor settings

Globally, non-communicable diseases (NCDs) represent an increasing proportion of child mortality as progress against infectious causes is made (Patton *et al.*, 2012; Force *et al.*, 2019). Sadly, cancer is a common cause of death in children. Among 5–14-year-olds, cancer is the 2nd cause of death in high-income countries (HICs) (e.g. Australia), the 3rd or 4th cause of death in middle- and low-income countries (e.g. Mexico, India, Tanzania) (Liu *et al.*, 2012). In fact, cancer is the most common NCD in children and is the leading cause of disease-related childhood death in HICs (Cunningham *et al.*, 2018; Khu *et al.*, 2018; WHO, 2020a, b, c).

Globally, each year about 400,000 children will develop cancer although up to half may be undiagnosed (Ward *et al.*, 2019). Thus, approximately 6.7 m children are expected to have developed cancer in the 15-year period from 2015–2030 and an estimated 14 m by 2050 (Ward *et al.*, 2019; Atun *et al.*, 2020). Approximately 90% of these children with cancer live in low- and middle-income countries (LMICs) (Bhakta *et al.*, 2019) and represent more than 84% of the deaths due to childhood cancer globally (Magrath *et al.*, 2013; Atun *et al.*, 2020). According to data from the Global Burden of Disease, in 2017, 82% of the global burden of childhood and adolescent cancer in terms of DALYS (disability-adjusted life years) is experienced in LMICs (Global Burden of Disease Collaboration, 2019). And these cancer figures are likely to be substantial underestimates given the lack of high-quality cancer, and even mortality registries, in most LMICs.

Disparity in childhood cancer care and the WHO Global Initiative for childhood cancer

A 2014 Lancet article states that the "political toleration of unfairness in access to affordable cancer treatment is unacceptable" (Coleman, 2014). Differences in mortality and in the mortality to incidence ratios for childhood cancers are large across countries, even within the same World Bank income category. This indicates that the level of economic development need not dictate childhood cancer outcomes. In LMICs, incredible progress has been made over the last 30 years with respect to childhood cancer diagnosis and outcomes. Currently there is a range of survival from child cancer, depending on the country, the center and the diagnosis–overall approximately 30% of children and adolescents with cancer survive, whereas in HICs the figure is 80% (Lam *et al.*, 2019).

In 2018, the World Health Organization (WHO) Global Initiative for Childhood Cancer recently set an ambitious goal to achieve at least 60% survival globally and save a million children and adolescents with cancer by 2030 (WHO, 2021b). An initial in-depth analysis of the challenges and strategies to achieve this goal are provided in the 2020 Lancet Oncology Commission on Sustainable Care for Children with Cancer (Atun *et al.*, 2020). One consideration is to focus on children and adolescents living in resource-poor settings including rural and remote regions of HICs as well as LMIC, and particularly those living far from major cities where tertiary care centres offering cancer care are located.

Rural and resource-poor settings

A large proportion of the world's population of children and adolescents live in rural areas (IAFD, 2019). Asia and Africa have the largest numbers of children and adolescents, and

Africa's share is predicted to grow dramatically in comparison with the rest of the world. By the year 2050, Africa is predicted to have 37% of the world's children and adolescents and Asia 50% (IAFD, 2019). Approximately 40% of people in Asia Pacific live in rural areas and that figure is 82% in Papua New Guinea and 76% in Cambodia (World Bank, 2019). Overall, 60% of people in sub-Saharan Africa live in rural areas, although the percentage is more than 80% for those living in Burundi, Niger and South Sudan; Ethiopia, the 2nd most populous country in Africa, has 79% rural inhabitants (World Bank, 2019).

We can do better, the knowledge exists and treatment is cost-effective

There is great opportunity to close the disparity in childhood cancer survival between resource-poor and resource-rich countries and regions. Unlike many adult cancers, survival rates are not improved by prevention. Yet, the majority of children and adolescents with cancer can be cured if they receive prompt, effective and complete treatment. The scientific knowledge exists on how to treat childhood cancers to achieve, on average, over 80% cure rates with appropriate and cost-effective supportive care and technology (Bhakta *et al.*, 2013). A systematic review found that the costs per DALYs averted through treatment was much less than the country per capita gross domestic product (GDP); therefore, treatment for childhood cancer is considered very cost-effective (Fung *et al.*, 2019).

To improve survival rates, we need to include digital solutions, like education to apply existing knowledge in more settings. Along with this education, access to essential medicines and technologies is needed, including provision of appropriate supportive care by healthcare professionals who have received specialized training and can effectively deploy or improve quality use of the existing infrastructure and care environment. Notably, the use of digital communication channels such as WhatsApp and Telegram are widely used for knowledge exchange by health professionals in LMIC rather than more equitable and systematic mechanisms for information exchange. This is where the value of digital solutions come in. Digital solutions in health include topics such as artificial intelligence (AI), telemedicine, electronic health records, digital education, clinical decision support, clinical apps and big data analytics. We focus here on digital education providing training content for healthcare providers focused on childhood cancer, per the WHO classification of digital health interventions.

Digital solutions

Digital solutions include e-learning, also called "internet-based learning", "online learning", "computer-assisted learning" and "web-based learning". There are a variety of digital solutions to healthcare learning including various forms of multi-media, webinars, virtual simulation exercises, web-based tutorials, interactive online modules with embedded quizzes and discussion boards. A meta-analysis by Cook *et al.* (2008) stressed that central to the definition of digital learning or e-learning is the use of the Internet and a smart phone, smart watch, tablet or computer to deliver information and interact directly with the learner.

Coronavirus disease 2019 (COVID-19) has shown us that digital solutions can deliver education and training and that harnessing these digital solutions to reach those most likely to be left behind will assist in meeting the WHO goals for childhood cancer by 2030. One distinctive feature of the move to an online world is the decline in the cost and challenge of accessing information. This has led to an increase in information access around the world, which is key to supporting health professional education and training, especially in rural and other low-resource regions, ultimately improving survival globally. Studies from diverse settings as Libya and Australia state that the COVID-19 pandemic has demonstrated that digital solutions can be central and integral to delivery of healthcare education and training and has the added advantage of reaching a newer audience and significantly reducing the

cost of teaching from a logistics perspective (Alsoufi *et al.*, 2020; Martin, 2020). Nonetheless, as acknowledged in WHO's global strategy on digital health (2020–2025) as well as the first G20 report on digital health released in 2020 (Digital Health Taskforce, 2020), it remains important to identify and address remaining digital divides (physical and financial) and advance equity in digital connectivity, including digital literacy and broadband access (WHO Global Strategy Digital Health, 2020). Solutions should also take into consideration the digital health maturity of the local setting. In a first global assessment of digital health maturity in 22 countries across 6 regions, most provided no or limited digital health training to health professionals (Global Digital Health Index, 2019).

Poor cancer survival in rural and low-resource regions could be improved in part by a sufficient, competent, equipped workforce

While there are multiple reasons for poor childhood cancer survival in rural and low-resource regions around the world, paediatric oncology education and training for health professionals is at least one core pillar (Afungchwi *et al.*, 2020; Martiniuk *et al.*, 2017; Faruqui *et al.*, 2019; Poyiadjis *et al.*, 2011; Zabih *et al.*, 2020). Accordingly, a sufficient and competent equipped workforce as part of centers of care and referral networks is the first pillar recognized in the WHO Global Initiative for Childhood Cancer's Cure*All* approach.

With existing and available digital information, the survival and quality of life of children and adolescents with cancer in resource-poor settings can be improved in part, through training and supporting local health professionals (Lam *et al.*, 2019). There is no one resource which provides quality training regarding paediatric oncology for health professionals online.

