International Journal of Mental Health Nursing

International Journal of Mental Health Nursing (2023) *32*, 290–313 doi: 10.1111/inm.13082

ORIGINAL ARTICLE

Improving the self-efficacy, knowledge, and attitude of nurses regarding concurrent disorder care: Results from a prospective cohort study of an interprofessional, videoconference-based programme using the ECHO model

Gabrielle Chicoine, [1,2,3] ***José Côté,*** [1,2,3] ***Jacinthe Pepin,*** [1] ***Alina Dyachenko,*** [2] ***Guillaume Fontaine*** [4,5,6] ***and Didier Jutras-Aswad*** [2,7]

[1]Faculty of Nursing, Université de Montréal, [2]Université de Montréal Hospital Research Centre, [3]Research Chair in Innovative Nursing Practices, Université de Montréal, Montreal, Quebec, [4]Center for Implementation Research, Clinical Epidemiology Program, Ottawa Hospital Research Institute, [5]Faculty of Medicine, University of Ottawa, Ottawa, Ontario, [6]Centre for Nursing Research, Jewish General Hospital, CIUSSS West-Central Montreal, and [7]Faculty of Medicine, Department of Psychiatry and Addiction, Université de Montréal, Montreal, Quebec, Canada

ABSTRACT: *Several challenges have been identified for patients with concurrent disorders to access adequate services and for nurses to care for them. These challenges contribute to a pressing need for continuing educational interventions, particularly within the mental health nursing workforce. To address this issue, an innovative interprofessional videoconferencing programme based on the ECHO® model (*Extension for Community Healthcare Outcomes*) was implemented in Quebec, Canada to support and build capacity among healthcare professionals for CD management. The aim of this prospective cohort study was to examine nurses' self-efficacy, knowledge, and attitude scores over a 12-month period. All nurses who registered in the programme between 2018 and 2020 were invited to participate in the study (*N = 65*). The data were collected online using a self-administered survey at baseline, after 6 months, and then*

Correspondence: Gabrielle Chicoine, Faculty of Nursing, Université de Montréal, 900, St-Denis Street, Montreal, Quebec (QC), Canada H2X 0A9. Email: gabrielle.chicoine@umontreal.ca

Authorship statement: Gabrielle Chicoine (GC): Conceptualization of the study, development of the study questionnaires, recruitment of participants, investigation, data analysis, interpretation of data, writing original draft, editing, and reviewing manuscript. José Côté (JC): Conceptualization of the study, interpretation of the data, reviewing original draft, editing, and reviewing manuscript. Jacinthe Pepin (JP): Conceptualization of the study, editing, and reviewing manuscript. Alina Dyachenko (AD): Data analysis, editing, and reviewing manuscript. Guillaume Fontaine (GF): Interpretation of the data, editing, and reviewing manuscript. Didier Jutras-Aswad (DJA): Conceptualization of the study, development of the study questionnaires, recruitment of participants, data analysis, interpretation of the data, editing, and reviewing manuscript.

Funding statement: This study was part of a larger research project that received funds from Health Canada and the Quebec's Ministry of Health and Social Services.

Disclosure statement: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethics approval statement: Ethical approval was sought from, and granted by, the Ethics Committee of the Université de Montréal Hospital Center (#18.245) in the city of Montreal, in the province of Quebec, Canada. All the participants provided written, and informed consent.

Gabrielle Chicoine, RN, MSc, PhD candidate.
José Côté, RN, PhD.
Jacinthe Pepin, RN, PhD.
Alina Dyachenko, MSc.
Guillaume Fontaine, RN, PhD.
Didier Jutras-Aswad, MD, MSc, FRCPC.

Accepted October 01 2022.

12 months following entry-to-programme. Twenty-eight nurses participated in the study (96.4% women), with a mean age of 39.1 (SD = 6.2). Compared to other professions (n = *146/174), the group of nurses also showed significant improvements in their knowledge and attitude scores, with respective effect sizes of 0.72 and −0.44 at 6 months, and 0.94 and −0.59 at 12 months. However, significant changes in self-efficacy were only found at the 12-month follow-up* (P = *0.0213), among the nurses who attended more than 25% of the 20-session curriculum. ECHO is a promising intervention to improve the accessibility of evidence-based practice and to support nurses in suitably managing concurrent disorders. Further research is needed to establish the effectiveness of this educational intervention on clinical nursing practice and patient outcomes.*

KEY WORDS: *continuing education, dual diagnosis, nursing, self-efficacy, videoconferencing.*

INTRODUCTION

Concurrent disorders (CDs) typically refer to co-occurring mental health and substance use disorders (APA 2013). The prevalence of CDs is high, worldwide (WHO 2021), as evidenced by the fact that roughly up to half the people with mental disorders also experience substance use problems, and vice versa (Mueser & Gingerich 2013). People with CDs often experience poorer physical health and social outcomes, greater psychological distress, and less-than-optimal healthcare than do people with a single disorder (Priester *et al*. 2016). For instance, CDs have been associated with increased risks of suicide, violence, homelessness, and social exclusion (Khan 2017). Furthermore, CDs are frequently associated with a chronic course, higher rates of relapse, and poorer compliance with treatment (Urbanoski *et al*. 2017). Failure to identify and address the complex healthcare needs of this subpopulation can have severe consequences for the patient and society, as witnessed by a steady increase in the burden of diseases attributable to mental health and substance use disorders in recent years (WHO 2021).

Nurses, who are typically the frontline providers, have increasingly been assigned to managing individuals with CDs (Smolowitz *et al*. 2015). Nurses play a crucial role in the delivery of healthcare for people living with CDs, because of their central position into the care team and their expanded roles and competencies (Bauer & Bodenheimer 2017). However, CDs is known to be challenging, and previous reviews have indicated that most nurses feel exhausted, powerlessness, and isolated when encountering people with CDs (Garrod *et al*. 2020). Research has also found that nurses often perceived themselves to be ill-equipped to evaluate and manage CDs, notably in terms of recognizing early symptoms, managing substance withdrawal, intervening in crisis situations, and ensuring continuity of care (Pinderup *et al*. 2016). Furthermore, nurses may hold conscious or unconscious stigmatizing attitudes when caring for individuals with problematic alcohol or drug use (van Boekel *et al*. 2013). This can increase the risk of underassessment and undertreatment and impair the therapeutic alliance. Moreover, negative or judgemental attitudes towards CDs can be a barrier to optimal treatment. As van Boekel *et al*. (2013) highlighted in their systematic review, mental health professionals holding stigmatizing attitudes towards substance-use disorders have a more task-oriented approach to care, and this, in turn, can lead to poorer communication with the patient, weakened empathy, and the misattribution of physical symptoms to substance-use problems. Overall, research evidence suggests that nurses are not well prepared to manage CDs adequately, due in part to insufficient professional training (Garrod *et al*. 2020; Petrakis *et al*. 2018). This situation is worse in rural and remote areas, where specialized resources are lacking.

This problematic situation calls for a pressing need for nurses to be offered additional educational opportunities. Accordingly, many healthcare organizations (NICE 2016) have recommended that continuing education in CDs should be standardized among healthcare professionals to improve the quality of care. In this context, continuing professional education can be understood as a planned and systematic effort to enhance knowledge and competence through formal learning experiences, in order to achieve effective clinical performance (Moore *et al*. 2009). A critical review of training in CDs reported a generally positive impact on healthcare professionals' learning outcomes (Pinderup *et al*. 2016), and another systematic review highlighted that supervision by experts in the field of CDs was found to support healthcare professionals in

difficult situations and to allow them to reflect on the process as it occurs (Petrakis *et al*. 2018). Additionally, a scoping review of the nursing literature by Garrod *et al*. (2020) reported that education in CDs has been shown to increase knowledge and confidence, and support practice change. One such promising educational intervention is the Extension for Community Healthcare Outcomes (ECHO), a videoconference-based, interprofessional tele-mentoring model that aims to support and build capacity in healthcare professionals while they manage the complex and chronic health conditions of their patients.

BACKGROUND

ECHO is a technology-enabled collaborative learning model that addresses rural–urban disparities in access to specialty care by democratizing knowledge and building capacity among healthcare professionals, typically those in primary care settings. The model was launched in 2003 at the University of New Mexico, Albuquerque, United States (US), under the name Project ECHO® (Arora *et al*. 2007), and there have been over 590 replications of ECHO across 34 countries (McBain *et al*. 2019). ECHO involves pairing healthcare professionals (the "Spokes"), with an interdisciplinary team of experts (the "Hub") at a centralized academic centre, using multisite videoconferencing technology. Real-time educational sessions allow local healthcare professionals to discuss their patients and receive feedback, regardless of geographical barriers, through the ongoing sharing of expertise between mentors and peers.

There is growing evidence of the ECHO model's acceptability, feasibility, and positive impact on healthcare professionals' outcomes and on patient health. With respect to provider-related outcomes, two systematic reviews found similar favourable results across three areas, namely satisfaction, increased knowledge, and increased confidence (McBain *et al*. 2019; Zhou *et al*. 2016). Another systematic review, by Holmes *et al*. (2020), highlighted that the existing empirical research on ECHO is mainly limited to the areas of liver diseases, and noted that only five studies of three distinct CD-related ECHO programmes have been published so far (Chand *et al*. 2014; Komaromy *et al*. 2016, 2017; Mehrotra *et al*. 2018; Sockalingam *et al*. 2017). Of those five studies, three reported significant improvements in knowledge (Komaromy *et al*. 2017; Mehrotra *et al*. 2018; Sockalingam *et al*. 2017), and only one showed significant increases in participants' self-confidence from baseline to 6-month post-ECHO (Mehrotra *et al*. 2018). In addition to these modest results, much less attention has been given to the impact of ECHO on nurses' outcomes and/or perceptions. Indeed, only one study to date has focused on nurses, by formally assessing changes in self-efficacy resulting from ECHO (White *et al*. 2019). In that 6-month longitudinal mixed-methods study (n = 28), piloted in a community palliative care setting, significant improvements in all areas of nurses' self-efficacy were reported. The study also found that mean knowledge score improved significantly, by 11.3% from baseline to post-ECHO.

To address this gap and further investigate whether the ECHO model is as beneficial for nurses as it is for other professional groups, the overarching aim of this study was to examine the evolution of nurses' outcomes over a 12-month period of participation in a Canadian ECHO programme for CD management. The specific objectives were to:

1. Measure changes in nurses' self-efficacy in CD management (primary outcome), knowledge about, and attitude towards, CDs 6 and 12 months following entry-to-programme;
2. Describe the nurses' patterns of participation, satisfaction and acceptability towards the programme, and perception of clinical performance at the 6- and 12-month follow-ups;
3. Describe the extent to which the changes observed in nurses' outcomes are comparable to other ECHO participants' observed outcomes, including allied and medical healthcare professionals.

