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Online learning for allied health knowledge translation: A systematic review

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Abstract

Purpose: *To synthesise evidence on the effectiveness of online learning platforms for facilitating knowledge translation in allied health professionals.*

Approach: *A systematic review of the literature searched three databases (Medline-OVID, CINAHL, Embase) in November 2023 for studies measuring outcomes of knowledge translation initiatives targeting allied health professionals delivered using online learning platforms. Papers were eligible if allied health professionals made up at least 50% of the sample, most of the learning component was online, and comparative data was reported. Data were extracted using a customised form. Quality of studies was appraised using the Downs and Black checklist. Meta-analyses were conducted where sufficient homogenous data were available.*

Findings: *Twenty-three studies published over a 13-year period were included in this review primarily using pre-post study designs. All reported improvements in either knowledge, skill and/or confidence, with an meta-analysis (n=9 studies) showing a significant increase in knowledge gain after exposure to online learning (SMD 1.39; 95% CI = 0.96-1.83). However, there is little evidence that participation in online learning is associated with a change in clinical practice.*

Research implications: *This study supports previous research that online learning can improve knowledge but highlights a need for more rigorous studies addressing the impacts on behaviour change.*

Practical Implications: *Online learning is an effective way of improving knowledge, skill and/or confidence but additional knowledge translation strategies may be needed to lead to a behaviour change.*

Originality/value: *Synthesis of current knowledge of the value and limitations of online learning as a tool to facilitate the implementation of evidence into practice in the allied health professions.*

Limitations: *This review was limited to studies published in the English language only. The quality of studies in this field is low. Few studies measure behaviour change.*

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Conflict of Interest: *No authors report a conflict of interest for this study.*

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Keywords: Electronic learning, online learning, allied health professionals, knowledge translation, behaviour change.

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INTRODUCTION

The ability of healthcare workers to translate clinical practice guidelines and research evidence into clinical practice is an important component of knowledge translation.[1] Knowledge translation has been defined as the exchange, synthesis and application of research findings into practice. A recognition of the lengthy delays in translation of knowledge into practice[2-4] has led to the emergence of implementation science as field of enquiry that addresses questions of how interventions are adopted.[5] The intended outcome of successful knowledge translation is an improvement in the quality of patient care by increasing the provision of clinical care that is informed by high quality clinical evidence.[6] For allied health professionals this not only requires the acquisition of knowledge, skill and confidence,[7] but also a change in behaviour.

Allied health practitioners encompass a range of healthcare professional groups. While some definitions of allied health are broad, incorporating professions such as pharmacy and medical imaging, a narrower subgroup of allied health therapies has also been defined that includes occupational therapists, physiotherapists, speech pathologists, social workers, and dietitians all with a wide range of evidence supporting their assessment and intervention practices.[8] In relation to use of evidence in practice, allied health professionals share common issues with other members of the healthcare workforce, such as medical and nursing professionals, but also have differences. The type of evidence requiring translation often includes a focus on delivery of complex interventions and optimising wellbeing through prevention and recovery rather than diagnosis and cure, and allied health professionals practise in a very diverse range of settings. Although allied health professionals have an interest in using evidence-informed practice previous studies have suggested that they lack confidence in translating evidence into practice.[9] Barriers have been identified that impact the implementation of evidence-based practice in allied health care such as a lack of time, skills and resources.[10] Targeted approaches need to be used to support allied health clinicians to change their practice in response to emerging evidence.[11]

Methods of professional learning have traditionally included conferences, workshops, courses and journal clubs delivered in face to face settings. Online learning platforms are systems that enable learners to access educational content digitally, typically through the use of websites or mobile phone applications. The use of online learning platforms to assist knowledge translation is emerging, with a rapid increase in online learning adopted during the COVID-19 pandemic when traditional face-to-face learning opportunities were limited.[12, 13] Online learning platforms can facilitate synchronous or asynchronous delivery of information, or a combination of these two modes of learning. They can teach knowledge or skills through structured online courses, provide access to information through apps or databases with built in decision aids or connect people through online communities of practice.[14-16] Online learning platforms may be used alone, or in combination with other modes of education delivery.[17]