Therefore, we aimed to provide a narrative synthesis and quality assessment of existing digital platforms that reinforce and further specialize the education, training and provide real-time professional support regarding childhood cancers for health professionals in low-resource settings (such as rural settings and LMICs). We also aimed to highlight digital resources that have been evaluated. Last, we aimed to provide recommendations following the narrative synthesis, quality assessment and ascertainment of any existing evaluations to improve evidence-based healthcare training online.

Methods

This paper presents a narrative review of peer-review publications, grey literature and free (no-cost) digital platforms that contribute to paediatric oncology health professionals' education and training. The authors did not seek to systematically review the literature regarding the effectiveness of digital platforms for education in general or summarize mobile applications (apps) that may be useful for paediatric oncology health professionals. However, where literature evaluated the effectiveness or utility of digital platforms for health professionals regarding paediatric oncology this was noted. We focused on resources on digital platforms for childhood cancer which are in English (some are translated into Spanish and French), and there may be other digital platforms in languages other than English with training, continuing education and support of paediatric oncology health professionals.

Our aim was to identify existing digital platforms that support paediatric oncology health professional education and training as well as provide real-time support in low-resource settings most broadly for English speakers. This is in keeping with the WHO Classification of Digital Health Interventions section 2.8.1 "training content for health providers" (WHO Classification Digital Health Interventions, 2018). We included all resource-limited settings and all areas of cancer care for children and adolescents (from detection, diagnosis, treatment, palliation, survivorship). Given that individual countries around the world may have country-

specific digital solutions for education and training of their paediatric oncology workforce and given this would be too large a scope for one publication we have chosen to illustrate digital solutions which are available globally and present several examples of national or state specific resources. Our search focused on database systems and digital platforms (e.g. websites) supporting health professionals only and excluded those supporting patients or families, or those primarily geared to health system managers. We also excluded paid online courses (common at universities), topics on software, mobile apps, algorithms for clinical care and digital technologies used in treatment (e.g. we excluded health records, telehealth consultations, referral coordination, prescriptions, lab testing, medical management etc.).

Using Google, we searched the websites of known organisations such as the WHO and (PAHO), the International Society of Paediatric Oncology (SIOP) and associated CancerPOINTE, International Network for Cancer Treatment and Research (INCTR), International Children's Palliative Care Network (ICPCN), International Atomic Energy Agency (IAEA) and International Agency for Research on Cancer (IARC), St Jude Children's Research Hospital Department of Global Paediatric Medicine, World Child Cancer (UK and USA) and the Union for International Cancer Control (UICC) (2021). We used the following searches: "@childcancer" to search social media posts on Google from Twitter, Facebook, blogs; we used the search term "Allinurl: child cancer rural" to search URLs with these terms as well, and "Allinurl: pediatric oncology digital", "health professionals child cancer digital" and "health professionals child cancer digital education". We continued by searching Google using the "vs" term with "child cancer urban vs rural". We also explored Medline using the following keywords: health, professionals, child, cancer, paediatric, oncology, digital, website, online, education, teaching OR training, restricted to English and the last 20 years.

We sought to include all sites which were referenced in peer-review publications indexed in MEDLINE. We sought the expertize of the SIOP Chair of Patient, Family and Stakeholder Engagement (co-author Julia Challinor) regarding comprehensiveness of inclusion of sites. We also sought the expertize of the co-director of the WHO Collaborating Center for Childhood Cancer regarding key sites for inclusion (co-author Cath Lam). Where there were multiple sites of one type, we opted to include one example. For instance, not-for-profit organisations such as "Cancer Councils, or Cancer Society" or country or state government specific sites such as "Indian national cancer. . ." or "New South Wales government. . .".

We also aimed to provide a quality assessment of the digital resources found during our search. To do so, we sought a quality assessment tool which had been used previously, for assessing online information for health professionals (and/patients) and had a scoring tool. We note that no single standard exists to measure the quality of medical information online whether that is directed towards patients or health professionals. There are multiple quality assurance criteria which have been developed for the purpose of assessing the quality of digital resources online. Several of these do not have any corresponding scoring tool and other quality assurance measures are very specific (e.g. for patients only or for urinary incontinence for instance).

We initially considered four different quality assessment rating tools. These included Sadvik's General Quality Criteria, QUEST, DISCERN and Currency, Relevance, Authority, Accuracy and Purpose (CRAAP). Our co-authorship team have previously published papers using DISCERN and the CRAAP Tool. For this current publication, we selected CRAAP (Blakeslee, 2004) as our quality assessment tool because it is a tool that has been widely used for different health topics, is used to assess the quality of health information online directed to health professionals and patients, and has a scoring tool (Garcia *et al.*, 2018) so that we could derive a total quality score for each digital resource.

The CRAAP tool contains a total of 23 items/questions. The associated maximum CRAAP test score is 35 (range 0–35). Higher scores on the CRAAP test demonstrate higher quality of online information. The items on the CRAAP tool fall into five domains. These domains are

Currency (timeliness of information), Relevance (information meets needs), Authority (source of information), Accuracy (reliability, correctness) and Purpose (reason for information). The CRAAP scale has the following psychometric properties: overall reliability–Cronbach's alpha ($a = 0.83$), subscale reliability–currency, $a = 0.47$; relevance, $a = 0.48$; authority, $a = 0.68$; accuracy, $a = 0.72$ and purpose, $a = 0.70$ (Garcia *et al.*, 2018).

Analysis

The challenges that digital solutions set out to address and why

Early diagnosis. One of the major goals in childhood cancer is early diagnosis to improve survival. If a cancer is detected early, and treatment can start before the disease burden is large, then survival is possible. However, there must be healthcare professional education and action at the family care (community and primary care) level and the secondary and tertiary health system level to achieve early diagnosis and treatment (Dang-Tan and Franco, 2007). Yet professional education about rare diseases like childhood cancer is often lacking, particularly in resource-poor settings such as rural communities and LMICs.

Rural location. Even in HICs, families who live in rural communities and have a child with cancer cite many challenges to achieving a timely diagnosis and appropriate treatment in their settings (Scott-Findlay and Chalmers, 2001). Research demonstrates that rural living reduces overall five-years-survival for some childhood cancers (Panagopoulou *et al.*, 2018). In one US study, one-third of families reported moving to the city to be closer to where their children were being treated for cancer (Fluchel *et al.*, 2014). Families who opted to remain living in a rural area, missed more days of work and school than urban families and reported greater travel costs and financial sacrifice such as one parent needing to quit their job in order to undertake the necessary travel for treatment (Fluchel *et al.*, 2014). Much of the data from adults show that the further they live from the city, the more progressed the cancer is at diagnosis, leading to a worst prognosis and worse quality of life (Ambroggi *et al.*, 2015). Digital solutions can support rural health professionals with limited exposure to cancer-specific training to access trusted resources and empower them to appropriately triage needs and to seek timely referrals and second opinions to optimize quality care.

The differences in diagnosis and survival from cancer between urban and rural areas are not fully clear for adults (Heathcote and Armstrong, 2007; McCullough and Flowers, 2018). The situation is even less clear for paediatric cancers. A 2008 study from Canada showed that rural living plays a role in late diagnosis for childhood cancers (Dang-Tan *et al.*, 2008). Another, more recent study in the USA in 2018 demonstrated that children and adolescents from rural areas had poorer outcomes from cancer (Lindley and Oyana, 2016). However, there are other studies which do not show poorer outcomes for rural living children with leukemia (Lemieux-Sarrasin *et al.*, 2020). The urban/rural differences in diagnosis and survival for children with cancer likely differs by country and even regions within countries and the differences are likely due to a complex interplay of factors including socio-economic status of the family, access to healthcare, type of cancer, education of health professionals and possibly other factors as well.