METHODS

Design

This mixed-methods study was an original addition to a larger two-year prospective cohort study (N = 174) investigating the impact of a Canadian ECHO programme for CD management (ECHO-CD) on healthcare professionals' outcomes; a research protocol has been published and can be found elsewhere (Chicoine *et al*. 2021b). This article presents instead the quantitative results obtained from a subgroup of nurses who participated in ECHO-CD, and it does so by using a single-group repeated-measures design. Detailed methods and results for the qualitative component of the mixed-methods study can be found in another publication elsewhere (Chicoine *et al*. 2022). Participation was

voluntary, and all participants provided written and informed consent. The reporting of the study was handled according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (Vandenbroucke *et al*. 2014; see Table A1: Appendix I).

Setting and educational intervention

ECHO-CD was developed in 2017 and implemented in September 2018 at a quaternary hospital centre in the province of Quebec, Canada. The programme was scheduled through 90-min online educational sessions every 2 weeks from September to June, with up to 200 registrants each year, and an average of 50 attendees connecting during each session. The participants and experts included healthcare professionals from diverse healthcare and social disciplines. Participants were able to join the sessions via the Zoom platform (©2016 Zoom Video Communications, Inc.), using a computer, phone, or other mobile device, from their work or home environment.

In accordance with the ECHO model, ECHO-CD was replicated on the basis of three main components, that is, educational methods: case-based discussion and reflexive practice, expert-novice mentoring, and peer learning (Chicoine *et al*. 2021a). Online sessions were organized as follows: (i) 15-min introduction, in which Hub and Spokes participants introduced themselves; (ii) 60-min case-based learning, which involved a healthcare professional or a team of healthcare professionals presenting a real patient case, and the expert team leading a discussion and sharing recommendations; and (iii) 15-min didactic presentations about CD evidence-based practice. Each online session allowed for questions and discussion through all media (i.e., video, chat, phone), ensuring that participants were able to interact, regardless of the technology they had access to. Further information regarding the educational intervention can be found in the study protocol (Chicoine *et al*. 2021b).

Participants and recruitment procedures

The potential study population comprises 65 nurses who participated in ECHO-CD between September 2018 and June 2020. A census approach to sampling was undertaken: all nurses who registered in ECHO-CD for the 2018–2019 and 2019–2020 curriculum were invited to participate in the study. To be eligible, nurses had to be practicing in the province of Quebec, Canada, regardless of their work setting. Nurses were excluded from the study if they did not complete the baseline survey. Nurses were recruited via email during the programme's registration period and virtually during the first online session.

Data collection

Study outcome assessment

Based on Moore *et al*.'s (2009) Expanded Outcomes Framework for Planning and Assessing Continuing Medical Education, five outcome levels were operationalized to develop a self-administered online survey for the purpose of this study. The study outcomes and measurements, together with their respective definitions, are described in Table 1 and summarized in the following paragraphs.

Self-efficacy was chosen as the primary outcome in this study. Self-efficacy is a construct defined by Bandura (1997) as the "person's judgement of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with judgements of what one can do with whatever skills ones possesses" (p. 3). Accordingly, the self-efficacy questionnaire was developed to measure nurses' self-efficacy in CD management, based on guidelines in self-efficacy scale development (Bandura 2006), and on a U.K. government "Capability Framework" for working effectively with individuals with CDs (Hughes 2006). The questionnaire was validated in terms of content through an iterative and collaborative approach between the researchers and clinical experts in the field of CDs.

Other outcomes of interest included knowledge about CDs and attitude towards working with people with CDs. Changes in nurses' knowledge score were assessed using a 16-question test of CD knowledge that was specifically developed for this study. The structure of the knowledge test was inspired from the previous ECHO studies (Sockalingam *et al*. 2017); its content, however, was designed to reflect the pedagogical objectives of the educational programme and the topics of the didactic presentations and to be in accordance with CD evidence-based practice (NICE 2016).

Changes in nurses' attitude were measured using the Comorbidity Problems Perceptions Questionnaire (CMPPQ; Watson *et al*. 2007), which is a self-administered questionnaire adapted from the Alcohol and Alcohol Problems Perceptions Questionnaire (AAPPQ; Shaw *et al*. 1978). In this context, attitude

refers to the nurses' values in regard to working with individuals with CDs (Watson *et al*. 2007). According to Shaw *et al*. (1978), professionals' attitudes are influenced by their concept of *role adequacy*, *role legitimacy*, and *role support*; the presence of these three factors enhances their *motivation* to work with individuals with CDs, their expectations of *work satisfaction* with this patient group, and their *self-esteem* in these clinical situations. The CMPPQ was chosen because it was specifically developed to measure therapeutic attitudes towards working with people with CDs, and because it has been used in many other studies involving nurses (Munro *et al*. 2007; Pinderup 2017, 2018; Pinderup *et al*. 2016). The CMPPQ includes six subscales corresponding to the six, attitude-related factors, as described previously. The CMPPQ has established content validity and the internal consistency for the full scale was good (at $\alpha = 0.90$; Pinderup 2018). The CMPPQ was translated from English into French by the first author and a certified translator using a back-translation method.

Participation, satisfaction, and acceptability regarding the educational programme, and perception of clinical performance were also explored. Demographics and practice characteristics were collected at baseline. The self-administered online survey was validated with a small sample ($n = 7$) of healthcare professionals prior to its use. Details regarding the survey development, including information for each outcome measure, were previously published and can be found in the study protocol (Chicoine *et al*. 2021b).

Procedure

During the study period, the self-administered online survey was used to collect data at baseline (T0), and at the 6-month (T1) and 12-month (T2) follow-ups. Participants were able to use any computer or mobile device to open the link and fill out the baseline and post-surveys, via the SurveyMonkey platform (©1999–2022 Momentive). Baseline data were collected 6 weeks prior to, and 6 weeks after the beginning of the programme. This extended period allowed participants enough time to complete the surveys and ensured that they would not have been exposed to more than three online sessions at their baseline assessment. For the two following time measurements, a 6-week period was also established to collect the data, after which late questionnaire completions were excluded from the analysis and the participants with uncompleted surveys were deemed a loss to follow-up.

Data analysis

The Statistical Analysis System (SAS) software, version 9.4, was used for all calculations (©2022 SAS Institute, Inc.), and all analyses were conducted by an experienced biostatistician. Descriptive analyses of the sample characteristics included means and standard deviations (SD) for continuous variables, and the frequency of distribution for categorical variables. Study "completers" were those who completed all three survey assessments. Patterns of participation were calculated from attendance frequency in two ways: (1) summarizing by session and (2) by participant. Satisfaction and acceptability towards the programme, and perception of clinical performance were both assessed descriptively at T1 and T2.

A repeated measures analysis (ANOVA) was conducted to compare the outcomes of interest (i.e., self-efficacy, knowledge, and attitude) over the three data collection time points, and each of them was analysed separately. The linear mixed model (Fitzmaurice *et al*. 2004) included the continuous dependent outcome measured at T0, T1, and T2, with the within-participant effect of the time as a fixed effect and the participant intercept as a random effect. Based on the existing literature on the ECHO model (McBain *et al*. 2019), the initial univariate models were expanded to adjust for predefined covariates (i.e., age, gender, profession, work setting) as fixed between-participant effects. The least-squares mean differences of change from baseline to T1 and T2, with a 95% confidence interval (CI), were computed from the models. The Cohen's *d* effect size (ES) (Ferguson 2009) was calculated as estimated means difference divided by the pooled standard deviation. In addition, the descriptive statistics for the six CMPPQ subscales were presented and the differences between baseline and the follow-up times were assessed using paired t-tests. All tests were conducted at a 2-sided 0.05 level of significance. Due to the relatively small total sample size ($n = 28$), the statistical analysis had low statistical power, and thus, the findings are focused on results that are potentially relevant clinically.

In a similar analytical approach, we used linear-mixed models to examine subgroups and interactions with the study's main outcomes: (1) stratified by session attendance frequency (i.e., low vs high) and (2) stratified by professional group (i.e., nurses vs other healthcare professionals). Based on the results of a previous CD-related ECHO study (Sockalingam *et al*. 2017), low attendance was defined as participating in 25% or

TABLE 1 *Study outcomes overview, based on Moore* et al.*'s (2009) Expanded Outcomes Framework*

Moore *et al.*'s (2009) outcome level		Moore *et al.*'s definition	Study outcome	Measurements
LEVEL 1 – Participation		"The number of physicians and other healthcare professionals who participated in the CME activity"	Participation in ECHO-CD	• Online session attendance records • Number of patient cases presented during online sessions
LEVEL 2 – Satisfaction		"The degree to which the expectations of the participants about the setting and delivery of the CME activity were met"	Satisfaction with, and acceptability of, ECHO-CD	• A 30-item questionnaire developed for the purpose of this study, which included six dimensions of satisfaction and acceptability: (1) general satisfaction with ECHO-CD (two items); (2) quality of information and technology (three items); (3) satisfaction towards technological infrastructure (six items); (4) perceived usefulness of ECHO-CD (eight items); (5) perceived impacts of technological infrastructure on learning activities (four items); and (6) perceived interactions and collaboration between group members (six items) • Each item was rated on a seven-point Likert scale, from 1 (totally disagree) to 7 (totally agree)
LEVEL 3 – Learning	LEVEL 3A – Declarative Knowledge	The degree to which participants state what the CME activity intended them to know"	Knowledge about CDs	• A 16-question knowledge test on CDs, specifically developed for the this study to reflect the programme content • Consisting of four clinical vignettes describing a case scenario related to various aspects of working with people with CDs, each of them including between 3–5 multiple-choice questions • The total knowledge score was obtained by first summing the number of correct responses on a maximum score of 16, and then this ratio was calculated in percentage unit – yielding a total score range from 0 to 100

(*Continued*)

TABLE 1 (Continued)

Moore *et al.*'s (2009) outcome level	Moore *et al.*'s definition	Study outcome	Measurements
LEVEL 3B - Procedural Knowledge	"The degree to which participants state how to do what the CME activity intended them to know how to do"	Therapeutic attitude towards working with people with CD	• The CMPPQ (Watson *et al.* 2007), a self-administered questionnaire comprising six subscales: role adequacy (11 items), role legitimacy (three items), role support (three items), motivation (five items), task-specific self-esteem (six items), work satisfaction (five items) • The CMPPQ contains 33 items rated on a seven-point Likert scale from strongly agree (1) to strongly disagree (7) • To score the CMPPQ, several items (items 20, 21, 22, 24–27, and 29) are first reverse scored and then all items are summed, which yields a score range from 33 to 231 • A low total score represents a positive attitude and a high total score represents a more negative attitude towards CDs
LEVEL 4 – Competence	"The degree to which participants show in an educational setting how to do what the CME activity intended them to be able to do"	Self-efficacy in CD management	• A 25-item questionnaire allowing participants to rate their level of confidence in being able to perform a specific clinical behaviour in CD management (e.g., "Offering basic but accurate and up-to-date information and advice about effects of substances on mental and physical health and vice versa"), from "not certain at all can do" (1) to "highly certain can do" (10) • The final score was obtained by calculating the mean of all items' rating (possible range from 0 to 10)

(*Continued*)

TABLE 1 (Continued)

Moore *et al.*'s (2009) outcome level	Moore *et al.*'s definition	Study outcome	Measurements
LEVEL 5 – Performance	"The degree to which participants do what the CME activity intended them to be able to do in their practices"	Perception of clinical performance	Three questions regarding: • Number of patients with CDs having been given care (e.g., screening, evaluation, treatment, follow-up) during the last 6 months • Of those patients with CDs having been given care, the number of managed without referral to specialized healthcare services, since participation in ECHO-CD • Application in clinical practice of recommendations or learning acquisitions gained from ECHO-CD (yes/no) during the last 6 months

CDs, concurrent disorders; CME, continuing medical education; CMPPQ, Comorbidity Problems Perceptions Questionnaire; ECHO-CD, ECHO programme for concurrent disorder management.

less of the whole programme curriculum (i.e., 0–5 sessions), while high attendance included participants who attended more than 25% of the curriculum (i.e., 6–20 sessions).