Online learning platforms have been widely reported in the literature and can enable access to learning opportunities that may otherwise be limited by geographical barriers, time or resources.[10, 18] The use of online learning platforms has potential to facilitate the translation of knowledge into clinical practice across a range of clinical settings, by enhancing access to

knowledge translation interventions. However, it is also possible that online learning platforms lack known strategies required to change behaviour, such as practical skill acquisition, identification of champions, and adaptation of knowledge translation to the local environment.[19, 20]

Several systematic reviews have synthesised literature in fields related to e-learning and the allied health professions. Rohwer et al.[20] evaluated the use of e-learning on increasing competencies in healthcare professions including medical, nursing and allied health and found that e-learning increased competencies (comprised of knowledge and skills) although not behaviour or attitudes. A systematic review of 16 randomised controlled trials by Vaona et al. (2018), found that e-learning was comparable to face-to-face learning in improving patient outcomes or knowledge, skill or behaviour of health professionals.[21] Dizon et al. reviewed studies (n=6) investigating evidence-based practice training across all modalities (including face-to-face training) for allied health professionals and highlighted that there is limited research but some evidence that training improves knowledge, skills and attitudes in this population.[22] However, questions remain over the role of online learning platforms for knowledge translation in the allied health professions, and whether they are effective in bringing about changes to clinical practice.

The aims of this systematic review were to synthesise current evidence on: (1) the effectiveness of online learning platforms for improving the knowledge, skills, and confidence of allied health professionals; and (2) the impact of knowledge translation interventions delivered electronically on clinical practice in the allied health professions.

METHODS

PROTOCOL AND REGISTRATION

Methods for this review were developed in advance and registered with PROSPERO (registration number CRD42020147013). The review is reported in accordance with the PRISMA 2020 guidelines.[23]

SEARCH STRATEGY

A comprehensive electronic search of original research literature was conducted in Medline-Ovid, CINAHL and Embase from the earliest available date to November 2023. Search terms and keywords that were used to complete the search included the three domains of: (1) online delivery (and synonyms such as technology, e-learning, and electronic); (2) learning (and synonyms such as teaching, training and education); and (3) knowledge translation (and synonyms such as evidence uptake, implementation, diffusion of innovation). MeSH headings were utilised in addition to keyword searches. Synonyms within the three domains were combined with the OR operator, then results combined using the AND operator. The researchers reviewed the reference lists and citations of included papers to identify further papers that met the inclusion criteria but were not identified in the initial database search.

SELECTION CRITERIA

Inclusion criteria encompassed: (a) peer-reviewed papers in which allied health professionals (minimum 50% of the sample) participated in online

learning for the purpose of translating knowledge into practice; (b) the majority of the learning component (at least 60%) was delivered electronically (such as through videos, access to online resources, mobile phone apps or chat rooms); (c) comparative data were reported (either pre post or between group comparisons) on any quantitative outcome of a knowledge translation initiative. Allied health therapy professions included in this review were occupational therapy, speech pathology, social work, dietetics, physiotherapy and podiatry, aligning with classifications by Turnbull et al.[8] Only studies published in English were included due to lack of resources for translation. Papers were excluded if they were book chapters, conference abstracts, theses, or review papers.

SELECTION PROCESS

The title and abstract of all papers retrieved in the initial search were downloaded into the online platform Covidence[24] and screened independently by two reviewers who applied the inclusion and exclusion criteria. The reviewers discussed any disagreement until a consensus was reached for papers to progress to review of the full text papers, with provision to call upon a third reviewer if required. Full text papers were retrieved for all studies that remained after the title and abstract screening, with the same process applied. The reference lists were checked and citations tracked of all included papers to check for any additional studies that may have been missed in the initial search.

QUALITY APPRAISAL

Quality appraisal was conducted by two independent reviewers using the Downs and Black Checklist[25]. This 27-item appraisal tool was designed for use with both randomised controlled trials and non-controlled trials. As a guide to interpretation, quality of studies can be considered excellent (score 26-32), good (20-25), fair (15-19) or poor (≦14).[26] Consensus was achieved through discussion between two reviewers. Scoring for the final question relating to whether the study had sufficient power to observe a clinically important difference[25] was conducted using methods described by Speed and Harding[27]. Studies were allocated a score of 5, 3 or 0 based on good evidence of adequate power, marginal evidence of adequate power or lack of any evidence of adequate power respectively. Studies were not excluded from the review based on the quality appraisal, but study quality was considered in the interpretation of findings.

