Developing a Physiotherapy-Specific Preliminary Clinical Decision-Making Tool for Oxygen Titration: A Modified Delphi Study

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ABSTRACT

Purpose: To develop and evaluate a preliminary clinical decision-making tool (CDMT) to assist physiotherapists in titrating oxygen for acutely ill adults in Ontario. **Methods:** A panel of 14 experienced cardiorespiratory physiotherapists was recruited. Factors relating to oxygen titration were identified using a modified Delphi technique. Four rounds of questionnaires were conducted, during which the goals were to (1) generate factors, (2) reduce factors and debate contentious factors, (3) finalize factors and develop the preliminary CDMT, and (4) evaluate the usability of the tool in a clinical context. **Results:** The panel reached consensus on a total of 89 factors, which were compiled to create the preliminary CDMT. The global tool reached consensus for sensibility, receiving a mean score of 6/7 on a 7-point Likert-type scale (1 = unacceptable; 7 = excellent). Five of the nine individual components of evaluation of the tool achieved scores ≥ 6.0 ; the remaining four had mean scores between 5.4 and 5.9. **Conclusion:** This study produced a preliminary CDMT for oxygen titration, which the panel agreed was highly comprehensible and globally sensible. Further research is necessary to evaluate the sensibility and applicability of the tool in a clinical setting.

Key Words: cardiorespiratory physiotherapy; Delphi technique; oxygen titration; decision support techniques.

RÉSUMÉ

Objectif : Élaborer et évaluer un outil préliminaire de prise de décision clinique pour aider les physiothérapeutes à doser l'oxygène pour le traitement des adultes gravement malades en Ontario. **Méthodes :** Un groupe de 14 physiothérapeutes chevronnés en physiothérapie cardiorespiratoire a été recruté. Les facteurs liés au dosage de l'oxygène ont été cernés à l'aide d'une technique Delphi modifiée. Quatre séries de questionnaires ont été distribuées, dans le but de (1) produire les facteurs, (2) réduire le nombre de facteurs et débattre des facteurs controversés, (3) mettre au point les facteurs et élaborer l'outil préliminaire, et (4) évaluer la sensibilité de l'outil. **Résultats :** Le groupe est parvenu à un consensus sur un total de 89 facteurs qui ont permis de constituer l'outil préliminaire. Il est ensuite arrivé à un consensus concernant la sensibilité de l'outil global, ce dernier ayant reçu une note moyenne de 6 sur 7 sur l'échelle Likert (1 étant inacceptable et 7, excellent). Cinq des neuf composantes individuelles de l'évaluation de l'outil ont obtenu des notes $\geq 6,0$, tandis que les quatre autres composantes obtenaient des notes moyennes s'échelonnant de 5,4 à 5,9. **Conclusion :** Cette étude a produit un outil préliminaire pour le dosage de l'oxygène qui, de l'avis du groupe, est tout à fait compréhensible et généralement pratique. Il faudra effectuer une recherche approfondie pour évaluer la sensibilité et l'applicabilité de l'outil dans le contexte clinique.

In the province of Ontario, Canada, legislative changes to the Physiotherapy Act in 2011 (Bill 179) allow physiotherapists to “administer a substance by inhalation when ordered by a member of another profession authorized to perform the procedure.”¹ This change has direct implications for physiotherapists working in acute-care settings, who will now be independently responsible for maintaining optimal oxygen saturation (SpO₂) levels during physiotherapy (PT) interventions. Before 2011, delegation by an authorized health care professional (HCP)

or a medical directive was required for physiotherapists to titrate oxygen as part of their practice, and only 39% of physiotherapists were titrating oxygen in hospitals in 2009.² With the newly expanded scope of practice, it is important that all physiotherapists, particularly those practising in cardiorespiratory care, have the appropriate levels of knowledge and confidence to competently titrate their patients' oxygen levels.

Practice guidelines and standardized clinical decision-making tools (SCDMTs) are used to improve quality of

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care and potentially reduce health care costs.^{3–6} Several guidelines and SCDMTs for oxygen management have been developed to direct HCPs in administering and titrating oxygen, as well as in weaning patients from mechanical ventilators.^{3,7,8} Studies have demonstrated that use of SCDMTs improves the efficiency of oxygen allocation, as protocol-directed care results in fewer instances of incorrect oxygen administration than physician-directed care.^{9–11} An additional benefit is that hospital care costs are reduced through an overall decrease in duration of oxygen use.^{9,12} The existing guidelines are structured around specific factors that should be monitored to determine whether oxygen titration is necessary and, if so, what adjustments need to be made.

