ORIGINAL RESEARCH

Implementation of an Acute Care COPD Exacerbation Patient Mobilization Tool

A Mixed-Methods Study

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ABSTRACT

Background: Improving the mobility of hospitalized patients with an acute exacerbation of chronic obstructive pulmonary disease (AECOPD) is a priority of care. AECOPD-Mob is a clinical decision-making tool for physical therapists, especially those who are newly graduated or are new to caring for patients with AECOPDs in acute care settings. Although this tool has been available for several years, dissemination via publication is not sufficient to implement it in clinical practice.

Objective: The primary objective of this study was to develop, implement, and evaluate different formats of AECOPD-Mob in an acute care setting.

Methods: We used a mixed-methods, convergent parallel design. In addition to the paper format of AECOPD-Mob, we developed a smartphone app, a web-based learner module, and an in-service learning session. Newly graduated physical therapists (PTs) or PTs new to the practice area were recruited from urban acute care hospitals. Participants used the different formats for 3 weeks and then completed the Post-Study System Usability Questionnaire. User data were retrieved for the learning module. Participants participated in focus groups at 3 weeks and 3 months.

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Results: Eighteen (72% of eligible PTs, 100% female, 94% graduated within 3 yr) PTs participated. Post-Study System Usability Questionnaire scores for the learning module and smartphone indicated that participants were satisfied with these formats (median score 2.0 on 1–7 Likert Scale for both technology formats, lower scores indicating greater satisfaction). However, the participants reported in the focus group that the paper format was preferred over other formats. Concerns with the smartphone app included infection control and the perception of lack of professionalism when using a smartphone during clinical practice. The learning module and in-service were considered helpful as an introduction but not as an ongoing support. The paper format was seen as the most efficient way to access the necessary information and to facilitate communication between other members of the care team about the importance of mobility for hospitalized patients with AECOPDs.

Conclusion: Newly graduated PTs strongly preferred the paper format of the AECOPD-Mob tool in the acute care setting. Future research will focus on knowledge translation strategies for other health disciplines.

Keywords:
chronic obstructive pulmonary disease; questionnaires and surveys; hospitalizations; knowledge translation

Acute exacerbations of chronic obstructive pulmonary disease (AECOPDs) are a leading cause of hospitalizations in the United States (1) and Canada (2). A common sequela of AECOPDs is reduced activity tolerance (3), which is an independent risk factor for readmissions (4) and mortality (5). In-hospital and postdischarge exercise programs for patients with an AECOPD improve patient outcomes and reduce the risk of readmission (6), but these programs must be appropriately prescribed.

Patients with an AECOPD are typically admitted to busy medical wards (7). Newly graduated physical therapists (PTs) report that these care settings are "intimidating" (8) and that they find it challenging to mobilize hospitalized patients with an AECOPD. To guide PTs, we developed AECOPD-Mob, a clinical decision-making tool to support safe and effective exercise of hospitalized patients with an AECOPD (9). Although the tool is available for download (www.prrl.rehab.med.ubc.ca), dissemination alone is insufficient to elicit practice change (10).

Clinicians need information in different formats, including technology-based formats, to best apply the knowledge in their clinical setting (11). The feasibility and usability of these formats in physical therapy clinical practice is not known yet is an important step when developing knowledge products (12). The purpose of this study was to develop, implement, and evaluate different formats of the AECOPD-Mob content in an acute care hospital setting.

METHODS

Study Overview and Participant Recruitment

We used a mixed-methods, convergent parallel study design (13) that enabled the exploration of how and why clinicians used the different formats of the AECOPD-Mob, separately and together, in real-world clinical practice. This design was selected instead of a randomized clinical trial design, as identifying a single format that was "best" would not reflect the context in which PTs synthesize information from different sources as part of their clinical

decision-making (11, 14). The study was conducted in five hospitals in three cities (Vancouver, Burnaby, and Surrey) in Canada. Ethical approval for this study was obtained from the research ethics boards at the University of British Columbia and participating hospitals (#H15-01582). The original AECOPD-Mob clinical decision-making tool is a four-page, paper-based document (Figure 1A). We developed three additional formats: a web-based learning module; a smartphone application; and a didactic in-person in-service session (Figures 1B–1D). We recruited newly graduated PTs (within 3 yr) or PTs new to the AECOPD practice area. These PTs were

A

a place of mind

AECOPD-Mob

Clinical Decision-Making Tool for Safe and Effective Mobilization of Hospitalized Patients with AECOPD

Purpose, Scope & Disclaimer. The purpose of this document is to provide recently graduated or returning clinicians working in acute care settings with guidance on safe and effective mobilization of the hospitalized patient with an acute exacerbation of COPD. This decision-making tool is evidence- and expert-informed. It is not intended to replace the clinician's clinical reasoning skills and interprofessional collaboration.

Prior to any patient mobilization, ensure there is enough qualified staff available, the patient has consented to the treatment plan, and the patient's goals have been identified and effectively communicated between patient, staff and family.

WHAT TO ASSESS PRIOR TO MOBILIZATION

Equipment
- Mechanical lifts, poles, transfer belts etc. available
- Portable oximeter; portable oxygen tank and tubing, blood pressure unit
- Lines organized (i.e. cap feeding tubes, lines secure or capped as appropriate)
- Mobility aids in reach, used appropriately and maintained
- Glasses, footwear or hearing aids available

Review the chart:
- Comorbidities, medications, medical status, etc.