DATA EXTRACTION AND SYNTHESIS

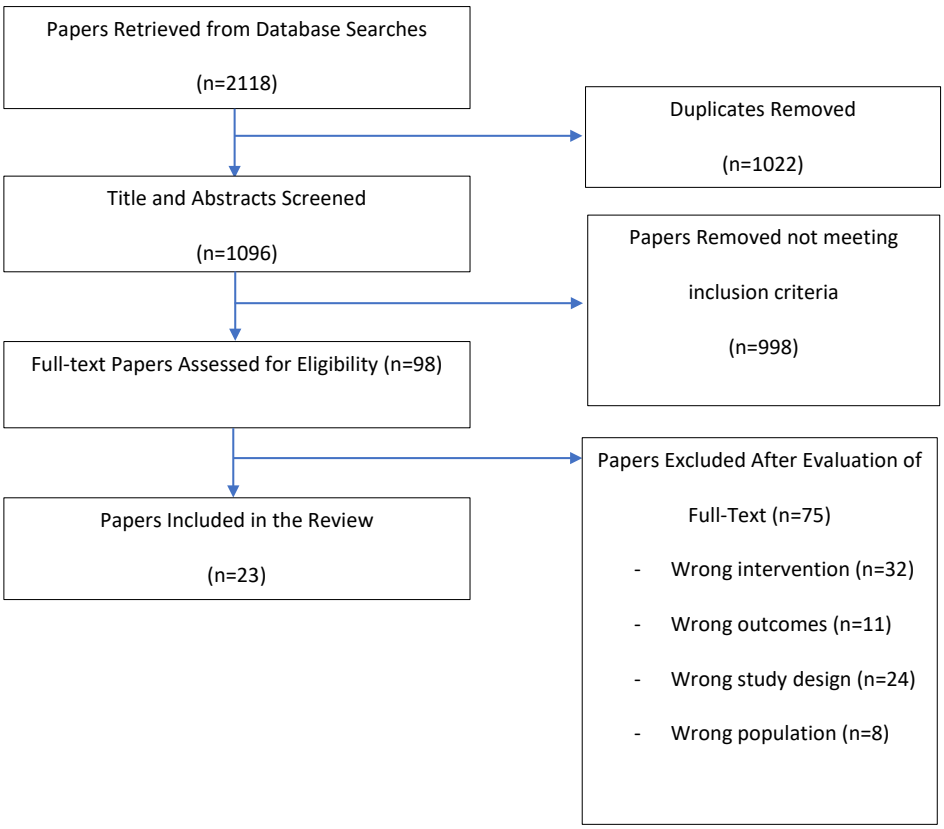
Data were extracted using a custom-designed data extraction form. The data were extracted from each included study by one reviewer, with the results checked by a second member of the review team. The results were organised into tables by the type of outcome measured for descriptive synthesis. Meta-analyses were undertaken for studies with appropriate levels of homogeneity, using Review Manager 5.4.1 software[28] with a random effects model. Standard mean differences were used to allow comparison of studies measuring knowledge change on different scales. Studies with pre-post designs as well as controlled studies were considered for inclusion in meta-analyses; while this approach has limitations, meta-analyses of pre-post effect sizes can be of value, particularly in fields where randomised controlled trials are rarely conducted.[29] The I^2 statistic was used as an indication of heterogeneity[30].