Current SCDMTs were designed by and for physicians, registered nurses, and respiratory therapists working in immediate post-operative care or in a medical clinical teaching unit,^{3,7} and therefore may not be entirely transferable to PT practice. Furthermore, research has not yet focused on constructing a decision-making tool for oxygen titration that is specific to the practice context of physiotherapists, who are commonly required to titrate oxygen for patients with acute illnesses pre- and post-treatment and during varying levels of physical exertion.¹³ We should not assume that current SCDMTs that are specific to one point in a patient's continuum of care can safely be applied across the continuum, including at various levels of physical exertion. A comprehensive SCDMT for oxygen titration should include both sequential steps to determine the need for oxygen titration and parameters to adjust the oxygen flow rate.

The purpose of our study was to develop a preliminary CDMT to help current physiotherapists and new graduates safely and effectively titrate oxygen for acutely ill adult patients, and to provide a framework for entry-level education on oxygen titration.

METHODS

Study design

Our study used a modified Delphi technique¹⁴ to gather responses from a panel of experienced clinicians and academic leaders in cardiorespiratory PT (CPT). Questionnaires were administered by email. The study was approved by the Ethics Review Board of the University of Toronto.

For the purpose of our study, we developed working definitions for “titration” and “acutely ill.” *Titration* was defined as the act of adjusting a patient's oxygen supply to maintain optimal oxygen saturation levels (between 94% and 98%) after supplemental oxygen is ordered by an authorized HCP. We defined an *acutely ill* patient as one who is at high risk for actual or potentially life-threatening health problems and/or requires detailed observation or intervention from higher levels of care.

Eligibility criteria

The experienced panel included practising clinicians and academic leaders in the field of CPT. Recruitment was localized to Ontario, as changes to the province's Physiotherapy Act in 2011 do not affect physiotherapy practice elsewhere in Canada. Clinicians were considered eligible for the study if they (1) were cardiorespiratory physiotherapists currently employed in either a tertiary-care or a community-care hospital in Ontario; (2) had a minimum of 2 years' experience in CPT; (3) had a case-load consisting of at least 50% cardiorespiratory cases; and (4) had taken at least one continuing education course in CPT or a related topic in the previous 5 years. Participating academic leaders were eligible if they (1) currently held an academic appointment in an Ontario university PT programme and were (2) responsible for delivering the CPT curriculum or (3) currently conducting research in the area of CPT.

Recruitment

Our target panel size was 20 to 25, with a ratio of 5 clinicians to 1 academic leader, reflecting our goal of creating a tool to support clinical decision making. We estimated that approximately 200 cardiorespiratory physiotherapists, academic leaders, and researchers across Ontario would be potential candidates for participation in the study. We sent recruitment packages to physiotherapists using the e-blast service of the Canadian Physiotherapy Association (Cardiorespiratory Division) and the Ontario Physiotherapy Association. We also directly emailed seven academic leaders and asked 28 centre coordinators of clinical education at tertiary-care or community-care hospitals to forward the invitation to cardiorespiratory physiotherapists working in their hospitals.

Data collection and data analysis

Pilot questionnaire

The Round 1 Delphi questionnaire was developed based on the literature and on recommendations from experts within the research team. The questionnaire consisted of six guiding questions and was piloted with seven local physiotherapists currently working as clinicians and/or academic leaders in CPT, who were asked to provide feedback on the appropriateness and clarity of the questions. The questionnaire was revised based on this feedback before being sent out to the Delphi panel; pilot participants were excluded from future participation on the panel.

Modified Delphi rounds

Over the course of the study we conducted three modified Delphi rounds, using the revised questionnaire, to generate a list of oxygen titration clinical factors. After each round, we summarized the data, which were then sent back to the panellists to determine the consensus

Box 1 Round 1 Questionnaire: Six Guiding Questions

Questions

1. What subjective and/or objective findings/measures of a clinical assessment would you consider when determining the need to titrate oxygen in an acutely ill adult patient?
2. What comorbidities or other pertinent patient history would you consider when determining the need to titrate oxygen in an acutely ill adult patient?
3. What preparatory steps, considerations, and/or titration methods are important to undertake when titrating oxygen in an acutely ill adult patient? (equipment needs can be included here)
4. What factors are important to consider after you have titrated a patient's oxygen?
5. What would cause you to terminate PT intervention?
6. What would cause you to call for emergency help?

for each factor. We then conducted a fourth round to assess the *sensibility* of the first draft of the CDMT, defined as the extent to which the tool makes sense for use in a clinical context. For each round, we sent a reminder email to panellists who did not complete the questionnaire within the specified time frame (2–4 weeks). For a modified Delphi approach, rather than recommending a specific consensus level, the literature suggests a range between 51% and 80%;^{14–16} we therefore defined an a priori consensus threshold of $\geq 80\%$.