Lack of training for the community health workforce. If cancers are diagnosed in a timely fashion, it is possible to improve a child or adolescent's chance of survival. Yet in resource-poor settings, cancer is often diagnosed in advanced stages leading to a poor quality of life and in some cases, more expensive healthcare costs (WHO Guide to Cancer Early Diagnosis, 2017).

Education of health professionals can improve early diagnosis. For instance, an intervention study in Nicaragua found a statistically significant reduction in lag time between symptoms to diagnosis (physician delay) in districts where a specific training program had been delivered on childhood cancer (De Angelis *et al.*, 2012). An inexpensive educational program linked to public health vaccination efforts was also associated with decrease in advanced retinoblastoma

(Leander *et al.*, 2007). Various educational platforms have been successfully deployed for paediatric oncology in LMICs, including use of digital platforms by the African School of Paediatric Oncology, led by the French African Paediatric Oncology Group (GFAOP) to support diploma- and certificate-based training as well as continuing education for providers (Howard *et al.*, 2018). In adult cancers, provider-oriented educational interventions to facilitate earlier cancer diagnosis in rural settings, including a cluster randomized trial in Rwanda focused on breast cancer, have also demonstrated measurable improvement in facilitating service utilization and earlier diagnosis (Pace *et al.*, 2019).

Health professionals need education to recognize childhood cancer signs and symptoms for prompt referrals for a more definitive diagnosis (Abelmabood *et al.*, 2017). As well, community health and primary care workers, general paediatricians and adult haematologists and oncologists need education to recognize paediatric cancers, which are rare diseases in children and therefore uncommon in their practice. In resource-poor settings, the opportunity for this specialist education is rarely available in person. Thus, digital solutions have been filling that gap.

Digital education can be used to address awareness raising for the general public and primary care health professionals to recognize features of childhood cancer that require immediate assessment, improvements in diagnosis and capacity to refer and enable timely access to high-quality treatment (Faruqui *et al.*, 2020; Faruqui *et al.*, 2019; WHO, 2017, 2020a, b, c).

Findings

Digital approaches to provide education and training, and connect and support the paediatric oncology workforce in resource-limited settings

This section provides information on digital approaches to education, and training and digital platforms that connect and enable support of the rural paediatric oncology workforce regardless of a country's income status. *The first part* describes specific paediatric oncology digital platforms that provide further specialized education and training, as well as connect and support health professionals caring for children and adolescents with cancer. *The second part* describes paediatric oncology content available on digital platforms specific to education.

There are multiple digital formats available for the rural paediatric oncology workforce, including general written, audio and video content; specific courses online for credit or continuing education points/units; expert opinion and peer-to-peer discussion for paediatric oncology health professionals. Some digital platforms provide more than one of these formats.

Part 1 Digital platforms specifically for the paediatric oncology health professionals

There are specific digital platforms for paediatric oncology health professionals, and several are aimed at health professionals in resource-poor settings such as rural communities and/or LMICs. These are in Tables 1 and 2 and Supplementry Table A1 are also described more fully in the text below.

Cure4Kids. The most prominent, active and long-standing digital platform is Cure4Kids from St. Jude Children's Research Hospital, USA (Cure4Kids, 2021). This is a free, web-based education platform. As of Feb 3, 2021, Cure4Kids had more than 10,000 active registered users (including doctors, nurses and other health professionals) with 50,000 content views per year and 2000 virtual meetings annually. The Cure4Kids platform includes Oncopedia and is "dedicated to enhancing the care of children who have cancer and other life-threatening diseases in countries around the globe". Nurses searching for material to teach patients and families may take advantage of the St. Jude "Together" website information to support parents and families in multiple languages. As an example, one group within the Cure4Kids

Digital platforms	Links	Purpose from website	CRAAP+ score
Cure4Kids	https://www.cure4kids.org/	Online resource for healthcare professionals in countries around the globe, includes online education and collaboration tools	32.5
The Global Neuroblastoma Network (GNN)	http://www.globalneuroblastoma.net/	Common platform for organizations conducting research and caring for children with neuroblastoma worldwide	28
The Global COVID-19 Observatory and Resource Center for Childhood Cancer	https://global.stjude.org/en-us/global-covid-19-observatory-and-resource-center-for-childhood-cancer.html	Provides a way for providers to collaborate, connect and find the latest information on COVID-19 as it relates to childhood cancer, including a paediatric cancer registry with real-time results	33
St. Jude Global Alliance Online Community	https://global.stjude.org/en-us/	Space for members of the St. Jude Global Alliance to connect, communicate and collaborate	27.5
International Society of Paediatric Oncology (SIOP) Knowledge Centre	https://casehippo.com/spa/courses/catalog/siop/home	Designed for professionals committed to continuing their education and improving patient outcomes	26
Young SIOPE, E-learning in Paediatric Oncology	https://siope.eu/activities/education	Learning opportunities for health professionals, medical students and parent and patient representatives	26.5
CancerPOINTE	https://cancerpointe.com/	A variety of resources related to educating and training the medical professional	31
World Health Organization (WHO) Knowledge Action Portal on NCDs	https://www.knowledge-action-portal.com/	Flagship online community-driven platform launched by the WHO Global Coordination Mechanism on the Prevention and Control of Noncommunicable Diseases (WHO GCM/NCD)	27
The Global Cancer Observatory (GCO)	https://gco.iarc.fr/	Interactive web-based platform presenting global cancer statistics to inform cancer control and research	32
International Children's Palliative Care Network (ICPCN)	http://www.icpcn.org/icpcns-elearning-programme/	Several short courses as part of a longer-term strategy of providing e-learning programmes on children's palliative care	27
The Union for International Cancer Control (UICC)	https://www.pathlms.com/uicc	Offers specialized knowledge for health professionals. Offers: Courses, content library and online events	27

(*continued*)

Table 1. Summary of digital platforms for paediatric oncology health professionals and associated quality assessment rating using the CRAAP score*

Digital platforms	Links	Purpose from website	CRAAP+ score
International Agency for Research on Cancer (IARC)	https://gicr.iarc.fr/about-the-gicr/	IARC coordinates the GICR an initiative focussing on training health staff how to develop cancer registries in resource-poor settings	25
SJCARES Registry	https://www.stjude.org HYPERLINK "https://www.stjude.org/global/sjcares/registry.html" HYPERLINK "https://www.stjude.org/global/sjcares/registry.html" HYPERLINK "https://www.stjude.org/global/sjcares/registry.html"/global/sjcares/registry.html	Hospital-based paediatric cancer registration and reporting system . . . designed specifically for low- and middle-income country contexts	26
*e*cancer	https://ecancer.org/en/about-ecancer	Free online platform which would allow everyone to share and benefit from new discoveries and developments	29
USA National Cancer Institute (NCI)	www.cancer.gov	Free, credible, and comprehensive information about cancer prevention and screening, diagnosis and treatment, research across the cancer spectrum, clinical trials, and news and links to other NCI websites	35
USA American Cancer Society (ACS)	www.cancer.org	Information on cancer diagnosis; treatments and side effects; caregivers and families; cancer statistics, facts and figures; and research	33
Macmillan Cancer Support professionals webpage	https://www.macmillan.org.uk/healthcare-professionals?origin=hp-2020-healthcare-professionals	Tools, opportunities, and information to support health professionals in their role as a health or social care professional	31
Children's Cancer and Leukemia Group (CCLG) Paediatric Oncology Trainees Group (POTG)	https://www.cclg.org.uk/ HYPERLINK "https://www.cclg.org.uk/POTG"POTG	Firstly, to provide education and training in paediatric oncology with a series of guest lectures based upon the expertize within the host institution	NA**
Paediatric Radiation Oncology Society (PROS)	https://intpros.org/resources/teaching-material/	Publicly available professional teaching material as well as member only online resources	28