RESULTS

YIELD

A total of 2118 papers resulted from the literature search, of which 1022 duplicates were removed. One additional paper was located through reference list checking or citation tracking. A total of 998 papers were excluded based on title and abstract. There was over 90% agreement between reviewers on title and abstract screening; for those with discrepancies (n=106), agreement was reached by consensus without the need for a third reviewer. Evaluation of full text was undertaken for 98 papers. A further 75 papers were excluded because: they did not evaluate an intervention that met the definition of online delivery (n=32); comparative outcomes of quantitative data were not reported (n=35); or the paper did not focus on allied health professionals (n=8) (Figure 1). The final library of included studies contained 23 papers.[14, 31-50]

Figure 1. Flow of studies through the review. Papers may have been excluded for failing to meet more than one inclusion criteria



SUMMARY OF INCLUDED PAPERS

Of the 23 papers included in the review, ten studies were based in Canada,[14, 32, 34, 35, 40-43, 49, 50] four in the United States of America,[33, 36, 39, 45] two in Australia,[37, 46] and one each in Mexico[51] and South Korea.[38] One study included participants from Israel, Canada and Australia.[44] The four remaining studies were open to participants from any country without specified geographical boundaries.[31, 47, 48, 52] Most studies (n=18) focused on online learning only with the remaining five studies employing blended learning with the inclusion of a minority face-to-face training component. All studies included at least one online learning module or webinar as a part of their training program. Seventeen studies used pre-post designs, three were clinical trials, one used a case study design, one used mixed methods (website analytics and quantitative survey) and one used a cross-sectional survey design. The knowledge to be translated was very diverse; for example, topics of study included tracheostomy care, electrical stimulation, determining decision making capacity and returning to driving following stroke[37, 43, 44, 48]. All reported measures of knowledge acquisition (including knowledge, skill, or confidence), six studies reported measures of attitude including intent to change practice, and seven studies measured practice change. A summary of the included papers is presented in Table 1.

QUALITY APPRAISAL

The quality of the included papers was appraised by two reviewers using the Downs and Black[25] checklist (Table 1), with all disagreements resolved by consensus without the need for a third reviewer. The Downs and Black scores ranged from seven to 29 (Table 1). The most common criteria that were not addressed in the included studies were randomisation of the intervention, blinding of study subjects to the intervention, and clear reporting of the main outcomes of the studies.