Round 1: Generation of oxygen titration clinical factors

The purpose of Delphi round 1 was to generate factors for inclusion in the preliminary CDMT based on the revised questionnaire. Each question (see Box 1) was intended to represent a phase of the oxygen titration process that physiotherapists are likely to consider when titrating oxygen for acutely ill adults. Panellists were given a framework outlining the concept (identifying all important factors for physiotherapists to consider when titrating oxygen), the relevant population (acutely ill adults in acute-care hospital settings), and the purpose of the CDMT (to help new graduates and practising physiotherapists titrate oxygen competently and safely). They were also given an existing clinical guideline for oxygen administration, developed for use in nursing, as a reference for the intended outcome of the study.³ Panellists were instructed to generate a list of all possible factors that should be considered when titrating oxygen, based on the six guiding questions. We then collated the lists of suggested factors.

Round 2: Reduction of oxygen titration clinical factors

The purpose of round 2 was to reduce and/or refine the list factors generated in round 1. Panellists were asked to review the lists of factors and to state (using yes/no responses) whether or not they considered each factor appropriate, feasible, and clear for inclusion in the preliminary CDMT. They were also asked to comment on the lists, suggest revisions, and propose any additional factors they considered relevant. A factor reached consensus and was retained for use in the CDMT only if

$\geq 80\%$ of panellists agreed that it was appropriate, feasible, and clear. If a factor achieved $\geq 80\%$ consensus for appropriateness and feasibility, but not for clarity, it was considered a contentious factor; those that achieved 75%–79.9% consensus for appropriateness and/or feasibility were also identified as contentious and were retained for further consideration. We revised the contentious factors based on the results and comments provided by the panellists. All other factors were eliminated from future rounds.

Round 3: Finalization of clinical factors and development of preliminary CDMT

The purpose of round 3 was to confirm the panel's opinion on the revised contentious factors and on any additional factors generated during round 2. We asked panellists to review these factors and then to restate, using yes/no responses, whether or not they considered each one appropriate, feasible, and clear for inclusion in the CDMT. Panellists were also asked to comment on or suggest revisions to any factor, as necessary. For reference, we provided a list of retained and eliminated factors for each guiding question. Only those contentious factors that met the $\geq 80\%$ consensus threshold for all three conditions were accepted for inclusion in the preliminary CDMT, which was then drafted using all retained clinical factors generated from the three modified Delphi rounds.

Round 4: Evaluation of preliminary CDMT

Round 4 was designed to obtain feedback regarding the sensibility of the preliminary CDMT for oxygen titration in acutely ill adult patients. This round used a sensibility questionnaire adapted from the work of Rowe and Oxman,¹⁷ who have defined sensibility as “enlightened common sense,” combining common sense and a reasonable knowledge of pathophysiology and clinical reality.¹⁷ We asked panellists to review the proposed CDMT and then complete the sensibility questionnaire, which consisted of 11 questions (see Box 2) evaluating the tool's purpose, layout, face validity, content validity, applicability, and ease of use. Mean, median, and mode values for questions 1–9 were calculated on a 7-point Likert-type

Box 2 Round 4 Questions from Sensibility Questionnaire

Questions

1. How would you rate the tool in terms of clarity?
2. How would you rate the tool in terms of simplicity?
3. The tool was developed to assist physical therapists in titrating oxygen for acutely ill adult patients who are already using oxygen. This tool will be used by new graduates and currently practicing physical therapists as an adjunct to their existing knowledge to competently and safely titrate oxygen as allowed by the new scope of practice. To what extent do you think this goal has been achieved?
4. How many of the factors identified in the tool are crucial or necessary?
5. How many of the factors identified in the tool are redundant?
6. Are there any important factors that should have been included in the clinical decision making tool that have not been included?
7. Would the tool be acceptable to other physical therapists in terms of the clarity of the factors, comprehensiveness of the tool, and the amount of time it would take to complete the tool?
8. Would you incorporate the tool into your clinical practice as a resource?
9. In your opinion, would the tool be useful to help new graduates/coverage staff, or students to determine the appropriate steps to take when titrating oxygen with acutely ill adults?
10. The purpose of this study was to identify the steps that should be taken by physical therapists when titrating oxygen up or down in acutely ill adult patients. We would like to draw your attention to the "Titration Methods" section of the tool. Please list any additional steps you consider to be applicable.
11. Additional comments or suggestions