Review the patient:
- Not: combative, severely confused or agitated, or heavily sedated
- Medically stable and without significant pain, fatigue, or diaphoresis
- Cardiovascular signs and symptoms assessed – no angina at rest, untreated arrhythmia, decompensated left or right heart failure, severe postural hypotension
- Mobility assessment
  - Standing/balance assessed to determine fall risk (eyes open, eyes closed, tandem, reaching / Berg)
  - Adequate body strength and energy required to perform specific exercise, transfer, or ambulation
- Medications accessible and appropriate staff available to administer them if needed during activity
- Note: SpO_2 < 88% at rest or during exercise requires supplemental oxygen

WHEN TO CONSIDER NOT MOBILIZING OR TO DISCONTINUE MOBILIZATION

(For patients in critical care settings, see SAFEMOB*)

Cardiovascular status
- **BP** - A drop in systolic pressure (>20 mm Hg) or below pre-exercise level **OR** a disproportionate rise i.e. >200 mm Hg for systolic or >110 mm Hg for diastolic.[1]
- **HR** - < 40[2] or > 130[2,3]; requiring temporary pacer
- **Pulmonary embolus** – discussion with physician required to determine suitability.
- **Deep venous thrombosis –** May mobilize as tolerated immediately after low molecular weight heparin is given. If patient is on any other form of anticoagulation, check mobility orders with the physician. Monitor patient for changes in pain, swelling, colour and sudden shortness of breath.[4]
- **Angina** before, during or after activity
- **Untreated arrhythmia** or decompensated left or right heart failure

Respiratory status
- **SpO_2** <88%[2,5] at rest or during exercise
- **RR** - <5 or >40[2]
- **F_iO_2** - >60%[3] or high flow oxygen > 6 lpm
- **Uncontrolled asthma**

Other
- Intermittent hemodialysis[2]
- Unstable fracture
- Excessive muscle soreness or fatigue that is residual from last exercise or activity session
- Other contraindications specific to a given setting/unit

WHAT TO MONITOR DURING MOBILIZATION FOR PATIENT SAFETY

Staff should be available to monitor patient signs and symptoms, and the need for O_2

Ensure supplemental oxygen and tubing are nearby to administer if SpO_2 drops below 88%

Patient -- Subjective:
- Dizziness, vertigo,
- Dyspnea, fatigue
- Nausea, pain
- Consider use of scales e.g., Borg Dyspnea Scale or Rating of Perceived Exertion

Patient -- Objective
- Cognition, balance
- Perspiration, cyanosis, heart rate, oxygen saturation, respiratory rate and blood pressure
- Other factors relevant to patient and mobility task, for example, cardiac rhythm in those patients when ECG is essential during mobilization or blood pressure monitoring in patient that is prone to postural hypotension.

WHAT TO MONITOR AND HOW TO PROGRESS MOBILIZATION TO ENHANCE EFFECTIVENESS

Written communication regarding daily targets for exercise activities and a record of exercise activities accomplished should be posted at bedside and documented

- Type of **exercise activities match patient's functional needs** upon discharge i.e. walk distance, stairs, balance, strength sufficient to carry and unpack groceries.
- **Targets for progression are determined daily** i.e. increase walk distance and/or increase number of walks, stair climbing, standing balance, U/E exercises.
- Pertinent **exercise parameters** i.e. heart rate and breathlessness, **increase** proportionately **with incremental activity and recover** to baseline within 5 minutes post activity