Table 1. (*continued*)

Digital platforms	Links	Purpose from website	CRAAP+ score
International Atomic Energy Agency (IAEA)	https://elearning.iaea.org/m2/	Open learning management system courses, e.g. nuclear technology and applications, nuclear safety and security, safeguards and verification	23
The Paediatric Oncology Group of Ontario (POGO)	https://www.pogo.ca/healthcare/paediatric-oncology-nursing/#Resources	POGO nursing telepractice guidelines (online training), Clinical guidelines for professionals and satellite manual, and virtual education sessions for professionals	28
Cancer Council Australia Paediatric Oncology section	https://www.cancer.org.au/search/?query=paediatric%20oncology	Cancer Learning professional development platform with learning activities for health professionals, trainees, students and the wider community interested in cancer care	28
Children's Cancer and Leukemia Group UK	https://www.cclg.org.uk/elearning-for-health-professionals	E-learning resources for health professionals caring for children and young people with cancer across the globe building upon the Paediatric Oncology Nurses Forum education	19
New South Wales, Australia government eviQ for cancer	https://www.eviq.org.au/	Free resource of evidence-based, consensus driven cancer treatment protocols and information for use at the point of care. 13 free courses about paediatric oncology, and 54 related educational content	31
Global HOPE Education	https://txchglobalhope.moodle.school/	Provides courses for health care professionals caring for children with cancer and haematologic disorders across Sub-Saharan Africa	12
Project ECHO	https://www.aap.org/en-us/professional-resources/practice-transformation/echo/Pages/About-Project-Echo.aspx; https://sickkids.echoontario.ca/; https://www.echoindia.in/healthcare/; https://www.childrens.health.qld.gov.au/chq/health-professionals/integrated-care/project-echo/	Reduces health disparities in under-served and remote areas in the world. Through tele-mentoring, using a hub-and-spoke knowledge-sharing approach where expert teams lead virtual clinics, amplifying the capacity for providers to deliver best-in-practice care to the underserved in their own communities	22 American Academic Peds ECHO 11 Project ECHO India 12 Project ECHO Queens-land, Australia

(*continued*)

Table 1.

Digital platforms	Links	Purpose from website	CRAAP+ score
Oncolink	https://www.oncolink.org/	Resources and tools for healthcare professionals in oncology	31
Platforms under-development			
Global Initiative for Cancer Registry Development GICR*Net*	https://gicr.iarc.fr/building-capacity/training-via-gicrnet/	The GIRC	31
Research for Health in Conflict partnership (R4HC)	https://r4hc-mena.org/our-work/	Developing capability, partnerships and research in the Middle East and North Africa	29
International Society of Paediatric Surgical Oncology (IPSO)	https://ipso-online.org/	Courses planned	30
Indian National Cancer grid	https://ncgeducation.in/	Educational content and course modules	30

Note(s): +CRAAP Score: Currency, Relevance, Authority, Accuracy and Purpose (CRAAP) Score
*Not an exhaustive list; provides the most common, and most broadly used digital platforms in paediatric oncology as well as illustrative platforms (e.g. not for profit platforms such as Australian Cancer Council)
**NA: Health professional area is a member only area with log in required. Members must be CCLG members. Some information for patients is accessible, however information for health professionals not accessible

Table 1.

platform, the Global Neuroblastoma Network has grown over the past decade to more than 500 members from more than 50 countries.

Offerings in Cure4Kids include narrated seminars, e-learning classrooms, mini courses, Oncopedia chapters, polls and images, as well as resources for online meetings and instructional design support. More than 600 participants have benefited from competency-based regional training seminars. This website also includes nursing education resources including palliative care, basic chemotherapy administration and articles on diagnoses and nursing care in multiple languages. Cure4Kids also hosts monthly meetings for the International Society for Paediatric Oncology (SIOP) Paediatric Oncology in Developing Countries Committee which has 11 working groups and five task forces for professional collaboration and learning.

More recently, St. Jude has also launched an online community (called the St. Jude Global Alliance Online Community) readily accessible on various platforms (including mobile phones and tablets) for timely information exchange on COVID-19 and other critical needs in paediatric oncology, which has welcomed participants from more than 75 countries. Digital global resources offered for paediatric oncology providers to continuously improve care spanning patient, hospital, community, health system and national level needs as part of the SJ*CARES* tool suite are outlined below. A two-year blended, primarily online masters in global child health degree program also incentivizes and supports providers in LMICs to receive specialized training and funded support to implement their training to benefit populations in their home settings (St Jude Education and Training, 2021).

Global Paediatric Medicine and St. Jude Global SJ*CARES* (St. Jude Global Childhood *C*ancer *A*nalytics *R*esource and *E*pidemiological *S*urveillance System (SJ*CARES*) provides a new system to continuously identify, target and monitor the vital health metrics that impact patient outcomes while simultaneously providing the free tools to advance practical understanding of global childhood cancer epidemiology, identify scalable interventions for

Digital platforms	Links	Purpose from website
World Child Cancer UK Pharmacist and Nurse Training Programs	https://www.worldchildcancer.us/news/world-child-cancer-supports-training-paediatric-oncology-pharmacists-ghana	Distance learning platforms for lectures from high-income country experts in multiple countries
SickKids-Caribbean Initiative	https://www.sickkidsfoundation.com/whyweneedyou/partnerforbettercare/caribbeaninitiative	Live videoconferencing technology for meetings, case rounds and educational rounds for healthcare professionals across the Caribbean with those at SickKids and around the world. This initiative also supports specialized paediatric nursing training programs, fellowships at SickKids, and training for Caribbean doctors
French African Paediatric Oncology Group (GFAOP), African School of Paediatric Oncology (EAOP) (Francophone)	https://formation.gustaveroussy.fr/shop/diuop https://formation.gustaveroussy.fr/shop/diuop–diu-oncologie-pediatrique https://formation.gustaveroussy.fr/shop/diuop–diu-oncologie-pediatrique https://formation.gustaveroussy.fr/shop/diuop–diu-oncologie-pediatrique"diu-oncologie-pediatrique	Formal paediatric oncologist training diploma program for Francophone Africa (Diplôme Universitaire de Cancerologie Pédiatrique). Includes e-learning platform and post-graduation online continuing education
The Aslan Project paediatric oncology fellowship training in Ethiopia	https://www.aslanproject.org/	Two-year fellowship program engages renowned international specialists to provide virtual education to local paediatricians in paediatric haematology-oncology and palliative care complemented by local attending physician clinical training

Note(s): *Not an exhaustive list; showing twinning programs with digital platforms for education, training and support of paediatric oncology health professionals in resource-limited settings. These sites are examples of sites with information about training, but the sites themselves do not contain training therefore they have not been scored using the CRAAP tool

Table 2. Paediatric oncology professional twinning training programs using digital solutions*

quality improvement and strengthen health systems and national policies. Tailored training kits designed for providers in low-resource settings are provided, including childhood cancer data registration and a learning exchange platform for health systems and policy research.

Global paediatric oncology organisations. SIOP. SIOP was founded in 1969. SIOP has over 1,800 members including doctors, nurses, other health professionals, researchers and families. It aims to increase knowledge about childhood cancer including a focus on teaching and outreach for all countries globally.

In 2020, SIOP (SIOP, 2021) held their annual conference online with continued digital access to talks and posters for three months after the conference itself for registrants. This includes content eligible for continuing medical/nursing education credits. Highlights included nine keynote lectures on topics such as Brain Tumours in Infants, Genomic Guided Radiotherapy for Children and The Imperative to Listen to the Child's Voice in Paediatric Oncology. Nine symposia gathered experts to discuss topics such as Immunotherapies for Solid Tumours and (Radiotherapeutic) Management of Craniopharyngioma. A professional

debate on stem cell transplantation in neuroblastoma and several "Meet the Expert" meetings offered participants cutting edge learning in their home setting on their own time schedule.