RESULTS

Participant flow

The participant flow diagram is illustrated in Figure 1 (Vandenbroucke *et al.* 2014). Of the 65 nurses who registered in ECHO-CD between 2018 and 2020, 33 nurses declined to participate in the study, and four others were excluded due to non- or late completion of the baseline survey – yielding an acceptance rate of 43% (95% CI: 32–55%). Of the nurses who declined to participate or who were excluded (n = 37), six nurses cancelled their registration in the programme, and 15 never attended any of the online sessions. All remaining 28 participants completed the baseline survey, and 19 (68%) and 12 (43%) completed the 6- and 12-month follow-up surveys, respectively.

Baseline characteristics of study participants

The study sample consisted of 28 nurses (96.4% women), with a mean age of 39.1 years old (SD = 6.2). Table 2 depicts the sample baseline characteristics overall, by study completer and by session attendance. Most nurses had between 11 and 15 years of clinical experience (n = 15/28; 53.6%), and 71.4% (n = 20/28) had earned a baccalaureate degree. The most frequently endorsed professional role was registered nurse (n = 25/28; 89.3%). Hospital-based healthcare settings (n = 15/28; 53.6%) and community-based mental healthcare settings (n = 8/28; 28.6%) were the most common workplace, with 60.7% (n = 17) of the sample working in urban areas. On average, 67.5% (SD = 21.3%) of all patients encountered by the nurses in their clinical practice had CDs.

Participation

Regarding year of participation, 10 nurses were registered in the curriculum for 2018–2019, and 18 in the curriculum for 2019–2020. Of the 10 nurses who participated in the 2018–2019 curriculum, three registered themselves for a second year. Of all 20 sessions, the median of session participant attendance was 39% (interquartile range [IQR]: 30–50%), with a slightly decreasing trend by the end of the curriculum.

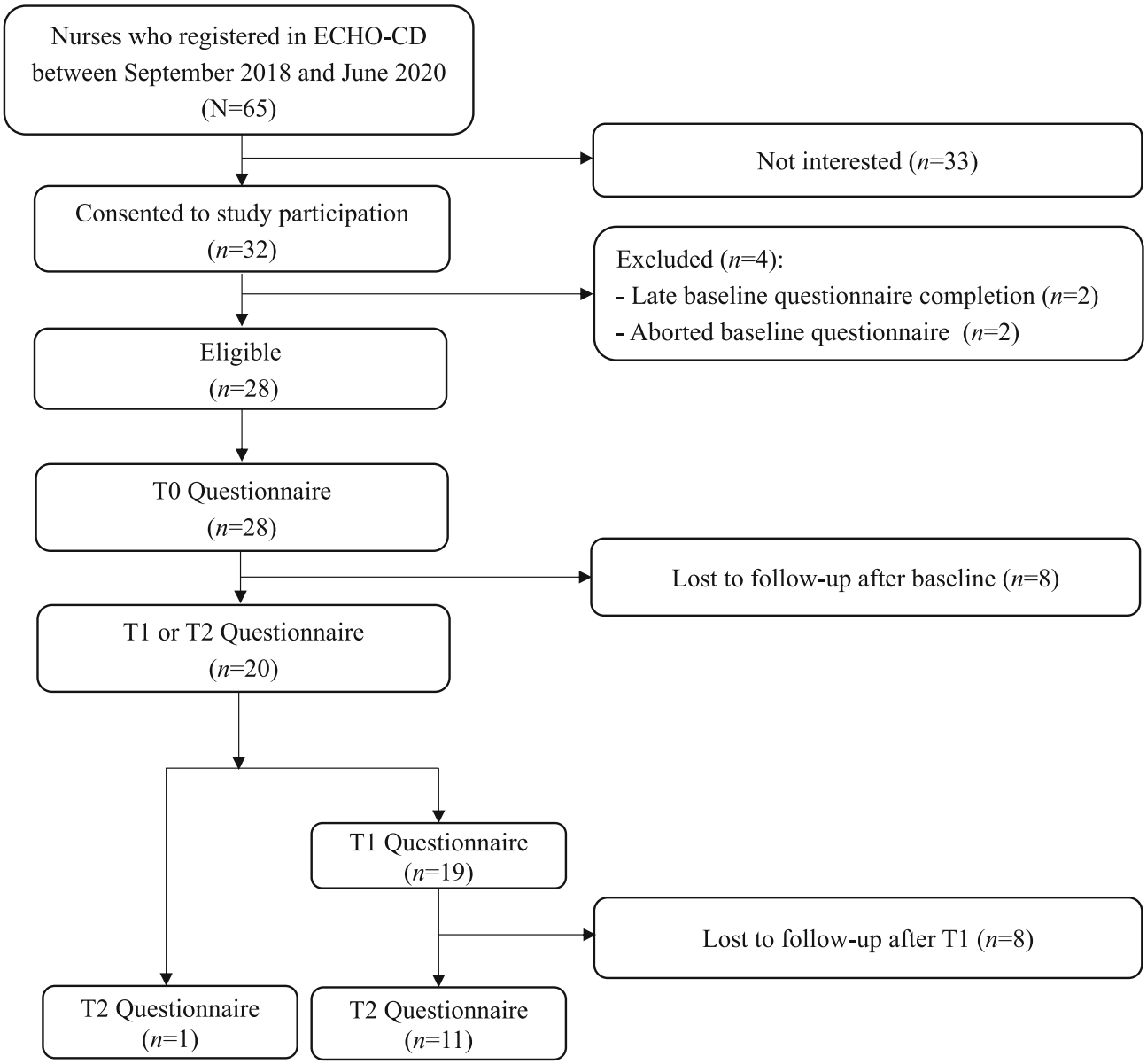

FIG. 1 Participant flow diagram. ECHO-CD, ECHO programme for concurrent disorder management; *n*, number of participants; N, potential study population; T0, baseline; T1, 6-month follow-up; T2, 12-month follow-up.

Overall, there were 12 study participants (42.9%) who attended between 0–5 sessions and 16 others (57.1%) who attended six sessions or more. The mean numbers of patient cases presented were 0.3 (SD = 0.6) and 0.7 (SD = 0.9) at T1 and T2, respectively (data not shown).

Self-efficacy, knowledge, and attitude

Table 3 shows the estimated least-squares means and least-squares means difference in self-efficacy, knowledge, and attitude for all responders over time. The estimates adjusted by predefined covariates were very similar to those not adjusted. At baseline, least-squares mean for self-efficacy was 7.8 (95% CI: 7.4–8.2), and the results remained closed to this at the 6-month (7.8; 95% CI: 7.4–8.3) and 12-month (7.9; 95% CI: 7.3–8.4) follow-ups. Overall, the ANOVA longitudinal analysis revealed that there was no statistically significant improvement at the 6- and 12-month follow-ups, as compared to the baseline, for self-efficacy ($P_{T1\text{-}T0} = 0.8363$, $P_{T2\text{-}T0} = 0.7665$).

With respect to the ANOVA longitudinal analysis, our results indicated that variations in the knowledge scores reached significance at both the 6-month (P = 0.0045) and 12-month (P = 0.0014) follow-ups, compared to the baseline. Following Cohen's d definition (Ferguson 2009), medium ($ES_{T1\text{-}T0}$ = 0.72) and medium-large ($ES_{T2\text{-}T0}$ = 0.94) ESs of change were observed from the baseline to the 6- and 12-month follow-ups, respectively.

In terms of nurses' attitude towards working with people with CDs, statistically significant improvements were found at the 6-month (P = 0.0472) and 12-month (P = 0.0139) follow-ups, compared to the baseline attitude scores, with a, respectively, small ($ES_{T1\text{-}T0}$ = -0.44) and medium ($ES_{T2\text{-}T0}$ = -0.59) ES of change. Descriptive statistics for the CMPPQ six subscales are provided in Table A2: Appendix I. These include the results for mean differences between baseline and T1 and T2. Overall, it was noted that all six subscales obtained a low score at baseline, indicating a positive attitude towards CDs. *Role adequacy* was the only subscale that showed statistically significant improvements at both T1 (P = 0.0316) and T2 (P = 0.0020).

The first subgroup analysis revealed that improvements in self-efficacy were statistically significant for nurses with a high session attendance at the 12-month follow-up, with a medium ES (see Table A3: Appendix I; P = 0.0213, $ES_{T2\text{-}T0}$ = 0.53). Also, the improvements in the knowledge and attitude scores found in the longitudinal ANOVA analysis (Table 3) only remained statistically significant for nurses with a high session attendance at both T1 (see Table A3: Appendix I; P = 0.0011 and P = 0.0063 for knowledge and attitude, respectively), and T2 (see Table A3: Appendix I; P = 0.0015 and P = 0.0027 for knowledge and attitude, respectively).

Satisfaction and acceptability towards the programme, and perception of clinical performance

As shown in Table 4, mostly all dimensions of satisfaction and acceptability towards the programme were highly rated on the seven-point Likert scale, varying from 5.1 (SD = 0.7) to 5.7 (SD = 1.1) at T1, and from 4.6 (SD = 0.6) to 5.8 (SD = 1.0) at T2.