***SAFEMOB** available at http://physicaltherapy.med.ubc.ca/physical-therapy-knowledge-broker/safemob-project/

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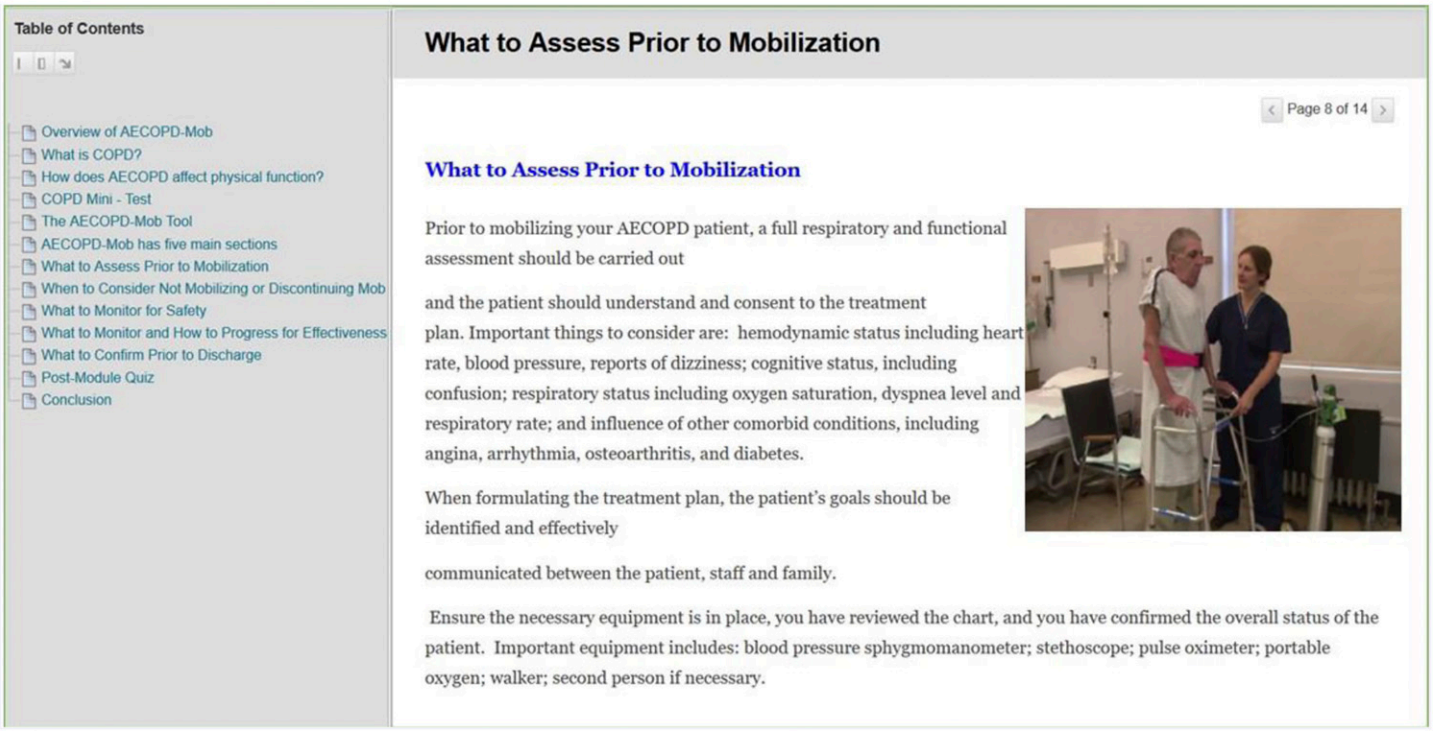
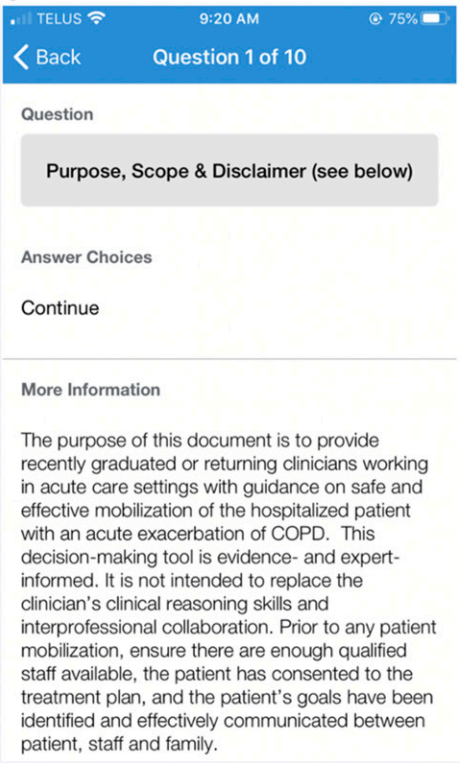
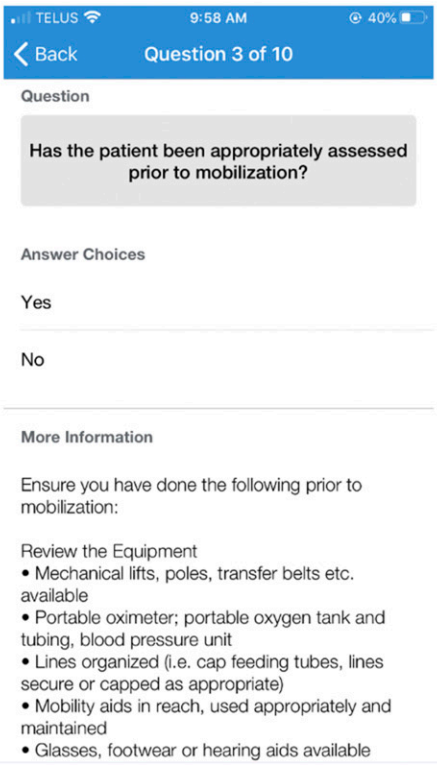
Figure 1. Formats of AECOPD-Mob. (*a–c*) Example images from the formats of AECOPD-Mob. (*a*) The first page of the paper format of AECOPD-Mob. The full paper document can be downloaded from https://prrl.rehab.med.ubc.ca/research/aecopd-mob-clinical-decision-making-tool/. (*b*) Screenshot from the video-based learner module. Each page of the module had text, and several pages had a video to view that highlighted a case-based scenario. (*c*) Screenshots of the smartphone application. The full app can be viewed on the QxMD Calculate App, under the category of "Physiotherapy." (*d*) In addition to these formats, each participant attended an in-service presentation delivered by a clinical specialist. AECOPD = acute exacerbation of chronic obstructive pulmonary disease; BP = blood pressure; COPD = chronic obstructive pulmonary disease; ECG = electrocardiogram; $F_{I_{O_2}}$ = fraction of inspired oxygen; HR = heart rate; RR = respiratory rate; Sp_{O_2} = oxygen saturation as measured by pulse oximetry.

B



C





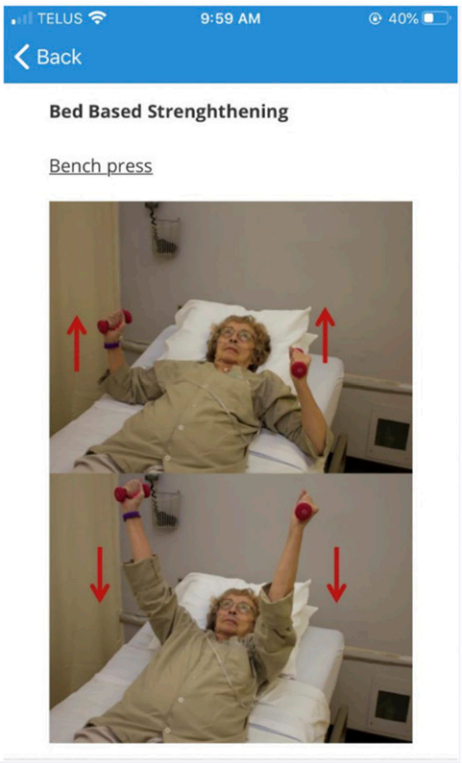


Figure 1. (*Continued*).