In addition to moving their annual conference online, SIOP hosts other digital solutions for education and training, including SIOP Paediatric Oncology in Developing Countries (PODC), the SIOP Knowledge Centre (SIOP, 2021) with recordings from past conferences and courses on topics such as genetic testing and high-dose methotrexate toxicity management (some are accredited), SIOPE E-learning in Paediatric Oncology together with the European Society for Paediatric Oncology (ESO) and an interactive webinar on difficult cases with the European Reference Network for Paediatric Oncology (ERN PaedCan) and Young SIOPE. SIOP also hosts the *P*aediatric *O*ncology *I*nternational *N*etwork for *T*raining and *E*ducation (CancerPOINTE) under the PaediatricPODC Education and Training Working Group. This website includes professional podcasts, learning resources and a list of training opportunities and expert mentors.

World Child Cancer and twinning programs. World Child Cancer is a not-for-profit non-governmental organization (NGO) aiming to close the gap in childhood cancer care globally. It was founded in 2007. It has headquarters in the UK, USA, Netherlands and program offices in 13 countries. Partners of SIOP include the World Child Cancer Program UK and the World Child Cancer program USA which also support paediatric oncology health professionals in low-resource settings. In our personal communication with the Program Director of World Child Cancer, UK, we have verified that their teaching is now digital. For instance: the paediatric oncology nursing program partnership between Sick Children's Hospital in Edinburgh to Accra, Ghana (Korle Bu Teaching Hospital) (Ghana Program, 2019). Currently, a one-year certificate program in paediatric oncology nursing is being conducted in Accra with visiting nursing faculty online from North American and European experts to complement the local faculty. Another example of a partnership which includes digital education is the SickKids Hospital (Toronto, Canada)-Caribbean Initiative. This is both an in-person and digital collaboration to improve the diagnosis and care of children with cancer and serious blood disorders in the Caribbean (Reece-Mills *et al.*, 2017) and includes the Paediatric Haematology/Oncology Nursing Education Program (PHONEP, 2019). This project is a collaboration between the SickKids and the University of the West Indies and has graduated 25 nurses in three years from five partner islands as of Dec 2019.

WHO Global Initiative for Childhood Cancer with the Knowledge Action Portal (KAP). The WHO Global Initiative for Childhood Cancer, launched in Sept 2018, aims to improve outcomes for children with cancer globally. On International Childhood Cancer Day this Feb 2021, the CureAll Children with Cancer technical package was launched. Among the core tools of this technical package, a Knowledge Action Portal hosted by WHO now enables digital access for program managers in noncommunicable diseases and other colleagues to connect with vetted resources in childhood cancer, translated into six United Nations languages (WHO Knowledge Action Portal, 2021a).

Union for International Cancer Control (UICC). Based in Geneva, the UICC is an NGO bringing together approximately 1,180 member organisations in about 170 countries. UICC was founded in 1933. The UICC e-learning platform has existed since 2014. This digital education platform is sought after for its courses. In 2020, the UICC online learning hub took applications from 1,000 applicants hoping to learn via the UICC online courses. In the end, 294 participants from 65 countries were selected.

IARC. IARC is the cancer agency of the WHO. IARC was founded in 1,065 with the aim to promote international collaboration in cancer research and currently has 26 member countries. At IARC, the Global Cancer Observatory (GCO) is an interactive web-based platform presenting global cancer statistics to inform cancer control and research. This platform offers a childhood cancer information system and International Incidence of Childhood Cancer. This digital platform makes freely available: ICD-10 (2010), Global

Initiative for Cancer Registry Development, Cancer Registries Portal, Data reports for Central and South America and other documents. Several free software packages are also available for cancer registry set-up. This interactive web-based platform facilitates paediatric oncology professionals in accessing the latest data for various purposes, including research, education and advocacy. IARC also coordinates the Global Initiative for Cancer Registry Development (GICR) is an initiative focussing on training health staff how to develop cancer registries in resource-poor settings. IARC Regional Hubs for Cancer Registration, in collaboration with countries in the Hub region and partner organizations, are developing course materials to improve access to educational materials through the GICRNet. This regional partnership model coupled with a digital education platform leverages on existing expertize and peer-to-peer networking to build local capacity.

International Agency for Atomic Energy (IAEA). The IAEA, created in 1957, is an inter-governmental organization aiming to increase scientific collaboration in the nuclear field. Important mandates include working towards safe and peaceful uses of nuclear science. IAEA provides training and equipment for radiation oncology (diagnostic imaging as well as radiotherapy) and for paediatric cancer services. The IAEA is currently working with St Jude Children's Research Hospital to create a virtual library of childhood cancer cases for paediatric radiation oncologists globally.

*ecancer. e*cancer, founded in 2007, provides an online and free access to resources on every cancer type and treatment. Learners can access open-access research resources to facilitate knowledge sharing, video resources (e.g. 8,000 videos) and conference coverage, which help improve clinical practice or research. Many resources are available in Spanish in addition to English.

Cancer institutes and cancer councils and cancer specific not-for-profits. There are multiple not-for-profit organisations which provide digital education, training and support of paediatric oncology health professionals. Here, we provide several examples. For instance, Cancer Council (Australia) has online digital learning with three sections about paediatric oncology (Warning Signs of Cancer in Children, Children's Cancers and Diagnosing Children's Cancers), the Cancer Council Victoria in Australia also hosts courses for paediatric oncology nurses and videos for health professionals aimed towards the primary care doctor. The USA National Cancer Institute has comprehensive healthcare professional information on childhood cancer in English and Spanish as does the USA American Cancer Society and Macmillian Cancer Support and Children's Cancer and Leukemia Group (CCLG) in the UK. Australia Canteen has resources specifically for teenagers and young adults (12–25) with cancer and health professionals in English. The Paediatric Oncology Group of Ontario (POGO) in Canada has a satellite manual to help children return to their regional and rural communities for care. This information was created by a multidisciplinary team of health professionals including nurses, psychologists, pharmacists and physicians to support community healthcare for children and adolescents on treatment for cancer. POGO also hosts the paediatric oncology education portal with several videos of past conference talks on the site.

Country-specific digital solutions (for example: India). There is an Indian-specific digital platform for supporting the education of oncology professionals called the National Cancer Grid where education content is slowly developing. The National Cancer Grid offers monthly virtual tumour boards for paediatric cancers. The Paediatric Haematology/Oncology community in India does weekly teaching rounds using Zoom software and then shares the content on its private YouTube channel.

Part 2 Paediatric oncology specific content on digital platforms for education

Moodle. Moodle stands for Modular Object-Oriented Dynamic Learning Environment. A Moodle is an open-source learning platform which means the user can tailor it to their

needs. Moodle is web-based and has mobile compatible interfaces that enable anyone to make an online course with functions such as quizzes. Moodle has been used in paediatric oncology to support the training of health professionals in resource-poor settings. For instance, a program called Global HOPE developed a set of courses using the Moodle platform. The Global HOPE program teaches basic principles of nursing care for a child with cancer and has been implemented in Malawi, Uganda and Botswana. Global HOPE uses the Moodle to teach using a modular approach and core competencies are established for each module. Zoom and WhatsApp are then used to reinforce the independent learning done over the Moodle course content (Hockenberry *et al.*, 2020). CancerPOINTE also includes this Global HOPE Moodle in its list of contents. Many other courses made on Moodles are associated with universities and are not freely available.