The mean number of patients with CD receiving care from the nurses was 29.4 (SD = 39.2) at baseline; while at T1 and T2, these numbers were 26.6 (SD = 30.5) and 32.6 (SD = 60.7), respectively. Of those patients with CD receiving care by the nurses, the mean numbers who were being managed without referral to specialized healthcare services since ECHO were 15.3 (SD = 15.2) and 22.1 (SD = 33.5) at T1 and T2, respectively. At both T1 (n = 19/28) and T2 (n = 12/28), 58% of the nurses reported that they had incorporated into their clinical practice either the recommendations they received, or the learning acquired during ECHO.

Benefits of educational intervention exposure for improvements in nurses' outcomes as compared to other healthcare professionals

With regard to the other healthcare professionals who participated in the larger cohort study (n = 146/174), the most frequently reported professions were social worker, at 31.5% (n = 46/146), and psychologist or therapist, at 25.3% (n = 37/146); followed by addiction worker, at 12.3% (n = 18/146), psychiatrist, at 6.8% (n = 10/146), and physician, at 2.1% (n = 3/146). The remaining 32 participants (21.9%) endorsed other allied health professions such as community health workers, clinical administrators, and care coordinator (see Table A4: Appendix I).

The second subgroup analysis (see Table A5: Appendix I) showed that, compared to the nurses, the other healthcare professionals significantly improved their self-efficacy scores between the baseline and the 6- and 12-month follow-ups, with small ESs, regardless of session attendance frequency. In terms of knowledge, there were significant improvements in both nurses and other healthcare professionals at the 6- and 12-month follow-ups, with a greater ES at T2. Similarly, attitude scores also improved significantly in both groups at T1 and T2, with, respectively, small and medium ESs.

DISCUSSION

The present study examined changes in nurses' self-efficacy, knowledge, and attitude over a 12-month period during the implementation of an ECHO programme for CD management over a widespread geographical area in the province of Quebec, Canada. We also assessed nurses' satisfaction and acceptability towards the programme, and their perception of their own clinical performance. Our findings showed that the use of an ECHO programme to support and train nurses in CD evidence-based practice led to statistically significant improvements in knowledge and

TABLE 2 *Baseline characteristics of study participants overall, by follow-up completers and attendance*

Variable	All (n = 28) n (%)	Non-completers (n = 17) n (%)	Completers (n = 11) n (%)	Attendance: 0–5 sessions (n = 12) n (%)	Attendance: 6–20 sessions (n = 16) n (%)
Demographics					
Age, mean (SD)	39.1 (6.2)	40.7 (5.3)	36.6 (7.0)	38.0 (4.8)	39.9 (7.2)
Gender					
Women	27 (96.4%)	16 (94.1%)	11 (100.0%)	12 (100.0%)	15 (93.8%)
Men	1 (3.6%)	1 (5.9%)	0 (0.0%)	0 (0.0%)	1 (6.3%)
Degree earned					
Undergraduate diploma	2 (7.1%)	2 (11.8%)	0 (0.0%)	1 (8.3%)	1 (6.3%)
Baccalaureate	20 (71.4%)	12 (70.6%)	8 (72.7%)	9 (75.0%)	11 (68.8%)
Master	6 (21.4%)	3 (17.6%)	3 (27.3%)	2 (16.7%)	4 (25.0%)
Professional role					
Registered nurse	25 (89.3%)	14 (782.4%)	11 (100.0%)	12 (100.0%)	13 (81.3%)
Clinical nurse specialist	2 (7.1%)	1 (11.8%)	0 (0.0%)	0 (0.0%)	2 (12.5%)
Auxiliary nurse	1 (3.6%)	1 (5.9%)	0 (0.0%)	0 (0.0%)	1 (6.3%)
Years of clinical experience					
0–5	3 (10.7%)	1 (5.9%)	2 (18.2%)	1 (8.3%)	2 (12.5%)
6–10	5 (17.9%)	2 (11.8%)	3 (27.3%)	3 (25.0%)	2 (12.5%)
1–15	15 (53.6%)	11 (64.7%)	4 (36.4%)	8 (66.7%)	7 (43.8%)
16–20	2 (7.1%)	2 (11.8%)	0 (0.0%)	0 (0.0%)	2 (12.5%)
21+	3 (10.7%)	1 (5.9%)	2 (18.2%)	0 (0.0%)	3 (18.8%)
Practice characteristics					
Work setting					
Primary care	1 (3.6%)	1 (5.9%)	0 (0.0%)	1 (8.3%)	0 (0.0%)
Community-based mental health care	8 (28.6%)	4 (23.5%)	4 (36.4%)	4 (33.3%)	4 (25.0%)
Hospital-based health care	15 (53.6%)	9 (52.9%)	6 (54.5%)	7 (58.3%)	8 (50.0%)
Community-based addiction treatment	3 (10.7%)	2 (11.8%)	1 (9.1%)	0 (0.0%)	3 (18.8%)
Other	1 (3.6%)	1 (5.9%)	0 (0.0%)	0 (0.0%)	1 (6.3%)
Area					
Urban/Suburban	17 (60.7%)	9 (52.9%)	8 (72.7%)	8 (66.7%)	9 (56.3%)
Rural	6 (21.4%)	3 (17.6%)	3 (27.3%)	1 (8.3%)	5 (31.3%)
Remote	3 (10.7%)	3 (17.6%)	0 (0.0%)	2 (16.7%)	1 (6.3%)
Mixed	2 (7.1%)	2 (11.8%)	0 (0.0%)	1 (8.3%)	1 (6.3%)
ECHO-CD session details					
Curriculum					
(1) 2018–2019	10 (35.7%)	6 (35.3%)	4 (36.4%)	3 (25.0%)	7 (43.8%)
(2) 2019–2020	18 (64.3%)	11 (64.7%)	7 (63.6%)	9 (75.0%)	9 (56.3%)
Session attendance, mean (SD)[†]	8.6 (5.9)	6.5 (4.7)	11.9 (6.1)	3.2 (1.9)	12.8 (4.1)

%, percentage; ECHO-CD, ECHO programme for concurrent disorder management; n, number of participants; P, P-value; SD, standard deviation.

[†]During the first year of registration.

attitude, and in self-efficacy for the nurses who attended over 25% of the 20-session curriculum.

Self-efficacy is a construct referring to an individual's belief in their capacity to execute a behaviour necessary to produce a specific action (Bandura 1997). In the literature on continuing education in nursing, some authors refer to self-efficacy as a situation-specific form of competence – or perceived competence (Watson *et al*. 2002), and it is the first step towards behavioural change. Our findings showed that the group of other healthcare professionals significantly improved their self-efficacy post-ECHO; however, among the nurses, significant increases in the self-efficacy scores were only found among high attendees at the 12-month follow-up. We also observed significant improvements in nurses' knowledge and attitude scores at the 6- and 12-month follow-ups, including participants with a high or a low session attendance frequency. Similarly, all other professions, regardless of attendance frequency, also significantly improved their

TABLE 3 *Longitudinal ANOVA results, for all responders* (n = 28)

			Unadjusted analysis, $n = 28^{\dagger}$				Adjusted analysis, $n = 28^{\ddagger}$			
Outcome	n	T	LS mean (95% CI)	LS mean diff (95% CI)	P	ES[§]	LS mean (95% CI)	LS mean diff (95% CI)	P	ES[§]
Self-efficacy	28	0	7.8 (7.4; 8.2)	0	–	–	8.1 (7.3; 8.8)	0	–	–
	19	1	7.8 (7.4; 8.3)	0.0 (−0.4; 0.5)	0.8363	0.06	8.1 (7.3; 8.9)	0.0 (−0.4; 0.5)	0.8182	0.07
	12	2	7.9 (7.3; 8.4)	0.1 (−0.4; 0.6)	0.7665	0.07	8.1 (7.3; 9.0)	0.1 (−0.4; 0.6)	0.7515	0.07
Knowledge	28	0	63.4 (58.6; 68.2)	0	–	–	68.8 (61.3; 76.3)	0	–	–
	19	1	71.5 (66.0; 77.1)	8.1 (2.7; 13.5)	**0.0045***	0.72	76.8 (68.7; 84.9)	8.0 (2.7; 13.3)	**0.0043***	0.71
	12	2	74.5 (67.9; 81.1)	11.1 (4.7; 17.6)	**0.0014***	0.94	79.7 (70.7; 88.7)	10.9 (4.6; 17.3)	**0.0014***	0.93
Attitude	28	0	90.5 (83.4; 97.6)	0	–	–	85.9 (73.8; 97.9)	0	–	–
	19	1	82.2 (74.0; 90.5)	−8.3 (−16.5; −0.1)	**0.0472***	−0.44	77.4 (64.4; 90.4)	−8.5 (−16.6; −0.3)	**0.0424***	−0.45
	12	2	78.0 (68.2; 87.8)	−12.5 (−22.3; −2.7)	**0.0139***	−0.59	73.0 (58.7; 87.3)	−12.8 (−22.6; −3.1)	**0.0118***	−0.61

%, percentage; CI, confidence interval; ES, estimated effect size; LS mean diff, least-squares mean difference; LS mean, least-squares mean; n, number of participants; P, P-value; T, time; T0, baseline; T1, 6-month follow-up; T2, 12-month follow-up. (*) Significant P-value ($P < 0.05$).

[†]Unadjusted analysis = Linear mixed models with repeated measures and time as fixed effect.

[‡]Adjusted analysis = Linear mixed models with repeated measures and time, age, gender, and workplace as fixed effect.

[§]Estimated effect size = Estimated mean difference divided by the pooled standard deviation.

TABLE 4 *Results for the satisfaction and acceptability questionnaire at T1and T2*

Dimension (mean, SD)	T1[†]	T2[‡]
General satisfaction towards ECHO-CD	5.7 (1.1)	5.8 (1.0)
Quality of information and technology	5.4 (0.8)	5.3 (1.1)
Satisfaction towards technological infrastructure	5.3 (1.1)	5.6 (1.1)
Perceived usefulness of ECHO-CD	5.1 (0.8)	4.8 (0.7)
Perceived impacts of technological infrastructure	5.3 (1.0)	5.3 (1.0)
Perceived interactions and collaboration between participants	5.1 (0.7)	4.6 (0.6)

ECHO-CD, ECHO programme for CD management; SD, standard deviation; T0, baseline; T1, 6-month follow-up; T2, 12-month follow-up.

[†]n = 19/28 (67.9%).

[‡]n = 12/28 (42.9%).

knowledge and attitude scores at 6 and 12 months. Reflecting on Bandura's (1997) social cognitive theory, these results were expected, as the nurses who were more engaged in the programme perceived that they were benefiting from the intervention and gained knowledge and built confidence in their own abilities, by observing and receiving feedback from others, and by having mentors reinforce behaviour changes. These findings are promising in that ECHO-CD is achieving its goals of attracting healthcare professionals who are encountering people with CDs on a regular basis and mentoring them on how to manage these conditions appropriately.