scale (1 = unacceptable; 7 = excellent). We determined a priori that individual criteria would be considered sensible if the mean value for each question was $\geq 6/7$ and that the tool would be considered sensible overall if the global mean was $\geq 6/7$. Because of the small sample size, we calculated median and mode values as well as mean values.

RESULTS

Demographics of modified Delphi panel

A total of 14 people (5 academic leaders in CPT and 9 cardiorespiratory physiotherapists) returned signed consent forms in response to the recruitment packages; 13 returned the demographics questionnaire. Demographic data for panellists are provided in Table 1.

Response rates

We calculated the response rate for each round based on the number of panellists to whom questionnaires were sent; any panellist who did not respond in a given round was excluded from future rounds. In round 1, 12/14 panellists responded; 11/12 panellists responded in round 2, and 10/11 panellists in round 3. Finally, 8/10 panellists responded to the sensibility questionnaire in round 4. There were no consistent differences in demographic characteristics between those who dropped out and those who did not. Two of the four panellists who dropped out indicated that the questionnaires took too much time to complete. The time between the start of round 1 and the end of round 4 was 3 months.

Developing the CDMT

In round 1, panellists generated a total of 64 clinical factors related to subjective and objective findings of

a clinical assessment that they considered necessary to determine when oxygen titration is necessary for acutely ill adult patients. By the end of round 3, the list had been refined to 12 factors (see Table 2) relating to shortness of breath, relevant medical history, baseline oxygen use, signs of respiratory distress, SpO₂ levels, and vital sign readings.

Of 45 factors generated in round 1 that related to comorbidities and patient history, 14 remained at the end of round 3 (see Table 2), including acute/chronic respiratory conditions, baseline oxygen use, recent trauma, cardiac conditions, neurological conditions, and history or recent episodes of oxygen desaturation.

We asked panellists to identify preparatory steps, considerations, and titration methods that are important to undertake when titrating oxygen for acutely ill adults. The 56 such factors generated in round 1 were reduced to 20 at the end of round 3 (see Table 2). The preparatory steps and considerations retained for inclusion in the preliminary CDMT focused on checking the medical order for SpO₂, understanding the process of oxygen titration, reviewing clinical presentation, and considering patient status and/or activities. Only four factors pertaining specifically to the method of oxygen titration reached consensus.

We also asked panellists to identify factors they would consider after titrating a patient's oxygen. Of 44 factors generated in round 1, 14 remained for inclusion in the draft CDMT (see Table 2), including patient's activity at time of desaturation, ensuring that SpO₂ remains within acceptable parameters, respiratory and cardiac responses, loss of consciousness (LOC), patient education, inter-professional communication of changes in oxygen requirements, and documentation.

Table 1 Demographic Information for Participating Modified Delphi Panellists

Characteristics	No. (%) of panellists*	
	Academic leaders (<i>n</i> = 5)	Clinicians (<i>n</i> = 8)
Current practice location*		
University	2 (40)	4 (50)
Tertiary care hospital	3 (60)	4 (50)
Education†		
BA	1 (20)	1 (13)
BSc / BSc (Hons)	4 (80)	6 (75)
MSc	3 (60)	4 (50)
Year of graduation		
Before 1990	0 (0)	2 (25)
1991–1995	2 (40)	2 (25)
1996–2000	0 (0)	1 (12.5)
2001–2005	1 (20)	1 (12.5)
2006–2010	2 (40)	2 (25)
Practice experience in the cardiorespiratory field, mean (median) y	13.0 (10)	12.5 (9.5)
Respondents with previous experience with titrating oxygen	5	6
No. of CE courses in CPT or related topics in previous 2 y		
0–4	3	8
5–8	1	
>8	1	
Current responsibilities		
% clinical		
0–49	2 (40)	0 (0)
50–100	3 (60)	8 (100)
% research		
0–49	4 (80)	8 (100)
50–100	1 (20)	0 (0)
% academic teaching		
0–49	4 (80)	8 (100)
50–100	1 (20)	0 (0)
“Yes” response to: previous experience in a consensus process	1 (20)	0 (0)

*Unless otherwise indicated.