Table 1. Summary of included studies

Study ID	QA*	Setting	Participants	Knowledge for translation	Study design	Intervention**
Applebaum[31]	19	Oncology care, worldwide	Healthcare professionals and students (n=46)	Acute cancer cognitive therapy	Pre post. Baseline, post training.	Online: 5x modules including teaching content, case scenarios, quizzes (AS)
Atack[32]	19	Hospital settings in Canada	Healthcare professionals (n=76)	Infection control and prevention	Pre post. Baseline, 2x post within 2 weeks of learning.	Online: 3 modules including video, quizzes, games (AS)
Beissner[33]	22	Visiting nurse service in New York, USA	Physiotherapists (n=238)	Pain self-management program	Cluster randomised controlled trial.	Blended: Online manual, videos, sample scripts (AS); 2x half day face to face sessions (S).
Camden[34]	17	Paediatric care in Canada	Physiotherapists (n=50)	Developmental Coordination Disorder	Pre post. Baseline; post training; 2 months post.	Online: 5x learning modules (AS)
Chepeha[35]	18	Post-surgical shoulder care in Alberta, Canada	Physiotherapists (n=181)	Postoperative shoulder pain	Mixed methods. Website analytics, quantitative survey.	Online: Guideline including narrated presentations and video demonstrations (AS)
Cunning-ham[14]	20	Paediatrics services, Ontario, Canada	Speech pathologists (n=52)	Communication function classification system	Pre post. Baseline, post completion of training.	Online: PowerPoint presentation, case scenarios, literature (AS)
Drabkin[36]	24	Public, community health services USA	Intimate partner violence (IPV) workers (n=156)	IPV Prevention	Pre post. Baseline; 3 months post.	Online only: 13 interactive modules using video, fact sheets and exercises (AS)
Frith[37]	14	Stroke care in Australia	Health professionals (n=12)	Return to driving guidelines	Pre post. Baseline; post training	Online: 30-minute e-learning module (AS)
Heitman[51]	17	Nutrition care in Mexico	Nutrition and dietetics professionals (n=11)	Nutrition care process	Pre post. Baseline; post training.	Online: Prework 4 hrs (AS), web-based training (S), post training support
Jeong[38]	15	Paediatric care in South Korea	Occupational therapists and educators (n=27)	Measuring participation of children with disabilities	Cross-sectional survey post training.	Online: 23-minute webinar including PowerPoint presentation (AS)
Jorge[52]	18	Osteoarthritis care, worldwide	Physiotherapists, dietitians, podiatrists (n=784)	Knee osteoarthritis care via telehealth	Pre post. Baseline; post training; 4 months post.	Online: E-learning modules (3-4hrs), videos, resources
Kobak[39]	22	Paediatric mental health services, USA	Licensed clinicians (n=18)	Integrating technology into CBT for depression	Pre post. Baseline, post training.	Online: 5.5-hour interactive modules including video (AS)
Levac[40]	17	Stroke rehabilitation in Canada	Physiotherapists and occupational therapists (n=11)	Motor learning and virtual reality stroke rehabilitation	Pre post. Post initial training and post implementation	Blended: 3x online modules, reminder email, practice (AS), 3x face-to-face sessions (S)
Lingum[41]	20	Long-term care homes in Canada	Healthcare professionals (n=133)	Caring for frail, medically complex older adults	Pre post. Baseline; post sessions; program completion	Online only: Weekly 1-hour online learning sessions over 12 weeks (S)
Miller[42]	18	Pediatric cerebral palsy care in Canada	Pediatric physical and occupational therapists (n=102)	Hip surveillance in cerebral palsy	Pre post. Baseline; 1 year follow up.	Blended learning: Webinars (S), learning module, presentations, clinician booklet (AS)
Orr[43]	22	Home care providers in Canada.	Healthcare professionals (n=83)	Electrical stimulation	Pre post. Baseline, post training, post workshop.	Blended: 8x online training modules (AS) and 1x face-to-face workshop (S).
Pesiah[44]	17	Aged care in Israel, Canada, and Australia.	Healthcare professionals (n=31)	Determining decision making capacity	Pre post. Baseline; post training.	Online: 25-minute module adapted based on pre-test results (AS)
Robitaille[49]	18	Canadian armed forces	Physiotherapists (n=67)	Ankle sprain management	Pre post. Baseline; post training.	Blended: Recorded presentation delivered synchronously with peer discussion.
Roberts[45]	7	USA	Dietitians (n=2)	Nutrition practice guidelines	Case study design	Online: webinar training session (S)
Sarkies[46]	29	Public health services in Melbourne, Australia	Nursing and allied health clinicians. (n=119)	Physical activity after DVT, Falls prevention strategies	Randomised Controlled Trial 1x survey	Online: Video summaries compared with written summaries (AS)
Scrivener[47]	10	Australian university (learners worldwide)	Student and qualified physiotherapists (n=174)	Task specific training	Pre post. Baseline; post training.	Online: 5x modules including video demonstrations (AS)
Szekeres[50]	19	Rehabilitation in Canada	Physiotherapist (n=98) and occupational therapists (n=26)	Rehabilitation outcomes measures	Trial comparing online with face to face training.	Online: 8-10 hours learning content and independent learning (AS); discussion with facilitator (S)
Swords[48]	18	22 countries globally	Health professionals, patients/caregivers (n=103)	Tracheostomy care	Pre post. Baseline assessment, post-webinar assessment.	Online: 5x webinar sessions, professional discourse over 12 months (S)

*QA: Quality appraisal Score out of 27 on the Downs and Black Checklist[24]

**Synchronous and asynchronous indicated by (S) or (AS)

KNOWLEDGE-RELATED OUTCOMES

Across the included studies, knowledge-related outcomes were described in the domains of knowledge acquisition, skill acquisition and confidence. All included studies reported on at least one measure in the knowledge category. Nineteen of the 23 studies evaluated knowledge acquisition, four studies evaluated skill acquisition and seven studies evaluated the self-reported confidence of participants in their ability to apply knowledge following the intervention. Table 2 summarises the key findings from all included studies. One study could be described as excellent,[46] six as good,[14, 33, 36, 39, 41, 43] thirteen as fair[31, 32, 34, 35, 38, 40, 42, 44, 48-52] and three as poor[37, 45, 47] based on the Downs and Black score.[26]