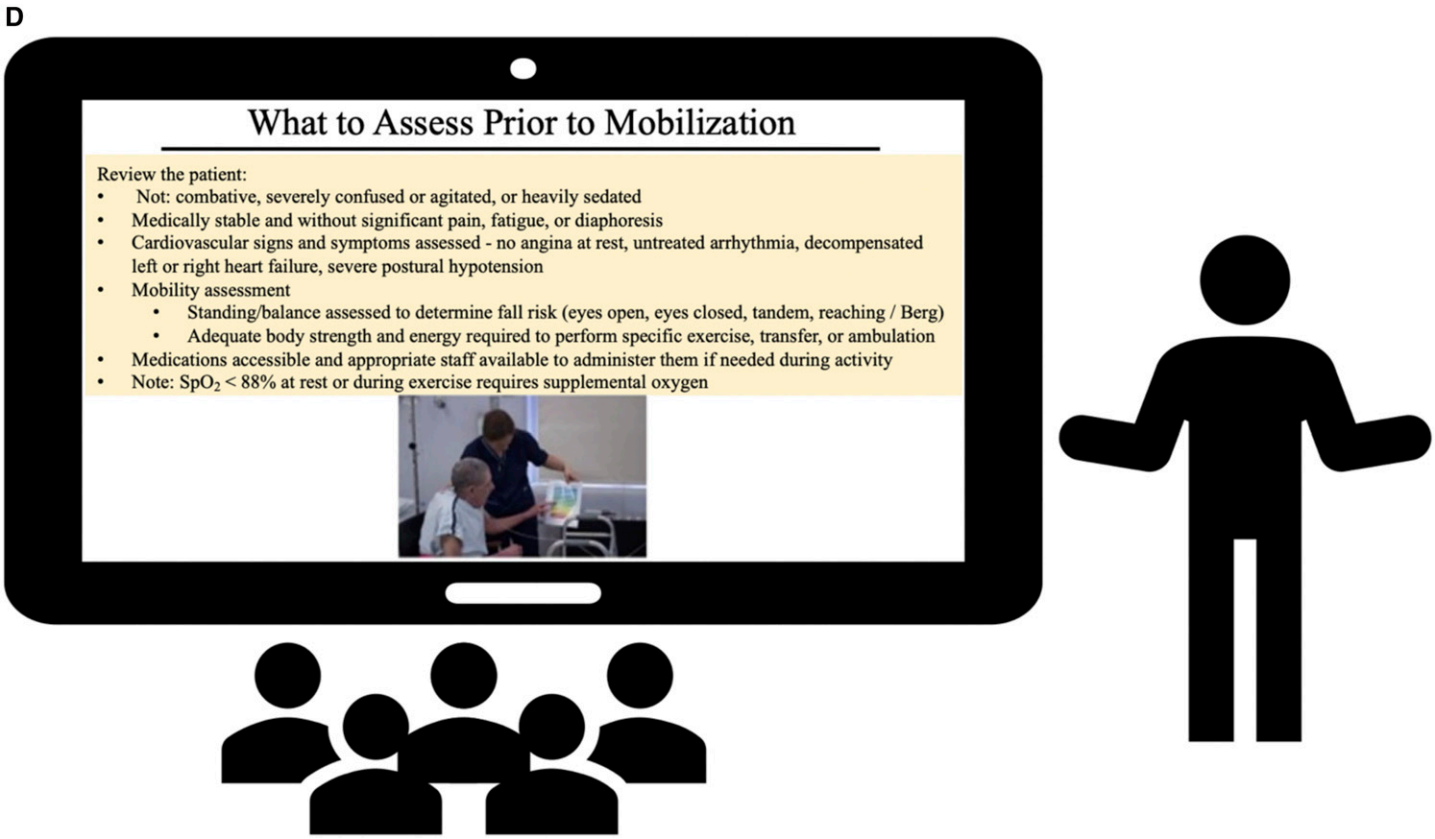


Figure 1. (*Continued*).

required to have provided physical therapy treatment to a minimum of five inpatients with an AECOPD within the previous month, based on self-report, and were currently working at least 2 days per week on an acute care ward. Participants also were required to own a compatible smartphone and have access to the Internet. PT department leads and PT clinical specialists invited PTs who met the study criteria to participate, and interested PTs contacted the research team coordinator.

Development of Learning Module, Smartphone Application, and In-Service

The AECOPD-Mob interactive web-based learning module included five 2- to 3-minute video case-based scenarios, textual information in multiple pages, and two multiple-choice quizzes to deliver the content and test the participants' knowledge (Figure 1B). The learning module was hosted on the Learning Management System (LMS) Blackboard Connect (Blackboard), a secure, web-based learning platform. The AECOPD-Mob smartphone application ("AECOPD-Mob app") was developed by QxMD and included screening questions and photographs of exercises described in the AECOPD-Mob tool (Figure 1C). The 1-hour, face-to-face in-service lecture was delivered by a clinical specialist PT and included an overview of AECOPD and guidance on how to use the AECOPD-Mob tool using case scenarios.