Our results regarding improvements in self-efficacy partially align with previous research on CD-related ECHO programmes. A previous pre-post cohort study of primary care providers (N = 131) – who were predominantly nurse practitioners (31.3%; n = 41) and nurses (13.0%; n = 13) – noted that participants who attended 8 or more sessions of a 32-week curriculum had higher self-efficacy ratings and mean knowledge scores 8 months post-ECHO, as compared to baseline, but these findings approach significance only (Sockalingam *et al*. 2017). Another research group in India evaluated the impact of an ECHO programme in mental health and addiction care on community-based clinical psychologists' and psychiatric social workers' outcomes over a 6-month period (Mehrotra *et al*. 2018). The study reported statistically significant increases in the participants' mean scores for knowledge and self-confidence (N = 12), with half the sample having attended 80% of the training. Interestingly, Shimasaki *et al*. (2019) conducted a mixed-methods study, involving 42 interviews and 34 completed surveys, with the primary care providers involved in an ECHO programme that covered a range of topics in mental health and substance use disorders and found that, compared to the group of registrants who participated minimally, the higher attenders discussed how they had applied their newly gained knowledge more frequently and indicated in the survey that their participation in the ECHO sessions contributed to enhancing their self-confidence. Bottom line – the results from the previous CD-related ECHO studies, combined with our findings, highlight that consistent and continued participation in ECHO is an essential condition to improve nurses' learning outcomes and further strengthen their confidence in CD management.

Consistent with the results of three previous systematic reviews on the ECHO model's impact (Holmes *et al*. 2020; McBain *et al*. 2019; Zhou *et al*. 2016), and a broader spectrum of research specific to CD education (Garrod *et al*. 2020; Petrakis *et al*. 2018; Pinderup *et al*. 2016), the results of this study suggest that the ECHO-CD intervention successfully enhanced healthcare professional's knowledge about CDs, regardless of profession. Several integral characteristics of the ECHO model have been associated with healthcare professionals' knowledge uptake, including having rapid access to evidence-based practice, appraising one's knowledge through peer learning, and being provided with relevant educational material and resources from experts (Page *et al*. 2021). However, further research remains to be done to interpret these knowledge gains within knowledge translation theories and frameworks (French *et al*. 2012) to deepen our understanding of the processes through which these gains are adapted, used, and sustained in clinical nursing practice.

In contrast with previous research evaluating the impact of ECHO in the field of CDs, our study was the first to formally measure changes in nurses' attitude towards CDs. Our results show significant changes in nurses' total CMPPQ scores at the 6- and 12-month follow-ups, in comparison to the baseline, regardless of session attendance frequency. The changes in total CMPPQ scores were slightly inferior to those found by other studies (Munro *et al*. 2007; Pinderup 2017, 2018); however, in our study, the nurses' mean total CMPPQ score at baseline was also inferior to those previously reported, thus denoting their positive attitude towards CD pre-ECHO. This difference can be explained by the fact that our sample was made up of nurses from a variety of settings, including community-based addiction treatment, while previous studies were focused only on nurses or professionals working in psychiatric and/or mental health healthcare departments. Given that nurses' learning needs may vary according to their work setting, improvements in attitude scores might have been greater if the ECHO-CD content had been adapted – or even more adapted – to their needs and local particularities. For example, nurses working in community-based or outpatient mental healthcare services may require education in the assessment, engagement, and management of patients with CDs, while nurses in hospital-based settings may need support to detect and assess mental health and substance use disorders, with less emphasis on longer-term intervention/treatment options.

Besides showing significant changes in the total CMPPQ scores, our results also indicate that the greatest variation was seen in the subscale *role adequacy*, that is, the extent to which nurses perceive their knowledge and skills as being adequate. Other studies have also found the greatest change in this subscale (Pinderup 2017), suggesting that training may simultaneously and positively affect knowledge about and attitude towards CD – both are important to the mechanism underlying the adoption of new clinical-practice behaviours. Attitude has indeed long been known to be a predictor of behaviour (Ajzen 1991), and, furthermore, mental health nurses' attitudes towards CDs have been shown to constitute a major predictor of their willingness to engage with this patient group (Anandan *et al*. 2021). It is therefore important that continuing education interventions that target mental health nurses address this relevant topic in their pedagogical content and thus provide opportunities for participants to reflect on their own knowledge, beliefs and/or misconceptions, and values around CDs.

Regarding satisfaction and acceptability, the nurses had a positive outlook on ECHO-CD, including the quality of its content, the perceived usefulness, the ease of use and flexibility of the technology, and the interactions between participants and experts. Consistently, previous research pertaining to exploring or measuring participants' satisfaction with ECHO reported favourable reactions (McBain *et al*. 2019), with some of them highlighting that the model's notoriety was associated by participants with rapid access to reliable information, networking opportunities, and increased possibilities of treatment and care options across frontline healthcare services (Page *et al*. 2021; Zhou *et al*. 2016). In addition, many studies found that participants perceived a sense of belonging to a community that developed throughout their participation in ECHO, which helped them to improve their confidence in their capacity to manage complex health conditions (Englander *et al*. 2020; Zhao *et al*. 2020).

Despite their enthusiasm towards ECHO-CD, the nurses in this study attended, on average, slightly less than half the programme's sessions, and the results showed that very few of them presented a patient case. With regard to the results from qualitative, and mixed-methods studies of other ECHO programmes worldwide (McBain *et al*. 2019; Zhou *et al*. 2016), several obstacles to participation and retention have been identified. These can help provide insight into the key factors that might have hindered the nurses' motivation to engage with or maintain their participation in ECHO-CD. Most of the challenges identified in the literature

are related to time constraints and managing hectic practice schedules to attend ECHO sessions (Zhou *et al*. 2016); and access to technology (Stevenson *et al*. 2018). Other common barriers to participation and engagement in ECHO were more specific to interactions between participants, such as the heterogeneity of professional backgrounds and experiences, medical hierarchy, and group learning (Damian *et al*. 2020; Englander *et al*. 2020; Page *et al*. 2021). For example, Zhao *et al*. (2020) explored the interprofessional aspects of an ECHO programme for chronic pain management, and found that the presence of a hierarchy where pharmacological approaches were prioritized negatively affected most non-physician participants' willingness to maintain participation. The same research group has also recently identified that engagement in ECHO was hindered by the participants' sense of fear, together with their apprehensions of being judged by the group, especially with regard to the most experienced participants or those in a senior position (Zhao *et al*. 2020). Consistently, White *et al*. (2019) conducted two focus groups with 14 nurses who participated in a palliative care ECHO programme, and reported that reluctance to speak in the group setting, due to shyness and a lack of confidence, was commonly expressed. Hence, despite the well-documented benefits of interprofessional education for mental health nursing practice (Marcussen *et al*. 2019), this particular issue revolving around group interactions appears to be an important disruptor of continued participation typically associated with ECHO programmes, and more broadly, with collaborative learning models such as communities of practice (McLoughlin *et al*. 2018).

There are several limitations in this study that affect the interpretability of its results. One major limitation is that we used an observational, prospective cohort study design without a control group. For this reason, causal assumptions regarding outcomes cannot be made. Other external factors than exposure to the educational intervention could therefore account for the changes observed in the study results, whether in part or in whole. A second limitation is that our small sample size was small, with a potential study population intentionally restricted to nurse participants within the context of a larger 2-year prospective cohort study that included ECHO participants from various professional disciplines. As a result, our statistical analysis had low statistical power and it is possible that the data we gathered may not have had sufficient observations to detect changes in nurses' self-efficacy, as it did for the group of other healthcare professionals. However, since this study took place under "real world" clinical settings – as opposed to controlled ideal circumstances – our approach to data analysis and interpretation, as outlined previously, focused on results that were potentially relevant clinically.

A third limitation is that the survey response rates decreased over time, going from 32% at 6 months to 57% at 12 months. Attrition bias could therefore be at play and could be associated with the smaller effects of the main outcomes. It is also possible that the nurses who were less engaged in the programme did not complete all the surveys and, as a result, their outcomes were not captured. A fourth limitation is that our data were collected using self-reported measurements, some of which were obtained with instruments that had not been assessed for validity, specifically those measuring self-efficacy and knowledge. A fifth limitation is that our stratified analytical approach for the subgroup analysis (i.e., low vs. high attendance) was based on the results of a single, similar ECHO study (Sockalingam *et al*. 2017); minimum required exposure to the programme for learning and for changes in practice to occur would require further investigation. A sixth limitation is the data were obtained from just one province in Canada and our sample was mostly comprised of nurses who had more than 10 years of clinical experience and a bachelor's degree. It is therefore unclear if the results will be generalizable to other countries or healthcare settings, or applicable to nurses with other academic and professional backgrounds. Lastly, as this cohort study was conducted during the programme's implementation and expansion period, our outcome assessment strategy focused on the first four levels of Moore *et al*.'s (2009) conceptual framework; the changes observed in nurses' self-efficacy, knowledge, and attitude do not necessarily mean that changes occurred in their practice. However, individual, semistructured interviews with a subgroup of nurses (n = 10) were conducted concurrently, allowing us to explore in depth how the nurses had developed and implemented their CD-management competencies in their clinical practice (Chicoine *et al*. 2022).

Despite these limitations, our study still brings valuable input to the scarce body of evidence on the benefits of CD-focused ECHO programmes on nurses' outcomes. Future studies should focus on addressing these limitations, with the purpose of evaluating the ECHO model's effectiveness on CD nursing care and, as such, formally determine how knowledge acquisitions gained through ECHO translate into clinical practice and patients' health outcomes.

RELEVANCE FOR CLINICAL PRACTICE

The ECHO model was initially developed to improve access to hepatitis C treatment, and it was designed to target medical providers only (Arora *et al*. 2007). Unlike hepatitis C virus treatment, CDs are inherently particularly complex and multifaceted, involving mental health and substance use specialties, and it is influenced by multiple biopsychosocial factors. As a result, CD management inevitably involves multidisciplinary efforts, and the care options or treatment recommendations are highly variable based on each patient's needs. These characteristics have driven the development of ECHO-CD, in promoting a tailored-based approach to learning, and an interprofessional environment comprising a diversity of healthcare professionals. As a low-cost high-impact model, ECHO can be adapted to meet the needs of different communities and populations where speciality mental healthcare resources are limited.

The results of this study revealed ECHO as a promising educational approach to improve nurses' attitude, and increased knowledge and confidence for working effectively with CD populations. This type of collaborative learning and capacity-building model can be particularly salient for breaking the silos of learning and mental health nursing practice, by providing nurses with many opportunities to apply the acquired knowledge with their own patients and then receive feedback from experts and peers, sometimes from outside their scope of practice. However, despite the value of the ECHO model, substantial barriers may prevent consistent participation, which are challenging for nurses to overcome without some flexibility in the programme's structure and timing, and without further support from their healthcare organization. In this regard and to ensure its long-term success, ECHO-CD has started amplifying its efforts by engaging participants and programme partners in assessing its impacts and opportunities for ongoing growth.