†Panellists could specify more than one practice location or degree.

CE = continuing education; CPT = cardiorespiratory physiotherapy.

Of 47 factors generated in round 1 that related to determining the need to terminate PT intervention, 10 were included in the preliminary CDMT (see Table 2). These factors relate to severe desaturation; significant increase in oxygen requirements; hypoxic signs and symptoms; acute change in vital signs; symptoms of chest pain, LOC, presyncope, fatigue, or breathing cessation; and subjective patient reports.

Finally, we asked panellists to identify factors that would indicate an emergency situation post-titration requiring them to call for help. In round 1, they identified 40 factors; at the end of round 3, we retained 21 factors (see Table 2) relating to decreasing LOC, chest pain, in-

creased respiratory distress, severe desaturation, detrimental changes in vitals, and the presence of stridor.

Preliminary clinical decision-making tool

After 3 rounds of questionnaires, the panellists identified a total of 89 factors as appropriate, feasible, and clear. We divided these factors into two sections: (1) pre-titration assessment, considerations, equipment, and preparatory steps if oxygen titration is indicated; and (2) titration methods/steps and post-titration considerations and actions dependent on patient response. We determined that several factors across the six questions conveyed similar concepts; as a result, these factors were

Table 2 Number of Factors Considered in the First Three Modified Delphi Rounds

Question	Round 1		Round 2		Round 3
	Factors generated	Factors retained	Contentious factors*	Factors eliminated	Total no. of factors retained†
1	64	8	10	37	12
2	45	2	14	14	12
3	56	20	4	23	20
4	44	14	7	23	14
5	47	8	9	21	10
6	40	13	9‡	19	21

*Synonymous contentious clinical factors were combined at the end of round 2; total indicates number after refinement of data.

†Tallies may not add up between rounds, as many synonymous clinical factors were combined during data analysis.

‡One new factor was generated by a panellist in round 2.

collapsed into a smaller number of factors to reduce redundancy. The preliminary CDMT was developed as a two-page tool. We organized 33 of the 89 factors into a chart on the first page, which covers information on subjective and objective factors to assess, situational considerations, preparatory steps, and equipment needed (see Figure 1a). The remaining 48 factors were organized into a flowchart on the second page that presents the titration steps. The flowchart has three branches that guide the user on what to assess following titration and what actions to take depending on the patient's response: positive (green), negative—caution (yellow), or negative—emergency (red) (see Figure 1b). The last step of the CDMT lists factors that should be considered after patient interaction, including patient education, documentation, and inter-professional communication. Data common to both guiding question 5 (termination of PT intervention) and guiding question 6 (emergency factors) were combined under the “emergency” heading.

Sensibility round

The global mean score for the tool was 6.0 out of 7 (see Table 3); five of the nine questions achieved a mean score ≥ 6.0 , and the remaining four questions had mean scores between 5.4 and 5.9. The majority of panellists gave a rating between 5 and 7 for each question. We used their comments to refine the draft of the CDMT by eliminating redundant factors.

When asked to provide general feedback on the draft CDMT, several panellists commented that it is comprehensive and captures possible patient responses to any type of intervention, including ambulation, use of a pedal bike, and manual CPT. One panellist also noted that the CDMT highlights the need for inter-professional communication during the process of oxygen titration.

DISCUSSION

The process documented in this article generated a preliminary CDMT for oxygen titration that is specifically targeted to physiotherapists and focuses on factors that

must be considered during PT interventions. The CDMT provides a framework to guide physiotherapists in assessing three areas: the need for oxygen titration, the patient's response during oxygen titration, and the patient's response following titration. The Assessment section (see Figure 1a) is meant to guide clinicians to consider subjective and objective findings or measures that will help them determine whether a patient requires oxygen titration; the presence of some of these factors would indicate that oxygen titration may be appropriate. However, users of this tool are also asked to consider whether a patient has any additional medical conditions that may suggest a need for oxygen titration during therapy. They are then asked to consider any special considerations, types of equipment, and preparatory steps before titrating oxygen (see Figure 1a). The flowchart (Figure 1b) helps clinicians to determine what action is appropriate based on the patient's response post-titration.