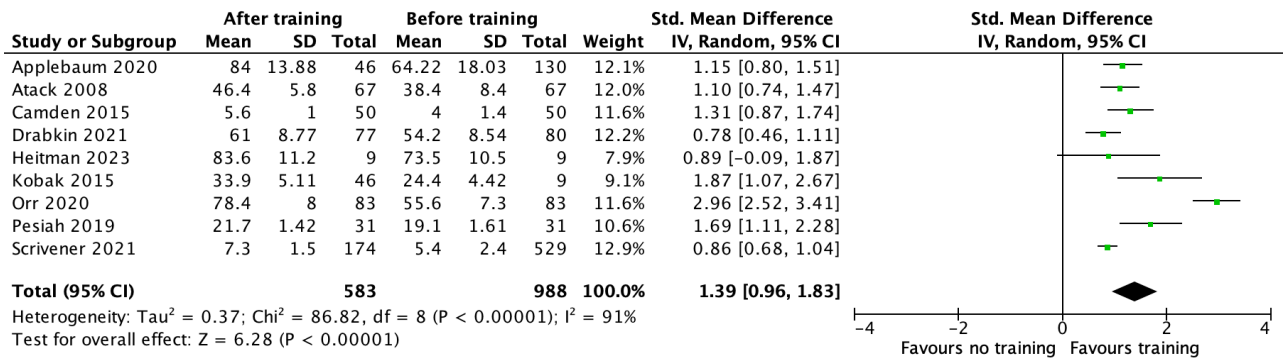
There was sufficient data presented in n=9 studies to be combined in a meta-analysis, which showed a significant improvement in knowledge after the online learning (standard mean difference 1.39; 95% CI = 0.96, 1.83; p-value <0.01; I^2=91%),[31, 32, 34, 36, 39, 43, 44, 47, 51] although the high I^2 value suggests heterogeneity in the analysis (Figure 2). All but one study included in the meta-analysis were rated fair or good quality studies.

For those studies who reported on knowledge acquisition but were not included in the meta-analysis (n=10), all reported improved knowledge associated with the intervention.[14, 35, 37, 38, 42, 45, 46, 48-50] Three fair or good quality studies demonstrated this improvement to be statistically significant. [14, 42, 48] The remaining seven studies, with quality ranging from poor to excellent, reported descriptive observations only.[35, 37, 38, 45, 46, 49, 50] One study showed a statistically significant improvement with knowledge acquired through video summaries, compared with no improvement through written summaries.[46]

Of four studies measuring skill acquisition two reported a statistically significant improvement.[14, 32] One study reported descriptive observations.[49] One fair quality study did not find any significant difference in clinical reasoning skills following online training.[40]

An increase in confidence following online learning was measured in seven studies.[31, 33, 36, 40, 41, 48, 52] Confidence improved in all seven studies, with four studies of fair or good quality demonstrating statistical significance of their results.[36, 40, 41, 48]

Figure 2. Meta-analysis of knowledge acquisition



ATTITUDES

Outcomes related to attitudes towards knowledge or skill acquired through online learning platforms were reported in n=6 studies.[14, 32, 41, 43, 50, 52] Three studies measured receptivity towards behaviour change based on the content learned through online learning platforms.[32, 43, 50] Three studies reported intent for future use of the knowledge or skill acquired through the online learning platform.[14, 41, 52] These six studies, of fair or good quality, reported that participants were receptive to change, or most participants had an intention to change their future clinical practice following engagement with an online learning platform.

BEHAVIOUR CHANGE

Outcomes related to behaviour change, (for example, actual change to clinical practice), were measured in n=7 studies.[33, 36, 39, 40, 45, 51, 52] Two studies provided evidence of self-reported improvements in implementation of guidelines following online learning interventions, one relating implementation of a nutrition clinical guideline[45] and the other in the field of knee osteoarthritis. [52] One study reported a statistically significant improvement in the delivery of only one out of six areas of pain self-management training delivered by an allied health professional.[33] The remaining four studies reported no difference in practice following engagement with an online learning platform designed to change practice in the fields of: intimate partner violence prevention; integrating technology into cognitive behavioural therapy for depression; using motor learning strategies within virtual reality stroke rehabilitation; and a virtual nutrition care process.[36, 39, 40, 51]