After recruitment, each participant attended a 1-hour standardized session led by a graduate student (coauthor O.B.) to complete questionnaires, activate the app, access the learning module, and schedule their attendance at the in-service. They were asked to complete the learning module when

convenient and to use any of the formats while caring for their patients hospitalized with an AECOPD. Participants were invited to return to a focus group session 3 weeks and then 3 months after the orientation session.

Data Collection

At baseline, each participant completed an adapted version of the Evidence-Based Practice (EBP) Questionnaire (15), which has been used in clinical and knowledge translation studies (16–18). The questionnaire has several statements for which the participant indicates their level of agreement. We adapted the EBP questionnaire in the following ways. The statement "My reimbursement rate will increase if I incorporate evidence-based practice into my practice" was removed, as Canada has a universal healthcare system and questions regarding reimbursement for physical therapy care in the public practice setting are not relevant. We also altered three questions to focus on AECOPD. The statement "Practice guidelines are available for topics related to my practice" was revised to "Practice guidelines for mobilizing or exercising hospitalized patients with AECOPD are available to me." The statement "I actively seek practice guidelines pertaining to areas of my practice" was revised to "I actively seek practice guidelines for treating hospitalized patients with AECOPD with mobility problems." The statement "I use practice guidelines in my practice" was revised to "I used practice guidelines while treating hospitalized patients with AECOPD and mobility problems." We are reporting on the questionnaire sections related to personal use and understanding of clinical practice guidelines, barriers to the use of evidence-based practice, and general demographic and practice information.

Throughout the study period, we collected data on how many times the learning module was accessed, the completion rate of each "page" of the module and the module as a whole, using the LMS system analytics. At 3 weeks after the orientation session, each participant completed the Post-Study System Usability Questionnaire (PSSUQ) (19). This is a validated Likert-scale tool (20) that was used to examine the learning module's and the smartphone app's usefulness, information quality, and interface quality. We used the following *a priori* categorization of the PSSUQ scores for the smartphone app and the learning module: less than 1.5 = excellent; 1.5–2.0 = very good; 2.01–2.5 = good; 2.51–3.5 = acceptable; and greater than 3.5 = poor. At 3 weeks and 3 months after the orientation session, each participant attended a focus group at their workplace, where information on the participants' views regarding the different formats of AECOPD-Mob, as well as suggestions for improvement, was collected (*see* data supplement). The focus groups were led by one of the coauthors (P.G.C., O.B., or A.K.) with a second assistant present to take notes. We aimed to have between two and five people per group. More than one focus group per hospital was scheduled to accommodate participants' schedules. At the 3 months focus group, we asked participants about their ongoing use of the different formats, using the topics and comments raised in the 3 weeks focus group as a guide. The focus groups were audiotaped and transcribed verbatim.

Data Analysis

Participant demographics are characterized using descriptive statistics. The EBP questionnaire scores are presented as counts and percentages. The PSSUQ scores are presented as means with standard deviations, with lower scores indicating better usability. We also calculated the task-completion rate of the activities in the

Table 1. Participant characteristics

	n (%)
Sex	
Female	17 (100)
Male	0 (0)
Age, yr	
20–29	15 (88)
30–39	2 (12)
Education	
Bachelor's degree	3 (18)
Entry-level Master's	14 (82)
Years practicing	
<5	16 (94)
5–14	1 (6)
Hospital	
1	2 (12)
2	9 (53)
3	3 (18)
4	3 (18)
AECOPD care, proportion of caseload	
<20%	10 (59)
21–40%	6 (35)
41–60%	1 (6)
Self-reported confidence in the mobilization of AECOPD inpatients	
Extremely confident	3 (18)
Somewhat confident	11 (65)
Neutral	3 (18)

Definition of abbreviation: AECOPD = acute exacerbation of chronic obstructive pulmonary disease.

learning module as an indicator of usability (21). We examined the completion rate of the seven predefined learning module activities: watching five videos in the learning module and completing two mandatory quizzes. We categorized video watching as "complete" if the video page was open for the length of the video. Successful completion of the quiz required the participant to correctly answer 80% of

the quiz questions. The overall proportion of activities completed was presented as a sum of all users that completed a given activity divided by the total users. Using the threshold proposed by Al-Kilidar and colleagues (21), we defined an activity to be successful if 78% of participants completed the activity.

To analyze the focus group data, we used the applied thematic analysis framework as described by Guest (22). Two coauthors (O.B. [Master of Science student] and A.K. [acute care rehabilitation assistant and research coordinator]) independently reviewed each transcript and used a codebook to generate and record codes. A research assistant double-checked their work. A third reviewer (P.G.C. [physical therapist, researcher]) reviewed all transcripts and coding to ensure analysis fidelity and resolved any discrepancies, then created themes by clustering similar codes and deriving meaning from the clusters. The other coauthors (all PTs and registered nurses) provided feedback.