Project ECHO. Project ECHO stands for Extension for Community Healthcare Outcomes. Project ECHO uses tele-mentoring where expert teams lead virtual clinics aiming to reduce health disparities in under-served and remote areas. In Project ECHO multipoint videoconferencing connects local healthcare workers with specialists at a hub site.

Data published in the New England Journal of Medicine about the first use of Project ECHO in 2011 (albeit for Hepatitis C) showed that patients who received care from healthcare professionals who were mentored over Project ECHO had outcomes as good or better than those treated at specialized hospitals (Arora *et al.*, 2011). ECHO sessions are typically held weekly or fortnightly and include didactic teaching and case presentations and discussions (Doherty *et al.*, 2021). Multiple locations have adopted the Project ECHO concept for paediatric oncology, for instance, Sick Kids Hospital in Canada and CanKids KidsCan in India. There are also ECHO superhubs such as the American Academy of Paediatrics ECHO superhub which is the paediatric training arm of the ECHO Institute.

Universities. Some universities have free content regarding cancer for education aimed at health professionals, for instance, Oncolink, which is an e-learning program from University of Pennsylvania, USA. This e-learning site contains learning modules related to child and adult cancers. The site reports that they trained and graduated the first Tanzanian oncology nurses in 2012.

Governments. Some governments provide free content regarding paediatric oncology for health professionals. For instance, in Australia the state of New South Wales (NSW) has the digital platform called NSW EviQ. This platform currently offers 13 free courses about paediatric oncology and 54 related other educational content such as courses on infection control or palliative care.

Quality assessment and evaluation of digital solutions for health professional education and support in regards to paediatric oncology

We conducted a quality assessment of each of the digital resources listed in Table 1. This was done using the CRAAP tool with an accompanying, previously published, scoring rubric. For the resources included in this paper, scores ranged from a high of 35 points to a low of 11 points (CRAAP was not applicable for one site, so it received a NA score). The average score across 33 digital sites was 26 points. The resources listed in Table 2 were not assessed for quality as these are information sites indicating where twinning programs exist (for instance Sick Kids Hospital pairing with a hospital in the Caribbean) and the digital site itself does not aim to support or train health professionals.

We observed that some digital resources have broad use, for instance, to inform and/or teach as well as to provide content for patients, carers and health professionals. An example of this is the platform launched by the WHO Global Coordination Mechanism on the Prevention and Control of Noncommunicable Diseases (WHO GCM/NCD). Quality assessment tools for digital resources, such as the CRAAP, exist for more singular use.

For instance, CRAAP asks if the digital resource is for patients or health professionals. Other quality assessment tools are for patients only. Where a digital resource had multiple aims, we assessed the training sections for health professionals.

It was also observed that even in some active resources, e.g. SIOP, some links no longer work and thus these digital resources received a lower score on the CRAAP quality assessment. For instance, at the digital resource Young SIOP if the user selects "Programme website", an error message is returned and no content is available.

For some resources, a login is required to access any content, for other resources a login is required to add to discussion boards but access to resources does not require an account or a log in. For some discussion boards, the date was indicated and the evidence being discussed was verifiable (for instance citations of peer-reviewed papers posted alongside the discussion) and the name and position/expertize and contact details of the poster were indicated (for instance, paediatric oncologist specialist in lymphoma, Professor at Institution, Country). However, for some sites the discussion did not contain these key details. These sites received a lower quality score.

Quality assessment scores for digital resources can change over time, either increasing or decreasing as new content is added or old content removed. For instance, the IARC site indicated the intention to launch new sections so the score for this digital resource may change in the future.

None of the digital resources that we included have been previously evaluated, with results in a peer-review publication. To date (June 2021), there are no peer-review publications indexed in Medline which evaluate digital resources regarding childhood cancer for health professionals. There are publications evaluating digital resources for cancer for patients and their families however there are no peer-reviewed, published, evaluations of digital resources about paediatric oncology for health professionals.

Discussion

How digital solutions improve access to education and support for the rural paediatric oncology workforce, their key features, and benefits

Our review identified 34 digital resources, of which 33 could be rated for quality. Of those that were rated, only 12 resources received a rating of high quality, 30 or above. Based on the reflections of our author team, the key features of digital solutions which improve access to education and support for the rural paediatric workforce are accessibility, timeliness, free/open-access and comprehensiveness. Digital solutions are accessible to all the health workforce with an Internet connection on a mobile phone, tablet or computer. These digital programs can be accessed at any time of day. These digital solutions are timely, offering up-to-date information and education as well as real-time contact with paediatric oncology health professionals in other countries for specific questions.

Findings from our quality assessment of key digital resources point to several specific recommendations to improve digital resources for health professionals seeking to train and/or gain support regarding paediatric oncology. To begin broadly, there is no one ideal quality assessment tool to score digital resources, and while the CRAAP tool was the best suited tool for the purposes of this paper, it could be improved. A valid and reliable quality assessment tool (with a scoring rubric) for digital resources aiming to train and/or support health professionals is needed. This is likely to assist in improving the overall quality of digital resources for health professionals.

With respect to recommendations to improve digital resources themselves, the quality of resources is likely to improve where the resource makes clear who the audience and what the intention of the resource is, for the site as a whole or for particular sections. Several resources

had content aimed to both health professionals and patients and therefore the depth and comprehensiveness of the information is limited for health professionals.

Several further specific recommendations can be made to improve the quality of digital resources for health professionals. These include placing an originated date (date the resource first began), as well as a "last updated date" for the site as a whole as well as for unique tabs, discussions and so on. Contact details should be provided where possible for the organisation as a whole, as well as for separate sub-groups and individual writers/posters. High quality sites will indicate, particularly for professional opinion sections or discussion boards, an indication of the background, skills, workplace of the poster/writer and that this is verifiable (by, for instance, searching their name on their institutional website) as well as when the content has been reviewed and by who—this was rarely done/available on existing sites. Resources and writing should be dated and cited.

For those digital resources requiring a log-on to enter the site, these sites will ideally provide an example of the content available without login so the consumer can better understand the scope and sources. Some digital resources aiming to train health professionals may be able to offer continuing professional development (CPD) points for some health professionals, and this will be an advantage.

Online platforms for health professionals in resource-poor settings are crucial for training and support. They offer flexibility and access where it may not otherwise be possible due to time and travel costs (Paliadelis *et al.*, 2015). On the other hand, in many LMICs as well as in rural areas in HICs, Internet connections are unstable and can be cut off entirely in times of political conflict. Data download charges when using mobile technology to access digital content can be costly for healthcare workers, such as nurses in particular as they have low salaries and often cannot afford smart phones. Studies have shown that in resource-poor settings, tablets and laptops are prone to being lost, stolen or broken and repair services are non-existent or poor. Humidity in some resource-poor settings without air-conditioned buildings wreaks havoc on technology hardware. Healthcare professionals who are working two jobs or have long travel to work on public buses, may not have the time to access digital resources. Thus, websites with downloadable PDFs can be valuable since the material can be printed during Internet access times, or at the hospital, and shared among teams caring for children and adolescents with cancer.

The main digital platforms for training and support of paediatric oncology physicians are highly interactive, involve problem-solving and application of knowledge, and align to the resources and infrastructure available to these professionals (Cook *et al.*, 2010; Forsetlund *et al.*, 2009; Lewis *et al.*, 2014; Lister *et al.*, 2014). Digital platforms for nurses in paediatric oncology are less aligned, if at all, with the infrastructure available on the ground for nurses working in resource poor settings. Previous research shows that the methods currently being used on the existing paediatric oncology digital platforms are known to expand knowledge and improve practice. These methods include real-time seminars, discussion boards, videos and photo resources that emphasize the local health professional's situation as demonstrated in the evaluation of a Canadian project on a psychosocial oncology web-based program (McLeod *et al.*, 2014).