Table 2. Summary of key knowledge, attitude and behaviour change outcomes

Education Focus	Education Components	Paper	Direction of Change
Knowledge gain	Knowledge	Applebaum[31]	Improved knowledge in acute cancer cognitive therapy (p<0.01)
		Atack[32]	Improved knowledge in infection prevention and control (p<0.01)
		Camden[34]	Improved knowledge of developmental coordination disorder (p<0.05)
		Chepeha[35]	Improved knowledge in postoperative shoulder care
		Cunningham[14]	Improved knowledge in methods for using the Communication Function Classification System (CFCS) (p<0.01)
		Drabkin[36]	Improved knowledge of intimate partner violence prevention-related topics (p<0.01)
		Frith[37]	Improved knowledge of Australian return to driving guidelines
		Heitman[51]	Improved knowledge of Nutrition Care Process (p<0.01)
		Jeong[38]	Improved knowledge of participation in children with disabilities
		Kobak[39]	Improved knowledge of CBT concepts (p<0.01)
		Miller[42]	Improved knowledge in hip surveillance for children with cerebral palsy in 15/16 knowledge areas. 5/16 areas (p<0.05)
		Orr[43]	Improved knowledge of electrical stimulation (p<0.01)
		Pesiah[44]	Improved knowledge in determining decision making capacity (p<0.01)
		Robitaille[49]	Improved knowledge of comprehensive rehabilitation program
		Roberts[45]	Improved knowledge of critical illness recommendations, used to create protocol reported by 60% of respondents (n=6)
		Sarkies[46]	Improved knowledge with video summaries (p<0.01), but not written summaries
		Scrivener[47]	Improved knowledge in task specific training. Standard mean difference 0.85
		Szekeres[50]	Improved knowledge in rehabilitation outcome measures from 51.1% to 55.4%
		Swords[48]	Improved knowledge in decannulation (p<0.01)
	Skills	Atack[32]	Improved competence in infection prevention and control (p<0.01)
		Cunningham[14]	Improved skill in classifying a child using the CFCS (p<0.01)
		Levac[40]	No significant change in clinical reasoning skills related to motor learning strategies
		Robitaille[49]	Improved performance in comprehensive rehabilitation program
	Confidence	Applebaum[31]	Improved confidence working in cancer care reported by 75% of respondents (n=38)
		Beissner[33]	80% respondents reported confidence in teaching the pain self-management program
		Drabkin[36]	Improved self-efficacy scores in intimate partner violence prevention strategies (p<0.01)
		Jorge[52]	Improved confidence with videoconferencing. Mean change 3.1/10 (95% CI 3.0-3.3)
		Levac[40]	Improved confidence in motor learning strategies in virtual reality rehabilitation (p<0.01)
		Lingum[41]	Improved confidence in working with residents with COVID-19 (p<0.01)
		Swords[48]	Improved confidence in decannulating children (p<0.05)
Attitude	Attitude	Atack[32]	Majority of respondents keen to adopt change.
		Orr[43]	Improved attitude towards electrical stimulation to stimulate healing p<0.05.
		Szekeres[50]	Significant increase in readiness for change following online learning; no difference compared with face to face group.
	Intent for future use	Cunningham[14]	Intention for future use of CFCS from 81% (n=42) of respondents
		Jorge[52]	Improved likelihood to use education. Mean change 0.4/10 (95% CI 0.3-0.5)
		Lingum[41]	Intention to change behaviour by 63% of respondents
Behaviour Change	Practice change	Beissner[33]	Significant improvement in documentation of the use of imagery (p<0.01), but no difference in documentation of other six domains measured.
		Drabkin[36]	No statistically significant difference in utilisation of intimate partner violence strategies following online learning
		Heitman[51]	Quality of clinical notes using a validated audit tool showed low quality clinical notes and no resolution of nutrition problems.
		Jorge[52]	Self-reported implementation e-learning knowledge reported by 99.3% of participants.
		Kobak[39]	No statistically significant difference in clinical ratings of improvement for CBT group.
		Levac[40]	No significant practice change with motor learning strategies (p=0.092)
		Roberts[45]	Improved implementation of critical illness guideline reported by 70% of respondents (n=7)

DISCUSSION

All studies in this review found that the knowledge, skill, or confidence of allied health professionals improved through engagement with online learning platforms. This finding was consistent with previous studies evaluating outcomes of online learning involving allied health, nursing and medical professionals.[17] However, few of the included studies measured change in clinical practice, and the findings of those that did also concurred with previous studies suggesting that online learning alone is not sufficient to change behaviour.[17, 20] Most of the studies included in this review were observational designs with a high risk of bias and overall confidence in the findings is low, but the findings highlight current gaps in understanding of the potential role of online learning platforms for supporting the translation of knowledge into practice.