RESULTS

Participant Characteristics

Of 25 eligible PTs at five participating teaching hospitals (each with a minimum of 300 beds), 18 (72%) in four hospitals consented to participate in the study. One

Table 2. Barriers for implementing EBP

	Primary Barrier for Implementing EBP [*n (%)*]	One of the Top Three Barriers for Implementing EBP [*n (%)*]
Insufficient time	10 (59)	16 (94)
Lack of information resources	1 (6)	2 (12)
Lack of generalizability of the literature findings to my patient population	2 (12)	11 (65)
Inability to apply research findings to individual patients with unique characteristics	2 (12)	8 (48)
Access to practice guidelines	0 (0)	4 (24)
Lack of research skills	0 (0)	1 (6)
Poor ability to critically appraise the literature	0 (0)	3 (18)
Lack of understanding of statistical analysis	1 (18)	1 (18)
Lack of collective support among my colleagues in my facility	1 (18)	4 (24)
Lack of interest	0 (0)	1 (18)
No clinical specialist or expert in my facility to demonstrate	0 (0)	0 (0)
Unsure how to apply research findings to a clinical situation	0 (0)	0 (0)

Definition of abbreviation: EBP = evidence-based practice.

person dropped out after providing consent and completing the barriers questionnaire, leaving data from 17 participants for analysis.

Participant characteristics are reported in Table 1. All participants were female, and 94% had graduated from their entry-level professional training within the last 3 years. Fifty-nine percent of participants reported that 20% of their caseload were patients with AECOPD, and an additional 35% of participants reported that patients with AECOPD were between 20% and 40% of their caseload. Only 18% of participants were "extremely confident" in the mobilization of hospitalized patients with AECOPD, whereas 65% were "somewhat confident" and 18% were neutral. Either formal practice guidelines for mobilization of hospitalized patients with AECOPD were not available (29% of respondents) or participants were not aware of them (24% of respondents). The top barrier for implementing EBP was "insufficient time," followed by "lack of generalizability of the literature findings to my patient population," and "inability to apply research findings to individual patients with unique characteristics" (Table 2).

Learning Module Use

All participants viewed at least one page of the learning module and 95% of the participants viewed all pages. The first and second quiz was completed by 100% and 95% of respondents, respectively. The videos were not often viewed—only 5% of participants watched the five videos to completion, and only 15–20% of participants watched any individual video.

The PSSUQ scores (Table 3) indicated that the participants were satisfied with the web-based learning module, with a median score of 2.0 (range 1–3, lower scores indicating greater satisfaction) for the question "Overall, I am satisfied with this system." The highest median score for any one item was 3.0 (range 1–4) for the question "I believe I could become more productive using the learning module." Sixty-five percent of participants reported they would refer back to the learning module in the future.

Smart Phone App Usability and Satisfaction

Sixteen participants (94%) reported they opened the app at least once, although 65% reported not using the app in its entirety (from first "page" to last "page"). Similar to the learning module, the median score was 2.0 for the question "Overall, I am satisfied with the system," but the range of scores for all questions was greater than for the learning module. The items that received the lowest levels of satisfaction (median score 3, range 1–7) were "I believe I could become more productive using the smartphone application," "Whenever I made a mistake navigating in the smartphone application, I could recover easily and quickly," and "I was able to fully utilize the smartphone application's potential." Fifty-three percent of participants reported they would use this app in the future.

Focus Groups

We conducted six focus groups at 3 weeks and again at 3 months. The number of participants in each group ranged from three to seven. Analysis of the qualitative data at 3 weeks enhanced the understanding of the quantitative results. Three themes emerged: *1*) AECOPD-Mob is a useful tool in PT clinical practice; *2*) Acute care PTs are open to different formats of AECOPD-Mob information; and *3*) Paper version is the most useful format of AECOPD-Mob.

Main theme 1. AECOPD-MOB is a useful tool in PT clinical practice

Subtheme 1a. AECOPD-Mob is a reminder of best practice. The participants confirmed

Table 3. Learning module and smartphone Post-Study System Usability Questionnaire

	Item	Learning Module			Smartphone Application		
		Median	Range	Mean (SD)	Median	Range	Mean (SD)
1	Overall, I am satisfied with how easy it is to use the learning module or smartphone application.	2.0	1–3	1.8 (0.6)	2.0	1–7	2.3 (1.7)
2	The interface of this learning module or smartphone application was pleasant.	1.0	1–3	1.6 (0.7)	2.0	1–7	2.1 (1.6)
3	I liked using the interface of this learning module or smartphone application.	1.0	1–3	1.6 (0.7)	2.0	1–7	2.5 (1.8)
4	It was simple to use the learning module or smartphone application.	1.0	1–2	1.3 (0.5)	1.0	1–7	2.0 (1.6)
5	I could effectively answer the questions and navigate through pages or move from screen to screen in the learning module or smartphone application.	1.0	1–4	1.5 (0.9)	2.0	1–7	2.1 (1.6)
6	I felt comfortable using the learning module or smartphone application.	1.0	1–3	1.4 (0.6)	2.0	1–7	2.5 (1.7)
7	It was easy to learn how to use the learning module or smartphone application.	1.0	1–3	1.4 (0.6)	1.0	1–7	2.0 (1.6)
8	I believe I could become more productive using the learning module or smartphone application.	3.0	1–4	2.6 (1.1)	3.0	1–7	3.0 (1.5)
9	Whenever I made a mistake navigating in the learning module or smartphone application, I could recover easily and quickly.	1.0	1–3	1.5 (0.6)	3.0	1–7	3.1 (1.8)
10	The learning module or smartphone applications' media (videos, narration or photos) functioned properly.	2.0	1–7	3.1 (2.6)	1.0	1–7	2.1 (1.8)
11	It was easy to find the information I needed.	1.0	1–3	1.6 (0.7)	2.0	1–7	2.8 (1.5)
12	The instructions provided with the learning modules or smartphone application were clear.	1.0	1–3	1.4 (0.7)	1.0	1–7	2.1 (1.8)
13	The information in the learning module or smartphone application was effective in helping me care for my patients with COPD	2.0	1–4	2.3 (0.9)	3.0	1–7	3.1 (2.2)
14	The organization of information in the learning module or smartphone application was clear.	1.0	1–4	(1.5) 0.9	1.0	1–7	2.2 (0.8)
15	This learning module or smartphone application has all the functions and capabilities I expect it to have.	1.0	1–4	1.7 (0.9)	2.0	1–7	2.7 (2.0)
16	I was able to complete all of the tasks in the learning module or fully utilize the smartphone application's potential.	1.0	1–6	1.8 (1.4)	3.0	1–7	3.2 (1.8)
17	Overall, I am satisfied with this system.	2.0	1–3	1.7 (0.6)	2.0	1–7	2.7 (1.7)