Digital responses to COVID-19. Based on our author observations, a number of digital platforms have responded to COVID-19 to assist children with cancer. This is particularly evident on the St Jude/SIOP Global COVID-19 Observatory and Resource Center for Childhood Cancer (Global St Jude COVID-19 Resource Center, 2020). Globally, COVID-19 is threatening the care of children with cancer and the safety of the health professionals as well. Striking during the second year of the WHO Global Initiative for Childhood Cancer, COVID-19 is likely causing a major backward slide to the progress made towards equity in childhood cancer survival globally. The St Jude/SIOP COVID-19 Observatory is an online data repository which has allowed for an immediate multidisciplinary clinical response by

childhood cancer experts (Sullivan *et al.*, 2020). The burden of COVID-19 upon paediatric oncology systems is even greater for those in low-resource settings and has made the need to share information greater than ever.

SIOP, Children's Oncology Group (COG), St Jude and leads from SIOP Europe, Children's Oncology Group (COG), and SIOP-PODC are providing online frameworks to support paediatric oncology health professional decision-making during COVID-19. These frameworks suggest diagnostic and treatment plans, taking into account the COVID-19 pandemic situation, for the six most curable childhood cancers already selected by the WHO Global Initiative in Childhood Cancer program, and Childhood Cancer International (Sullivan *et al.*, 2020). COVID-19 modified solutions being suggested include: providing families with maintenance oral chemotherapy and engaging in clinical follow-up through virtual means (video calls) to protect the child as well as the health care worker (Sullivan *et al.*, 2020).

This St Jude/SIOP Global COVID-19 Observatory and Resource Center for Childhood Cancer (which is for paediatric oncology health care professionals) has several main areas: a resource library, a collaboration space to connect with other healthcare providers and a COVID-19 registry of data regarding COVID-19 in children with cancer. There is also a weekly webinar available on the site. Modified treatment regimens are available on the site. For patients and families there is a separate site for COVID-19 and child cancer resources.

There is an urgent need for clinical data to understand how COVID-19 is impacting children with cancer globally. Therefore, St Jude Global and SIOP have created a global COVID-19 childhood cancer registry online at this Global COVID-19 Observatory and Resource Center for Childhood Cancer. This is an example of how digital platforms cannot only support, but also include clinicians from resource-poor settings, in the development of content. This data center is available for clinicians worldwide to report any child under their care with cancer who is also diagnosed with COVID-19. The clinical data entry form is freely available on the web using the web-based data capture tool REDCap. Then, using Microsoft Power BI the website illustrates, in real-time, analytics related to the data entered into REDCap. This includes real-time digital presentation of COVID-19 severity by underlying cancer diagnosis, management data such as hospital length of stay, COVID-19 treatments used, respiratory support required, cancer treatment modification type and length and patient status at follow up. For instance, currently the data reports on 47 (4%) children with cancer who died due to COVID out of a total of 1,438 cases in the database, with an additional 27 deaths due to "other" reasons (2%). This site is freely available to support the continuing education of paediatric oncology health professionals with regards to the clinical characteristics, treatments and outcomes of children with cancer who have also been diagnosed with COVID-19. As of 30/01/2021 in this database there were 47 countries reporting on 1,438 positive COVID-19 cases in paediatric oncology patients.

There is also a similar digital resource platform from the UK called the UK Paediatric Oncology Coronavirus Monitoring Project (POCM Project, 2020). It aims to track paediatric oncology patients who have tested positive for COVID-19 across the UK. However, this website provides only one data analysis summary from May 2020 which was before the COVID-19 variants of concern arose and thus its usefulness is now uncertain. This digital site demonstrates how important it is for platforms to remain up to date to remain relevant and useful.

The St Jude/SIOP Global COVID-19 resource centre is also being used to support online case discussions, and the resource centre also has videos "from the frontlines", papers and online discussions about COVID-19 in patients who also have childhood cancer. The Resource Section of the Global COVID-19 Observatory and Resource Center for Childhood Cancer provides access to full peer-review published papers regarding COVID and child cancer organized into clinical characteristics and outcomes, treatment, palliation, surgery and procedures, transfusion, radiotherapy, nursing fact sheets, impact on cancer care and delivery.

The facilitators and barriers of successful digital education and support for paediatric oncology health professionals

In the sections that follow our author team reflect on the facilitators and barriers of successful digital education and support for paediatric oncology health professionals. The WHO Report on Digital Education for building health workforce capacity presents a review of online education for health professionals, not specifically paediatric oncology (WHO, 2020a, b, c). In this report, the findings from 93 studies are summarized, noting that digital education already plays an important role in training medical doctors, "significantly improving learning outcomes compared with self-directed or face-to-face learning" (WHO, 2020a, b, c). Although the research studies summarized in this report were said to be generally of poor quality, the summary of findings indicated that blended learning is more effective at improving (practical, hands-on) skills and that digital education plays an important role in self-directed knowledge gain. The facilitators and barriers to the success of digital education and support for paediatric oncology health professionals are outlined below.

Facilitators of successful digital education. There are multiple facilitators for successful digital education as noted in several reviews. The increasing availability, and reduction in price for computers and mobile phones, as well as Internet connectivity, facilitates successful digital education. In a study of online education for handwashing in a paediatric oncology centre in Guatemala, a key feature of successful outcomes from the digital education was that the health professional had access to a computer with an Internet connection and used it at least weekly (Gonzalez *et al.*, 2016). Having taken previous education over the computer was not required for successful outcomes in the Guatemala study and all participants thought that e-learning was as effective as in-person learning; nevertheless, doctors were more prepared for digital education than nurses in this study (Gonzalez *et al.*, 2016).

Another one of the most important features of successful digital education is that the education being provided in based on evidence, both in terms of content as well as format of delivery. One review of 19 studies found key facilitators were peer-to-peer interaction, support from peers and instructors, being tested on knowledge, the way the digital platform is designed and using real world case studies (Carroll *et al.*, 2009). Cook *et al.* (2010) then conducted a systematic review of the literature regarding health professionals (including students and animal health) use of Internet-based learning. The authors found that facilitators of improved learning using digital platforms were programs that were interactive, had practice embedded, had repetition and feedback. Cook *et al.* recommended caution about generalization due to inconsistency in their findings. A more recent review, completed in 2020 and published in the WHO Digital Education for Building Health Workforce Capacity report also discussed facilitators of successful digital education being the ability to customize to the learner's needs and abilities and the ability to make the learning interactive (WHO, 2020a, b, c). Digital education generally has the benefit of allowing the student to learn at any time, pace and place.

Other facilitators of successful digital education include opportunities to obtain continuing education certification or points/units, aligning the digital education with professional registration, partnerships behind the digital platform facilitating broad learning especially if led from multiple countries (WHO, 2020a, b, c). Further facilitators discussed in a further review of online medical education include: incentives and rewards for the site developer for the time which is needed to modify content and teaching process when delivering education online, improved institutional support and positive attitudes from management and peers (O'Doherty *et al.*, 2018).

For paediatric oncology, digital platform facilitators likely also include adequate and sustained funding to maintain the platform, the involvement of senior respected paediatric oncologists and allied health providers, regular addition of new and updated content, free access for users and direct contact (communication chat boards etc) with global experts and peers experiencing similar oncology issues, health service setting, country or culture. A paper

by Gillian *et al.* (2018) which focused on e-learning for radiation oncology, discussed that a benefit and therefore also a facilitator of digital education is the ability to share resources in building and maintaining a digital platform for learning–across education centres and training programs. An online paediatric palliative care education program found that facilitators to participation included convenient session timing and duration, ease of access and reminder e-mails (Doherty *et al.*, 2021). A third study about e-learning to implement guidelines regarding fertility for adolescents and young adults with cancer found that a facilitator of success was sharing strategies within the online learning modules on how to initiate fertility conversations with other providers (Vedaparampil *et al.*, 2016). Finally, online learning programs will facilitate successful outcomes if they are culturally relevant and align with the healthcare realities of a particular country or setting (Doherty *et al.*, 2021).