Online learning platforms offer many benefits in the dissemination of information that are likely to contribute to the success of these programs in the acquisition of knowledge. For example, online learning provides opportunities for multimodal delivery of content, using video, audio, written materials, interactive activities, links to wider resources and connections with others. Consistent with principles of adult learning, online platforms also have the potential to tailor information based on users' experience or prior knowledge and enable self-paced and autonomous learning. [53] There are also many situations in which online learning platforms may offer advantages over face-to-face training by reducing travel time, overcoming geographical boundaries, or providing flexibility to complete training asynchronously at a time that is preferable for the learner. Online learning provides a potentially low cost and accessible way to disseminate information and may therefore be ideally suited to situations where the desired outcome is an improvement in knowledge, skill, or confidence.

However, it is not enough for allied health clinicians to complete online training and expect a change in clinical practice. This phenomenon is not unique to online learning platforms, with a systematic review by Scott et al.[11] highlighting multiple studies reporting that education alone has minimal influence on changing clinical practice. These findings align with current implementation science literature suggesting a need for a broader approach to knowledge translation[19, 54] The COM-B framework for behaviour change acknowledges that capacity (encompassing but not limited to knowledge and skills) is a necessary component, but also stresses the importance of opportunity and motivation as factors contributing to behaviour change success.[55] Examples of more active approaches to translating knowledge into practice in the allied health professions have included the use of knowledge brokers, electronic evidence libraries and clinical outcomes databases, and tailoring strategies to address barriers to change.[7, 56]

The findings of this review have implications for policy makers, clinical educators, and clinicians. Policy makers and clinical educators should acknowledge the potential role for online learning as an accessible and low cost alternative to face to face learning for increasing clinicians' knowledge, skill, or confidence. However, these same policy makers and clinical educators need to be aware of the need to employ time and resources to facilitate the translation of the acquired knowledge into clinical practice above and beyond providing funding support or professional development leave. This concept has been explored by Hitch and colleagues[57] who

defined four key stages of intervention required to support knowledge translation being: doing knowledge translation (knowledge, timeframes, align with theory, resources), social capital for knowledge translation (leadership, social networks, social skill sets), sustaining knowledge translation (discipline focus, capacity building, linked to organisational strategy, evaluating outcomes of knowledge translation), and inclusive knowledge translation (broaden beyond the team, dissemination strategies). Addressing these factors in the context of online learning may be challenging but potential solutions are emerging. Levac and colleagues,[58] for example, have proposed best practice recommendations for the development of online knowledge translation resources. Future studies could consider integrating a learning module into a training package that focuses on known knowledge translation strategies and frameworks, as a complement to the clinical knowledge content. Providing information about the need for deliberate, tailored attention to implementation strategies alongside learning modules designed to increase clinical knowledge and skills and confidence may be one potential mechanism for increasing the likelihood that knowledge acquired through online learning will be embedded into clinical practice.

This review was limited to studies published in the English language only which may have impacted on the inclusion of some international studies that could inform this review. There are a wide range of terms that are used to describe both knowledge translation and education which may have impacted on the search design. However, only one additional paper was found through citation checking so it is likely that our search has been successful in finding the available relevant literature. The meta-analysis in this review needs to be interpreted with caution, given that most of the studies used pre-post designs and many were of low quality with a high risk of bias. However, inclusion of this analysis provides a useful overview of current evidence in this field.

CONCLUSION

Online learning is an effective way of improving clinicians' knowledge, skill and/or confidence and attitude towards future use of the learned content. Online learning alone does not necessarily lead to a change in clinical practice. Known strategies that support the gap between knowledge and clinical practice should be employed to ensure that clients reap the benefits of investment into ongoing learning of clinicians. Policy makers and clinical educators can play a key role in prioritising the accompanying knowledge translation strategies required to facilitate practice change.

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