Definition of abbreviations: COPD = chronic obstructive pulmonary disease; SD = standard deviation.

that the content in AECOPD-Mob supported best practice:

I personally find it's very useful for those borderline patients where they're not ready to mobilize… I find those are the toughest. They're not super short (of breath), they're not just (with oxygen saturations) to 82%, they're 87, 86 and you're like mmmm… should I mobilize? … I do find because the nature of our job, you want to get everyone up,… so I think it gives you a good check to see under what circumstances you really shouldn't, or where you should give them an extra [push] and get them moving. I found that's really useful for those situations.

Subtheme 1b. AECOPD-Mob has the important information all in one place. The participants noted that although the paper format was four pages, it was structured so they could easily find the information they needed:

…sometimes you're in a bit of a rush and you're thinking, "oh I don't have time to throw together an exercise (plan)" but then you have ideas of exercises all laid out for you (in AECOPD-Mob), it's really quick and easy to put together a program.

Subtheme 1c. AECOPD-Mob gives clinicians a common language when caring for patients. AECOPD-Mob also gave the PTs a common language when speaking with patients and other healthcare professionals, in terms of vocabulary, assessment, and treatment approaches:

I think it's great having a tool that everyone can use… because everyone kind of had their education in different places in different areas so I like how it can be easily transferable and more universal.

Main theme 2. Acute care PTs are open to different formats of information

The participants reported they were keen to learn information in novel ways:

You get a million sheets of paper and they get kind of lost… so it would be good to have an alternate route to get the information and get more knowledge. When you're on the medical units we need something that's pretty fast where you can look at it and have a couple of ideas. So it's nice having different formats.

…great to see that there's a smartphone app because it will bridge the gap, use technology to our advantage on the floor.

Main theme 3. Paper is the best format for AECOPD-Mob

Despite the interest in accessing information from different sources, a strong theme from all the focus groups was that the original, paper-based version of AECOPD-Mob was the most useful format for use in clinical practice:

…the paper is easier to navigate, and I always referred to the paper copy when I needed it.

Subtheme 3a. Paper format facilitates communication with other healthcare professionals. The participants talked about how the paper format enabled conversations related to mobility:

I was just talking to some nurses the other day about the study… and I can quickly go to the computer and print off the (tool) and show it to them, we're still pretty paper-driven in healthcare and I found that was easy because I could have it in my hand right away and show people.

I find on the ward the nurse says, "he's a little bit short of breath, maybe just keep him in bed," but (with the AECOPD-Mob paper) you have something solid to show them, "actually according to this he should be out of bed." I think (the nurses) are more receptive to that.

Subtheme 3b. Smartphone app not feasible because of perceptions of others and ease of use. The majority of participants did not feel the app would be useful in their day-to-day care of patients with AECOPD. In addition to concerns about infection control, a main issue was the perceptions of patients and other healthcare professionals about using a smartphone in clinical practice:

I would say the professional appearance of bringing your phone out at work is not a great look in front of your colleagues or in front of your patients.

(Using the app) makes the patient feels like you're not connected to what you're doing with them, that you're playing on your phone, you're doing something else.

The design of the app, where safety questions needed to be answered first, also contributed to challenges with its use:

…if I want to use the app to get exercise, then I have to go through the whole process, he's got all the requirements, he can mobilize, just spit out my exercises. It would be easier to go to a separate page and put in their exercise ability and get (what you need).

Subtheme 3c. Web-based learning module and in-service work together. Although the participants did not like the LMS that housed the learning module (*…it's not intuitive to navigate*), the participants felt that the learning module and the in-service worked well together as an orientation to AECOPD-Mob but would not be needed on an ongoing basis.

I loved the online thing to get you started and get your head in the mind space of using the tool more. I thought it was useful for that but I don't think I'd refer to it in the future again.

I did the learner module actually before we did the in-service and I feel like they're pretty equal for a learning tool. Like I felt like a lot of the information was similar so I don't know that you would actually need both.

3 MONTHS FOLLOW-UP

The focus groups were reconvened after 3 months. We conducted six focus group sessions, with the number of participants ranging from three to six. Although PSSUQ data from the 3 weeks time period showed that the majority of participants intended to use the app and the learner module again, the findings from the 3 months focus group suggested otherwise. The paper tool continued to be the preferred format. In addition, most participants did not use the app again. Those who did used it to view the exercise pictures but did not use any of the other features. Participants suggested creating a patient handout with pictures of exercises similar to the ones in the app would facilitate the discharge discussion.

I want to say that more technology is great, but—I haven't really used the technology so I think for me it really is about easy accessible formats like papers or forms, something I can bring, that I can just grab and go kind of thing.