CONCLUSION

Opportunities for interprofessional continuing learning are rare, but a central pillar in the implementation of evidence-based interventions in mental health nursing. Using videoconferencing technology, ECHO-CD provided an interdisciplinary, flexible environment for nurses to learn more about CD evidence-based practice and find concrete solutions to dealing with complex clinical situations. The results of this study add to the current state of knowledge regarding the ECHO model's impact on provider-level outcomes. Further, this study reinforces that with continued and consistent participation, ECHO has the potential to make meaningful and measurable contributions to enhancing nurses' competencies in CD care. As a result of this study, we are encouraged to believe that other jurisdictions or healthcare organizations could benefit from the adoption of ECHO to spread evidence-based practice and improve care delivery in CD settings.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the Réseau Universitaire Intégré en Santé et Services Sociaux (RUISSS) of the Université de Montréal and the Université de Montréal Hospital Centre for their valuable support and assistance with the development and implementation of the ECHO-CD programme. The authors also wish to thank the nurses for their willingness to participate in this study and all the healthcare professionals involved in ECHO-CD, without whom this initiative could not be offered. GC received doctoral scholarships from the Foundation of the Université de Montréal Hospital Centre (CHUM), the Fonds de Recherche du Québec–Société et Culture (FRQSC), the Ministère de l'Enseignement Supérieur du Québec, the Research Chair in Innovative Nursing Practices and Équipe FUTUR-FRQSC. GF is supported by a Banting Postdoctoral Fellowship (#202010BPF-453986-255367) from the Canadian Institutes of Health Research (CIHR), a Postdoctoral Fellowship Supplement from the University of Ottawa, and a Postdoctoral Fellowship from the Canadian Network on Hepatitis C (CanHepC). DJA holds a clinical scientist career award from the Fonds de Recherche du Québec (FRQS) and acknowledges research support from Health Canada and the Quebec's Ministry of Health and Social Services.

FUNDING STATEMENT

This study received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

DATA AVAILABILITY STATEMENT

The data presented in this article are original and are not under consideration elsewhere. The data used and/or analysed in this study are available from the corresponding author upon reasonable request.

REFERENCES

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behavior and Human Decision Processes*, *50* (2), 179–211.

American Psychiatric Association (APA). (2013). *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V)*. Arlington, VA: American Psychiatric Publishing.

Anandan, R., Cross, W. & Olasoji, M. (2021). Mental health Nurses' attitudes towards consumers with co-existing mental health and drug and alcohol problems: A scoping review. *Issues in Mental Health Nursing*, *42* (4), 346–357.

Arora, S., Geppert, C. M., Kalishman, S. *et al*. (2007). Academic health center management of chronic diseases through knowledge networks: Project ECHO. *Academic Medicine*, *82* (2), 154–160.

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York, NY: Freeman.

Bandura, A. (2006). Guide for constructing self-efficacy scales. In: F. Pajares & T. Urdan (Eds). *Self-Efficacy Beliefs in Adolescents*. Greenwich, CT: Information Age Publishing.

Bauer, L. & Bodenheimer, T. (2017). Expanded roles of registered nurses in primary care delivery of the future. *Nursing Outlook*, *65* (5), 624–632.

van Boekel, L. C., Brouwers, E. P. M., Van Weeghel, J. & Garretsen, H. F. L. (2013). Stigma among health professionals towards patients with substance use disorders and its consequences for healthcare delivery: Systematic review. *Drug and Alcohol Dependance*, *13* (1), 23–35.

Chand, P., Murthy, P., Gupta, V., Kandasamy, A., Jayarajan, D., Sethu, L., Benegal, V., Varghese, M., Komaromy, M. & Arora, S. (2014). Technology enhanced learning in addiction mental health: Developing a virtual knowledge network: NIMHANS ECHO. *2014 IEEE Sixth International Conference on Technology for Education*, 229–232. https://doi.org/10.1109/T4E.2014.14

Chicoine, G., Côté, J., Pepin, J. *et al*. (2021a). Effectiveness and experiences of the extension for community healthcare outcomes (ECHO) model in developing competencies among healthcare professionals: A mixed methods systematic review protocol. *Systematic Reviews*, *10* (313), 313.

Chicoine, G., Côté, J., Pepin, J. *et al*. (2021b). Impact of a videoconferencing educational programme for the management of concurrent disorders on nurses' competency development and clinical practice: Protocol for a convergent mixed methods study. *BMJ Open*, *11* (3), e042875.

Chicoine, G., Côté, J., Pepin, J., Boyer, L., Rouleau, G. & Jutras-Aswad, D. (2022). Experiences and perceptions of nurses participating in an interprofessional, videoconference-based educational programme on concurrent mental health and substance use disorders: A qualitative study. *BMC Nursing*, *21* (1), 177.

Damian, A. J., Robinson, S., Manzoor, F. *et al*. (2020). A mixed methods evaluation of the feasibility, acceptability, and impact of a pilot project ECHO for community health workers (CHWs). *Pilot & Feasibility Studies*, *6* (132), 132.

Englander, H., Patten, A., Lockard, R., Muller, M. & Gregg, J. (2020). Spreading addictions care across Oregon's rural and community hospitals: Mixed-methods evaluation of an interprofessional Telementoring ECHO program. *Journal of General Internal Medicine*, *36*, 100–107.

Ferguson, C. J. (2009). An effect size primer: A guide for clinicians and researchers. *Professional Psychology: Research and Practice*, *40* (5), 532–538.

Fitzmaurice, G. M., Laird, N. M. & Ware, J. H. (2004). *Applied Longitudinal Analysis*. Hoboken, NJ: John Wiley & Sons.

French, S. D., Green, S. E., O'connor, D. A. *et al*. (2012). Developing theory-informed behaviour change interventions to implement evidence into practice: A systematic approach using the theoretical domains framework. *Implementation Science*, *7* (38), 38.

Garrod, E., Jenkins, E., Currie, L. M., McGuinness, L. & Bonnie, K. (2020). Leveraging nurses to improve care for patients with concurrent disorders in inpatient mental health settings: A scoping review. *Journal of Dual Diagnosis*, *16* (3), 357–372.

Holmes, C. M., Keyser-Marcus, L., Dave, B. & Mishra, V. (2020). Project ECHO and opioid education: A systematic review. *Current Treatment Options in Psychiatry*, *7*, 9–22.

Hughes, L. (2006). *Closing the gap: A capability framework for working effectively with people with combined mental health and substance use problems (dual diagnosis)*. Centre for Clinical and Academic Workforce Innovation (CCAWI), University of Lincoln. [Accessed 12 August 2022]. Available from: URL: https://eprints.lincoln.ac.uk/id/eprint/729/

Khan, S. (2017). *Concurrent mental and substance use disorders in Canada*. [Accessed 4 May 2022]. Available from: URL: https://www150.statcan.gc.ca/n1/en/pub/82-003-x/2017008/article/54853-eng.pdf?st=7pd_upjo

Komaromy, M., Duhigg, D., Metcalf, A. *et al*. (2016). Project ECHO (extension for community healthcare outcomes): A new model for educating primary care providers about treatment of substance use disorders. *Substance Abuse*, *37* (1), 20–24.

Komaromy, M., Bartlett, J., Manis, K. & Arora, S. (2017). Enhanced primary care treatment of behavioral disorders with ECHO case-based learning. *Psychiatric Services*, *68* (9), 873–875.

Marcussen, M., Nørgaard, B. & Arnfred, S. (2019). The effects of interprofessional education in mental health practice: Findings from a systematic review. *Academic Psychiatry*, *43* (2), 200–208.

McBain, R. K., Sousa, J. L., Rose, A. J. *et al*. (2019). Impact of project ECHO models of medical tele-education: A systematic review. *Journal of Geneneral Internal Medicine*, *34* (12), 2842–2857.

McLoughlin, C., Patel, K. D., O'callaghan, T. & Reeves, S. (2018). The use of virtual communities of practice to improve interprofessional collaboration and education:

Findings from an integrated review. *Journal of Interprofessional Care*, *32* (2), 136–142.

Mehrotra, K., Chand, P., Bandawar, M. *et al*. (2018). Effectiveness of NIMHANS ECHO blended tele-mentoring model on integrated mental health and addiction for counsellors in rural and underserved districts of Chhattisgarh, India. *Asian Journal of Psychiatry*, *36*, 123–127.

Moore, D. E., Green, J. S. & Gallis, H. A. (2009). Achieving desired results and improved outcomes: Integrating planning and assessment throughout learning activities. *Journal of Continuing Education in the Health Profession*, *29* (1), 1–15.

Mueser, K. T. & Gingerich, S. (2013). Treatment of co-occurring psychotic and substance use disorders. *Social Work in Public Health*, *28* (3–4), 424–439.

Munro, A., Watson, H. E. & McFadyen, A. (2007). Assessing the impact of training on mental health nurses' therapeutic attitudes and knowledge about co-morbidity: A randomised controlled trial. *International Journal of Nursing Studies*, *44* (8), 1430–1438.

National Institute for Care and Health Excellence (NICE). (2016). *Coexisting severe mental illness and substance misuse: Community health and social care services (NG58)*. [Accessed 5 May 2022]. Available from: URL: https://www.nice.org.uk/guidance/ng58

Page, M. G., Develay, É., Simard, P., Parent, J., Tremblay, N. & Boulanger, A. (2021). Qualitative study of health care providers' uptake of the project extension for community health outcomes for chronic pain. *Journal of Continuing Education in the Health Profession*, *42*(2), 97-104.

Petrakis, M., Robinson, R., Myers, K., Kroes, S. & O'connor, S. (2018). Dual diagnosis competencies: A systematic review of staff training literature. *Addictive Behavaviors Reports*, *7*, 53–57.

Pinderup, P. (2017). Training changes professionals' attitudes towards dual diagnosis. *International Journal of Mental Health Addiction*, *15*, 53–62.

Pinderup, P. (2018). Improving the knowledge, attitudes, and practices of mental health professionals regarding dual diagnosis treatment – A mixed methods study of an intervention. *Issues in Mental Health Nursing*, *39* (4), 292–303.

Pinderup, P., Thylstrup, B. & Hesse, M. (2016). Critical review of dual diagnosis training for mental health professionals. *International Journal of Mental Health Addiction*, *14* (5), 856–872.

Priester, M. A., Browne, T., Lachini, A., Clone, S., Dehart, D. & Seay, K. D. (2016). Treatment access barriers and disparities among individuals with Co-occurring mental health and substance use disorders: An integrative literature review. *Journal of Substance Abuse Treatment*, *61*, 47–59.