Barriers to successful digital education. The key barrier to successful digital education is Internet connectivity (Doherty *et al.*, 2021), which can be patchy or non-existent in some resource-poor settings, although this is changing rapidly. Of course, the health professional needs to have a digital tool to engage (such as a computer or smart phone) and some people do not have the technology skills or the funds to afford such device. The lack of information technology (IT) support can also be a barrier to successful digital education. The time to engage in online learning/training can also be a barrier in resource-poor setting and this may be a common issue since the proportion of health professionals per capita is much lower than in well-resourced settings (Doherty *et al.*, 2021; WHO, 2020a, b, c).

Other potential barriers to digital learning, training and support include the need for the individual to be motivated to undertake such opportunities and be motivated to engage in interactive discussions online which are critical for learning (Doherty *et al.*, 2021). Health professionals may also feel lonely in their learning and their clinical practice where there may be few other health professionals in their specialist field, or at all, and this is particularly true of rural and other resource-poor settings (Gillian *et al.*, 2018). Barriers to digital learning can also include the lack of peer interaction to support the learning and lack of immediate support from teachers and peers in a problem-solving context when the education does not fit the situation perfectly. This is a particular barrier which some of the current digital platforms for the education and support of paediatric oncology professionals have tried to address by having frequent visits and a sizeable number of people using the digital platforms.

A final important barrier to the ability of digital platforms to contribute to the training and support of paediatric oncology health professionals is the time and cost required to develop a platform and continue to provide updated content and to have live webinars, question/answer forums and host live or recent clinical "rounds". The impact of COVID-19 on digital and virtual education for healthcare professionals has been positive as the world pivots to move learning online. As well as negative, particularly for countries which had patchy electricity and Internet, little online learning in place prior to the pandemic and then little training or institutional support to implement rapid and new digital platforms and corresponding content for learning in the wake of the pandemic (Farooq *et al.*, 2020).

Global efforts to reduce childhood cancers

This paper is opportune because on Feb 15, 2021, on International Childhood Cancer Day, the WHO Global Initiative for Childhood Cancer launched the Childhood Cancer Technical Package and Cure All Framework. These are technical documents to accompany the Sept 2018 WHO announcement of the Global Initiative, which aims to approximately double the current global cure rate and achieve a 60% survival rate, or greater, for childhood cancer by 2030. This 2030 goal intentionally aligns with the Sustainable Development Goals (SDGs) in particular, SDG target 3.4 to reduce premature mortality from noncommunicable diseases by one-third by 2030. Reaching this goal will require increased awareness of childhood cancer, increasing access to medicines and technologies, health financing and insurance coverage

and increasing the capacity and knowledge of health professionals as well as responsive health systems and robust policies within countries to provide childhood cancer care.

Digital health is helping leverage solutions that are scalable. Digital health assists in going beyond the traditional high-income/low-income (low resource) twinning activities in paediatric oncology but also supports regional networks and low-resource to low-resource setting partnerships, with additional supports from all partners in all settings. Overall digital solutions are playing a role supporting access to information, increasing the number of qualified health professionals and improving quality of care through improved health worker competence, adherence to guidelines and support of health professionals (WHO Classification Digital Health Interventions, 2018). Digital solutions are also assisting with geographical issues related to access, improving efficiency of the health system (for instance improving the quality, timeliness and appropriateness of referrals), reducing costs and improving accountability in the system (WHO Classification Digital Health Interventions, 2018). However, we need to better understand the effectiveness, utility and identify quality features of resources to continue to improve these digital resources to ensure the resources assist in meeting the many needs that exist.

The paediatric oncology professional community can access a number of digital platforms to support their education and training. Along with the more specific resources shared in this paper, paediatric oncology education resources can also be found in: peer-review publications, ebooks and information located on websites or blogs. Document access can be via digital databases such as MEDLINE, EMBASE, CINAHL, ERIC, OVID, Google Scholar; pre-publication databases MedRXiv, arXiv and bioRxiv; or repositories like Research Gate, Mendeley, Sci-Hub to gain access to publications.

Education and training material can also be found in podcasts, webinars and videos–embedded into websites or on video-sharing platforms (e.g. YouTube, Vimeo). Podcasts for the paediatric oncology health professional can be found on podcast providers (e.g. Apple, Spotify) but must be assessed for rigour and accuracy (such as listening to a known leader in paediatric oncology), as well as podcasts produced by journals or other well-known sources (e.g. Journal of Paediatric Haematology/Oncology or Journal of Clinical Oncology) and (e.g. Cancer POINTE podcast "global health childhood cancer") (Global Health Childhood Cancer, 2021). Health professionals including the paediatric oncology workforce also connect with their local and global colleagues for support and opinion using email, mobile phone SMS, WhatsApp, WeChat, Telegram and social media. Paediatric oncology content can also be found social media such as Twitter, and Facebook, as well as many other sites specific to various language groups such as Groupe Franco Africain d'Oncologie Pédiatrique (GFAOP, 2021).

Strengths and limitations

The strengths of this paper is that the authors are the leaders globally with respect to digital solutions for the education, training and support of paediatric oncology health professionals in low resource settings, and this paper presents new knowledge from rigorous searches of both the grey literature as well as the peer-reviewed literature; the authors of this paper include researchers and practicing paediatric oncologists and paediatric oncology nurses living in high-resource as well as low-resource settings–enabling our team to best understand whether the digital platforms created truly meet the needs of paediatric oncology health professionals globally. This paper presents the state-of-the-art summary of current digital platforms for the audience (health professionals in paediatric oncology), including sites dedicated to COVID-19 and how it impacts upon paediatric oncology globally. Further strengths of this paper include the quality assessment of the digital resources using the CRAAP tool and recommendations for future improvement of digital resources. As such, this paper provides not only a list of existing digital resources and their quality assessment but also provides a platform for development and future assessment of future, high quality, digital resources for health professionals regarding

childhood cancer. Limitations of this paper are that we did not include non-English and specialized regional digital platforms. There are regional, local language specific digital platforms which educate/train and support paediatric oncology health professionals, e.g. such as groups for Latin America, the Caribbean etc.

Conclusion

This paper presented a narrative review identifying digital platforms that contribute to health professionals' education and training regarding paediatric oncology, particularly in rural and other low-resource settings. Our review identified various digital resources for building communities of practice, facilitating access to information and support and providing access to training, education and supervision. We identified 34 digital resources, of which 33 could be rated for quality. Of those that were rated, only 12 resources received a rating of high quality, 30 or above.

Finally, despite the benefits of digital solutions in addressing educational needs of the health workforce in rural areas and resource-limited settings, further research is needed to understand the use of digital platforms in the context of health systems. One area for future research includes the role of government in supporting and maintaining health workforce's motivation to utilize the digital education platforms. In some settings, lack of governments' approval of the curriculum in the digital platform for specific training may prevent platform utilization. Another research area is to understand how digital education uptake might differ between professions, e.g. between doctors and nurses and determine factors which may be ameliorated with respect to any differences. Lastly, while interaction with global paediatric oncology experts is key to the success of digital education, it is important to have a deeper understanding of the role and process of successful mentorship to facilitate further learning for those in low-resource settings.

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Further reading

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Supplementary material
The supplementary material is available online for this article.

Corresponding author
Alexandra Martiniuk can be contacted at: alexandra.martiniuk@sydney.edu.au