Being able to give them the pictures would be good because I have a lot of language barriers with patients and being able to show them a picture to teach exercises would be helpful.

DISCUSSION

Implementation science is the study of methods that support the application of evidence-based practice into the clinical setting (23, 24). The transfer of knowledge into practice is not achieved by the basic dissemination of information to the clinician—a carefully planned implementation strategy is required. Morris and colleagues (14) developed a comprehensive "road map" for implementation strategies and research in rehabilitation settings. They describe seven steps in this road map: *1*) understanding the evidence; *2*) understanding the context; *3*); selecting and using relevant implementation theories; *4*) applying relevant implementation strategies; *5*) selecting appropriate implementation outcomes; *6*) selecting appropriate implementation research designs; and *7*) sustaining implementation over time. AECOPD-Mob is created for and by

clinicians and is based on interdisciplinary expert consensus (9), thereby completing the first step of the road map. This study supports the second step, "understanding the context," which is exploring the "…factors that influence the intervention adoption, effectiveness or sustainability in real world settings" (14). This includes appreciating the individual characteristics and perspectives of the healthcare professionals in the setting in which they practice. In this mixed-methods study, we created multiple formats of AECOPD-Mob and recruited newly graduated PTs working in acute care hospitals to use them over a 3-month period. The design of this study enabled the exploration of context in the use of the different AECOPD-Mob formats.

Physical therapists in our study confirmed the clinical utility and value of AECOPD-Mob to support their care of hospitalized patients with AECOPD. Although the PTs were interested in technology to support their practice, they overwhelmingly preferred using a paper format. There were many reasons why clinicians preferred the paper-based tool over the other formats. Although using mobile devices has been suggested to improved access to point-of-care information for many health professionals (25), the participants in this study raised concerns about infection risks of smartphone use in a clinical setting. Improving infection control issues may not change use, as another common perception was that smartphone use in the acute care setting was unprofessional. Most physicians use mobile devices to support clinical decision-making (26), but it appears this practice has not transferred to physical therapy to the same extent (27). The participants in this study felt that others would assume their smartphone was for personal use. This finding is in line with a recent survey of physicians, nurses, pharmacists, and social workers (28) that found that "the perception of professionalism" was an important theme and that if the healthcare professional wanted to use their smartphone to access information, it would need to be out of view of colleagues and patients.

The participants in this study also believed the paper format enabled better communication between PTs and their colleagues with respect to the safety and efficacy of mobilizing the patient with AECOPD. Different health professions likely have different care priorities, and the paper tool enabled the PTs to initiate discussions with other members of the care team regarding the safety of patient mobilization, a priority of PT care. This has been well documented in studies of intensive care unit (ICU) mobility, in which the introduction of early physical therapy interventions required education for all team members on the benefits of early mobility, and these interventions ultimately decreased hospital and/or ICU lengths of stay (29). The physical therapists in the current study commented on the need to demonstrate the evidence base of safe and effective mobility, and the presence of a written document, with specific parameters for safety and effectiveness, reinforced the importance of mobility for these patients. The lack of ongoing use of the learning module and the smartphone app may be due to the challenges of using those systems as an acute care PT, or that those applications, once used, were not required on an ongoing basis.

The PTs in our study did value aspects of the other formats as a component of the implementation process. For example, having the hospital clinical experts deliver

the in-services supported learning via the case scenarios and opportunities to have their questions answered. This is in line with implementation strategies that aim to identify local champions and provide learners with the opportunities to observe expert clinicians model the expected clinical care (30).

Some limitations should be noted. We recruited participants from several urban hospitals. These settings were already using or were aware of AECOPD-Mob in the paper format and had support from PT leadership to use the document clinically. Although this allowed us to gain feedback about the different formats of the tool, instead of discussing at length if the tool should be a part of their clinical care, it is possible that PTs who have no previous exposure or no clinical support to use the tool might have different responses to our questions. It is well known that implementing any new evidence in a clinical setting is facilitated by having support from clinical leadership in the setting (31). Many of the criticisms of the smartphone app were related to the design and how the therapist navigated through the different parts of the app. Although we did work with a healthcare app designer, it was apparent that certain features of the app will need to be redesigned to improve its use at the bedside, and enabling analytics related to smartphone app use would provide further insight. However, the issue of professionalism and smartphone use will not be solved with a better app design. Changes in how phone use is perceived may require a change in the institutional culture, or enough "early adopters" (32) to use phones in clinical settings to make them commonplace. Similarly, we used the LMS of our institution for the web-based learning module, which also had specific features that may not be present in other systems. Thus, the generalizability of the comments related to the learning module may be limited. Nevertheless, the lessons learned from the design and use of these technology-based formats will inform future studies that aim to translate knowledge via technology. The PTs recruited in this study identified as female. It is possible that male PTs may have different responses and perspectives. Finally, although we recruited a large proportion of the available cohort of newly graduated PTs, the number of participants was relatively small, and the perspectives of our participants may not be shared with other PTs in other settings.

In conclusion, we found that the AECOPD-Mob clinical decision-making tool was used by newly graduated PTs in clinical practice. Although these PTs were receptive to the introduction of technology to facilitate knowledge translation, the paper format of AECOPD-Mob was strongly preferred as it aided communication, was the most feasible to use in clinical practice, and was seen as more professional and accessible than other formats. These findings are important to researchers and educators who are making decisions regarding the format of knowledge translation tools in their clinical area and can enable future research to explore how AECOPD-Mob could be implemented in other health disciplines.

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