Shaw, S., Cartwright, A., Spratley, T. & Harwin, J. (1978). *Responding to Drinking Problems*. London, UK: Croom Helm Ltd.

Shimasaki, S., Bishop, E., Guthrie, M. & Thomas, J. F. F. (2019). Strengthening the health workforce through the ECHO stages of participation: Participants' perspectives on key facilitators and barriers. *Journal of Medical Education and Curricular Development*, *6*, 1–8.

Smolowitz, J., Speakman, E., Wojnar, D. *et al*. (2015). Role of the registered nurse in primary health care: Meeting health care needs in the 21st century. *Nursing Outlook*, *63* (2), 130–136.

Sockalingam, S., Arena, A., Serhal, E., Mohri, L., Alloo, J. & Crawford, A. (2017). Building provincial mental health capacity in primary care: An evaluation of a project ECHO mental health program. *Academic Psychiatry*, *42*, 451–457.

Stevenson, L., Ball, S., Haverhals, L. M., Aron, D. C. & Lowery, J. (2018). Evaluation of a national telemedicine initiative in the veterans health administration: Factors associated with successful implementation. *Journal of Telemedicine and Telecare*, *24* (3), 168–178.

Urbanoski, K., Inglis, D. & Veldhuizen, S. (2017). Service use and unmet needs for substance use and mental disorders in Canada. *Canadian Journal of Psychiatry*, *62* (8), 551–559.

Vandenbroucke, J. P., Von Elm, E., Altman, D. G. *et al*. (2014). Strengthening the reporting of observational studies in epidemiology (STROBE): Explanation and elaboration. *International Journal of Surgery*, *12* (12), 1500–1524.

Watson, R., Stimpson, A., Topping, A. & Porock, D. (2002). Clinical competence assessment in nursing: A systematic review of the literature. *Journal of Advance Nursing*, *39* (5), 421–431.

Watson, H., Maclaren, W. & Kerr, S. (2007). Staff attitudes towards working with drug users: Development of the drug problems perceptions questionnaire. *Addiction*, *102* (2), 206–215.

White, C., Mcilfatrick, S. & Dunwoody, L. (2019). Supporting and improving community health services—A prospective evaluation of ECHO technology in community palliative care nursing teams. *BMJ Supportive & Palliative Care*, *9* (2), 202–208.

World Health Organization (WHO). (2021). *Comprehensive Mental Health Action Plan 2013–2030*. [Accessed 5 May 2022]. Available from: URL: https://www.who.int/publications/i/item/9789240031029

Zhao, J., Salemohamed, N., Stinson, J. & Carlin, L. (2020). Health care Providers' experiences and perceptions participating in a chronic pain telementoring education program: A qualitative study. *Canadian Journal of Pain*, *4* (1), 111–121.

Zhou, C., Crawford, A., Serhal, E., Kurdyak, P. & Sockalingam, S. (2016). The impact of project ECHO on participant and patient outcomes: A systematic review. *Academic Medicine*, *91* (10), 1439–1461.

APPENDIX I:

TABLE A1 *STROBE-statement checklist of items for reporting observational studies (cohort studies) (Vandenbroucke* et al. *2014)*

Item	No.	Recommendation	Manuscript reference and/or complementary information
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Done See the Title page and the 'Abstract and Keywords' section in the main text (P. 1)
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Done We described the design, the target population, the sampling method, the procedure for data collection and data analysis and the main results for the outcomes of interests See the 'Abstract and Keywords' section in the main text (P. 1)
Introduction			
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Done. We provided an accurate state of the literature on the ECHO model and more specifically we explained the lack of empirical knowledge regarding the impact of ECHO on nurses' outcomes in the context of concurrent disorder care See the 'Background' section in the main text (P. 4–5)
Objectives	3	State specific objectives, including any prespecified hypotheses	Done. We indicated the general aim of the study and then we state the specific objectives of the study See the 'Background' section in the main text (P. 5)
Methods			
Study design	4	Present key elements of study design early in the paper	Done We presented the study design at the beginning of the 'Methods' section See the 'Methods' section in the main text, 'Design' subsection (P. 5–6)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up and data collection	Done See the 'Methods' section in the main text: • We described the setting and educational intervention in the 'Setting and educational intervention' subsection (P. 6), including relevant dates for the development and implementation of the educational intervention; • Periods of recruitment are described in the 'Participants and recruitment procedures' sub-section (P. 6–7); • Relevant dates of exposure, follow-up and data collection are described in the 'Data collection' subsection (P. 8–9, paragraph entitled 'procedure')
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Done See the 'Methods' section in the main text: • Sources and methods of selection of participants are described in the 'Participants and recruitment procedures' subsection (P. 6–7); • Methods of follow-up are described in the 'Data collection' section (P. 8–9, subsection entitled 'Procedure')
		(b) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders and effect modifiers. Give diagnostic criteria, if applicable	Done We provided an overview of the study outcome in the 'Data collection' section (P. 6–7, 'Study outcome assessment' subsection)

(*Continued*)

TABLE A1 (Continued)

Item	No.	Recommendation	Manuscript reference and/or complementary information
			Table 1 also provides a clear definition for each outcome of interest (see the 'Tables' section of the main text, P. 26–28)
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Done Sources of data and methods of assessment (instruments), for each variable of interest, are described in Table 1 (See the 'Tables' section of the main text, P. 26–28) Comparability of assessment methods: NA
Bias	9	Describe any efforts to address potential sources of bias	Done Baseline data were collected 6 weeks prior to, and 6 weeks after the beginning of the programme. This extended period allowed participants enough time to complete the surveys and ensured that they would not have been exposed to more than three online sessions at their baseline assessment See the 'Data collection' section (P. 8–9, 'Procedure' subsection)
Study size	10	Explain how the study size was arrived at	Done We used a census approach to sampling—meaning that all the nurses who participated in the ECHO programme for concurrent disorder management between September 2018 and June 2020, that is, the potential study population ($N = 65$), were invited to participate in this study See the 'Methods' section in the main text, 'Participants and recruitment procedures' subsection (P. 6–7)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Done We explained how the outcome of interest of the study, i.e., self-efficacy, knowledge, and attitude, were handled in the analysis. See the 'Methods' section in the main text, 'Data analysis' subsection (P. 9–10) Groupings of quantitative variables: NA
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Done All statistical methods are described in the 'Methods' section in the main text, 'Data analysis' subsection (P. 9–10) Based on the results of two previous systematic reviews on the impact of the ECHO model (McBain *et al*. 2019; Zhou *et al*. 2016), we expanded our initial univariate models to adjust the repeated measure of analysis (ANOVA) for predefined covariates (i.e., age, gender, work setting) as fixed between-participant effects. See the 'Methods' section in the main text, 'Data analysis' subsection (P. 9–10)
		(b) Describe any methods used to examine subgroups and interactions	Done Two Subgroup analysis were conducted on the main outcomes of the study to examine interactions: (1) stratified by attendance (low versus high); and (2) stratified by professional group (nurses versus other healthcare professionals). See the 'Methods' section in the main text, 'Data analysis' subsection (P. 9–10)
		(c) Explain how missing data were addressed	The descriptive statistics were presented for initial raw data and the percentages of missing values were reported in the article. Missing continuous outcome scores (i.e., self-efficacy, knowledge, altitude) were prorated when at least 75% of items were completed (average of the completed items multiplied by 1 or by the total number of items depending on outcomes). Otherwise, the score was treated as missing. In the statistical model, our analysis relied on a linear mixed model (Fitzmaurice *et al*. 2004) to deal

(*Continued*)

TABLE A1 (Continued)

Item	No.	Recommendation	Manuscript reference and/or complementary information
			with partially missing longitudinal data at the 6- or 12-month follow-ups (i.e. participants who did not complete the 6- and/or 12-month surveys due their resignment from the programme or loss to follow-up). Outcomes were assessed, and time effect was estimated, based on the likelihood maximization principle, without the need to explicitly impute the missing values. All variables used as covariates (i.e. age, gender, work setting) had no missing observation
		(d) If applicable, explain how loss to follow up was addressed	Done See the 'Methods' section in the main text, 'Data analysis' subsection (P. 9–10)
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13	(a) Report numbers of individuals at each component of study—for example numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Done See the 'Results' section in the main text, 'Participant flow' subsection (P. 10) and Figure 1
		(b) Give reasons for non-participation at each component	Done See the 'Results' section in the main text, 'Participant flow' subsection (P. 10), and Figure 1
		(c) Consider use of a flow diagram	Done See Figure 1
Descriptive data	14	(a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	Done The characteristics of study participants are described in the 'Results' section in the main text, first in the 'Baseline characteristics of study participants' subsection (P. 11), then in Table 2 (see the 'Tables' section of the main text, P. 29–30) Information on exposures is described the 'Participation subsection' of the 'Results' section (P. 11) Potential cofounders: As described in the 'Methods' section ('Data analysis' subsection), age, gender and work setting were used as predefined covariates in the linear mixed model
		(b) Indicate number of participants with missing data for each variable of interest	Done See the 'Participant flow' subsection in the 'Results' section of the main text (P. 10) and Figure 1 for the study completers and non-completers See Table 3 in the 'Tables' section of the main text (P. 31) for self-efficacy, knowledge and attitude See Table 4 in the 'Tables' section of the main text (P. 32) for satisfaction and acceptability
		(c) Summarize follow-up time (e.g. average and total amount)	Done See Figure 1 for follow-up time See Table 3 in the 'Tables' section of the main text (P. 31) for self-efficacy, knowledge, and attitude See Table 4 in the 'Tables' section of the main text (P. 32) for satisfaction and acceptability
Outcome data	15	Report numbers of outcome events or summary measures over time	Done See Table 3 in the 'Tables' section of the main text (P. 31) for self-efficacy, knowledge and attitude See Table 4 in the 'Tables' section of the main text (P. 32) for satisfaction and acceptability

(*Continued*)

TABLE A1 (Continued)

Item	No.	Recommendation	Manuscript reference and/or complementary information
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g. 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Done See Table 3 in the 'Tables' section of the main text (P. 31) for self-efficacy, knowledge, and attitude
		(b) Report category boundaries when continuous variables were categorized	NA All categorical variables were extracted from the surveys in the categorical form
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA The linear coefficients *betas* only were used in the statistical model and these coefficients were presented in the 'Results' section of the article (P. 9–14)
Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	Done Two subgroup analysis were conducted: (1) stratified by attendance; (2) stratified by professional group. See the 'Results' section of the main text, 'Self-efficacy, knowledge, and attitude' subsection (P. 12, fourth paragraph) and the 'Benefits of educational intervention exposure for improvements in nurses' outcomes as compared to other healthcare professionals' subsection (P. 13–14), The data and results for both subgroup analyses are fully reported in Tables A3 and A5: Appendix I
Discussion			
Key results	18	Summarize key results with reference to study objectives	Done See the 'Discussion' section in the main text (P. 14, first paragraph)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Done See the 'Discussion' section in the main text (P. 19–20)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies and other relevant evidence	Done See the 'Discussion' section in the main text (P. 14–20)
Generalizability	21	Discuss the generalizability (external validity) of the study results	Done See the 'Discussion' section in the main text (P. 20)
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Done See the Title page (CRediT authorship contribution statement, funding disclosure statement and acknowledgements)

ECHO, Extension for Community Healthcare Outcomes; NA, not applicable; No., item reference number from the STROBE-Statement checklist (Vandenbroucke *et al*. 2014).

TABLE A2 *Descriptive statistics for the six CMPPQ subscales at baseline, T1 and T2*

Outcome	Subscale	T0 (n = 28) Mean (SD)	T1 (n = 19) Mean (SD)	T2 (n = 12) Mean (SD)	Comparison†	
					P (T1 vs T0)	P (T2 vs T0)
Attitude	Role Adequacy (11 items)	34.6 (9.4)	29.6 (7.9)	26.2 (5.5)	**0.0316***	**0.0020***
	Role legitimacy (3 items)	8.5 (3.1)	6.9 (2.1)	6.8 (2.5)	0.0858	0.0626
	Role Support (3 items)	9.1 (3.5)	7.3 (3.9)	8.5 (4.4)	0.1129	0.2604
	Motivation (5 items)	10.9 (3.8)	9.8 (3.6)	10.0 (3.1)	0.3566	0.8178
	Task specific self-esteem (6 items)	15.8 (6.2)	15.6 (4.0)	13.8 (3.5)	0.8608	0.3212
	Work satisfaction (5 items)	11.7 (4.0)	12.9 (5.0)	11.4 (3.4)	0.5792	0.3588
	CMPPQ total score	90.5 (19.1)	82.1 (19.2)	76.7 (13.8)	0.0700	**0.0404***

CMPPQ, Comorbidity Problems Perceptions Questionnaire; n, number of participants; P, P-value; SD, standard deviation; T, time; T0, baseline; T1, 6-month follow-up; T2, 12-month follow-up; vs, versus.

†Paired t-test. (*) Significant P-value ($P < 0.05$).

TABLE A3 *Longitudinal ANOVA results, stratified by attendance (*n *= 12/28 versus* n *= 16/28)*

Outcome	T	n	Low attendance = 0–5 sessions†				n	High attendance = 6–20 sessions†			
			LS mean (95% CI)	LS mean diff (95%CI)	P	ES‡		LS mean (95% CI)	LS mean diff (95% CI)	P	ES‡
Self-Efficacy	0	12	8.0 (6.7; 9.4)	0	–	–	16	7.9 (7.3; 8.4)	0	–	–
	1	5	7.6 (6.1; 9.2)	−0.4 (−1.4; 0.6)	0.3534	−0.55	14	8.1 (7.6; 8.7)	0.2 (−0.2; 0.6)	0.2162	0.33
	2	4	7.0 (5.5; 8.6)	−1.0 (−2.0; 0.1)	0.0626	−0.90	8	8.5 (7.8; 9.1)	0.6 (0.1; 1.0)	**0.0213***	0.53
Knowledge	0	12	65.1 (55.8; 74.4)	0	–	–	16	67.6 (58.0; 77.3)	0	–	–
	1	5	71.5 (58.4; 84.7)	4.0 (−8.2; 16.1)	0.3089	0.57	14	78.2 (68.4; 88.0)	10.7 (4.9; 16.5)	**0.0011**§**	0.93
	2	4	74.6 (61.2; 88.0)	9.9 (−3.3; 23.1)	0.1535	0.81	8	80.3 (69.5; 91.0)	12.7 (5.5; 19.9)	**0.0015***	1.07
Attitude	0	12	88.3 (65.6; 111.0)	0	–	–	16	88.4 (78.5; 98.4)	0	–	–
	1	5	95.0 (70.1; 119.9)	6.7 (−6.0; 19.3)	0.2528	0.35	14	74.9 (64.6; 85.1)	−13.6 (−22.8; −4.3)	**0.0063***	−0.72
	2	4	91.8 (66.2; 117.4)	3.5 (−10.4; 17.3)	0.5713	0.16	8	69.7 (57.2; 82.2)	−18.7 (−30.2; −7.3)	**0.0027***	−0.89

%, percentage; CI, confidence interval; ES, estimated effect size; LS mean diff, least-squares mean difference; LS mean, least-squares mean; n, number of participants; P, P-value; T, time; T0, baseline; T1, 6-month follow-up; T2, 12-month follow-up.

†Linear mixed model with repeated measures and time, age and work setting as fixed effect. The unadjusted analysis was very close to the adjusted analysis.

‡Estimated effect size = Estimated means difference divided by the pooled standard deviation. (*) Significant P-value ($P < 0.05$).

TABLE A4 *Baseline characteristics of the larger cohort study participants* (n = *174*), *by professional group*

Variable	Nurses (*n* = 28) *n* (%)	Other healthcare professionals (*n* = 146) *n* (%)	*P*[†]
Demographics			
Age, mean (SD)	39.1 (6.2)	39.9 (10.7)	0.6975
Gender			
Women	27 (96.4%)	122 (83.6%)	0.2046
Men	1 (3.6%)	23 (0.7%)	–
Degree earned			
Undergraduate diploma	2 (7.1%)	14 (9.6%)	**0.0218***
Baccalaureate	20 (71.4%)	61 (41.8%)	–
Master	6 (21.4%)	52 (35.6%)	–
PhD	0 (0.0%)	19 (13.0%)	–
Professional role			
Registered nurse	25 (89.3%)	0 (0.0%)	N/A
Clinical nurse specialist	2 (7.1%)	0 (0.0%)	
Auxiliary nurse	1 (3.6%)	0 (0.0%)	
Social worker	0 (0.0%)	46 (31.5%)	
Physician	0 (0.0%)	3 (2.1%)	
Psychiatrist	0 (0.0%)	10 (6.8%)	
Addiction worker	0 (0.0%)	18 (12.3%)	
Psychologist or therapist	0 (0.0%)	37 (25.3%)	
Other	0 (0.0%)	32 (21.9%)	
Years of clinical experience			
0–5	3 (10.7%)	34 (23.3%)	**0.0004****
6–10	5 (17.9%)	36 (24.7%)	–
11–15	15 (53.6%)	23 (15.8%)	–
16–20	2 (7.1%)	30 (20.5%)	–
21+	3 (10.7%)	23 (15.8%)	–
Practice characteristics			
Work setting			
Primary care	1 (3.6%)	16 (11.0%)	**0.0468***
Community-based mental health care	8 (28.6%)	29 (19.9%)	–
Hospital-based health care	15 (53.6%)	45 (30.8%)	–
Community-based addiction treatment	3 (10.7%)	39 (26.7%)	–
Other	1 (3.6%)	17 (11.6%)	–
Area[‡]			
Urban/Suburban	17 (60.7%)	87 (59.6%)	0.6772
Rural	6 (21.4%)	20 (13.7%)	–
Remote	3 (10.7%)	16 (11.0%)	–
Mixed	2 (7.1%)	20 (13.7%)	–
ECHO-CD session details			
Curriculum			
(1) 2018–2019	10 (35.7%)	41 (28.1%)	0.4164
(2) 2019–2020	18 (64.3%)	105 (71.9%)	–
Session attendance, mean (SD)[§]	8.6 (5.9)	9.3 (6.3)	0.6302

%, percentage; ECHO-CD, ECHO programme for concurrent disorder management. Extension for Community Healthcare; *n*, number of participants; N/A, not applicable; *P*, *P*-value; SD, standard deviation.

[†]Chi-squared test.

[‡]With 2.1% (*n* = 3/146) of participants in the group of other healthcare professionals preferring to not answer the question.

[§]During the first year of registration. (*) Significant P-value ($P < 0.05$). (**) Significant P-value ($P < 0.0001$).

TABLE A5 *Longitudinal ANOVA results, stratified by professional group* (n = *28/174 versus* n = *146/174)*

			Nurses†					Other healthcare professionals†			
Outcome	T	*n*	LS mean (95% CI)	LS mean diff (95% CI)	*P*	ES‡	*n*	LS mean (95%CI)	LS mean diff (95%CI)	*P*	ES‡
Self-efficacy	0	28	7.8 (6.5; 9.2)	0	–	–	141	7.7 (6.9; 8.5)	0	–	–
	1	19	7.9 (6.5; 9.2)	0.1 (−0.4; 0.5)	0.8092	0.04	105	8.0 (7.2; 8.8)	0.3 (0.0; 0.5)	**0.0354***	0.22
	2	12	7.9 (6.5; 9.3)	0.1 (−0.4; 0.6)	0.7612	0.06	78	8.2 (7.4; 9.0)	0.5 (0.2; 0.7)	**0.0354***	0.36
Knowledge	0	28	71.1 (57.6; 84.6)	0	–	–	146	60.8 (50.8; 70.8)	0	–	–
	1	19	79.1 (65.4; 92.8)	8.0 (2.7; 13.2)	**0.0046***	0.61	105	68.0 (57.9; 78.0)	7.2 (5.0; 9.4)	**<0.0001***	0.55
	2	12	82.1 (67.5; 96.6)	11.0 (4.6; 17.3)	**0.0014***	0.93	78	70.8 (60.7; 80.9)	10.0 (7.5; 12.4)	**<0.0001****	0.85
Attitude	0	28	92.1 (70.6; 113.7)	0	–	–	144	85.5 (71.5; 99.4)	0	–	–
	1	19	83.6 (61.7; 105.5)	−8.6 (−16.7; −0.4)	**0.0411***	−0.43	105	77.8 (63.8; 91.8)	−7.7 (−11.5; −3.9)	**<0.0001***	−0.39
	2	12	79.4 (56.3; 102.6)	−12.7 (−22.5; −2.9)	**0.0129***	−0.62	78	74.6 (60.5; 88.7)	−10.9 (−15.1; −6.7)	**<0.0001****	−0.53

CI, confidence interval; ES, estimated effect size; LS mean diff, least-squares mean difference; LS mean, least-squares mean; *n*, number of participants; *P*, *P*-value; T, time; T0, baseline; T1, 6-month follow-up; T2, 12-month follow-up.

†Linear mixed model with repeated measures and time, age, and work setting as fixed effect. The unadjusted analysis was very close to the adjusted analysis.

‡Estimated effect size = Estimated means difference divided by the pooled standard deviation. (*) Significant P-value ($P < 0.05$). (**) Significant P-value ($P < 0.0001$).