The preliminary CDMT accounts for the patient's general activity and mobility requirements during PT intervention, a factor not addressed by existing SCDMTs.^{3,7,8} The CDMT also accounts for the effect of physical exertion on the oxygen requirements of acutely ill adults, a factor pertinent to physiotherapists responsible for mobilizing patients on supplemental oxygen across the continuum of care.¹³ Existing SCDMTs for oxygen titration have often been developed for use at specific points in a patient's continuum of care; examples are Komara and Stoller's⁷ SCDMT for titrating oxygen during post-operative care and O'Driscoll and colleagues'⁸ guideline for emergency oxygen use. Another SCDMT was created by Wong and colleagues¹³ for use primarily in a hospital clinical teaching unit.

The SCDMT by Komara and Stoller⁷ and the guideline by O'Driscoll and colleagues⁸ identify specific factors associated with the need for oxygen titration, including risk of hypercapnia, SpO₂ level, and oxygen and carbon dioxide pressures. The SCDMT by Wong and colleagues¹³ also identifies chest pain and respiration rate as

OXYGEN TITRATION FOR ACUTELY ILL ADULT PATIENTS A PRELIMINARY CLINICAL DECISION-MAKING TOOL

Purpose: The purpose of this preliminary decision-making tool is to assist physical therapists in titrating oxygen for acutely ill adult patients. This tool will be used by new graduates and currently practicing physical therapists as an adjunct to their existing knowledge to competently and safely titrate oxygen as allowed by the new scope of practice. For the purposes of this tool, *titration* has been defined as “the act of adjusting a patient’s oxygen supply to maintain optimal oxygen saturation levels after supplemental oxygen is ordered by an authorized health professional.”

Instructions: The first page lists items to consider when deciding to titrate oxygen. It also includes preparatory steps and suggested equipment. The second page has been designed to assist in the process of titrating oxygen for acutely ill adult patient. This tool is not intended to replace the clinician’s clinical reasoning and interprofessional collaboration.

ASSESSMENT	
Subjective <ul style="list-style-type: none"> • SOB at rest and/or with activity as per patient reports • Baseline history of home O₂ use at rest and/or with activity • Pertinent Medical History: <ul style="list-style-type: none"> ○ Acute/Chronic respiratory conditions: <ul style="list-style-type: none"> ▪ Chronic lung disease (restrictive or obstructive) ▪ Acute chest infection ▪ Pulmonary embolism ▪ Pleural effusion ▪ Pulmonary hypertension ○ Post-surgical patient ○ Neurological conditions that may affect muscles of respiration and general mobility ○ History / recent episodes of desaturation with or without interventions (i.e., position change, chest PT, exercise, exertion) ○ Recent trauma (i.e., injury to chest, MVA, fractured ribs) ○ Cardiac involvement (includes CHF, arrhythmias, left ventricular dysfunction, known cardiomyopathy, angina, recent MI, previous cardiac surgery) 	Objective <ul style="list-style-type: none"> • Signs of respiratory distress (includes nasal flaring, laboured respirations, accessory muscle use, cyanosis, tracheal tug, intercostal indrawing, paradoxical breathing pattern) • SpO₂ values (at rest and with activity) • Vital Signs: <ul style="list-style-type: none"> ○ Heart rate (consider tachycardia, bradycardia, patient symptoms and abnormal rhythm) ○ CO₂ retainer (consider desaturation and patient symptoms)
CONSIDERATIONS	
<ul style="list-style-type: none"> • Recent nasal or throat surgery and/or procedure that affects patency of airway when choosing appropriate equipment • Activity level of patient to date – anticipate his/her O₂ requirements may increase when challenged • Tracheotomy: need humidification of oxygen – however not necessary for ambulation alone • Patient goals of care (palliation vs. active treatment) • Potential red flags – Would not titrate O₂ if patient is exhibiting: <ul style="list-style-type: none"> ○ Possible cardiac or neuro ischemia (chest pain, new onset confusion or other neurological symptoms) ○ Symptoms related to acute MI or CVA 	
EQUIPMENT	
<ul style="list-style-type: none"> • Saturation monitor, full oxygen tank, oxygen cylinder with flow meter, appropriate oxygen delivery systems, appropriate gait aid if going to ambulate, stethoscope • If patient is on nasal prongs, may consider bringing non-rebreather / venturi mask • Ensure extra full oxygen tank on hand if mobilizing 	
PREPARATORY STEPS	
<ul style="list-style-type: none"> • Know delivery method, flow, FiO₂, availability in tank • Check medical order for SpO₂ level / range • Explain procedure to patient • Check for issues that may impact reading and position pulse oximeter accordingly; consider alternate probes if available for patients with circulation disorders 	

Figure 1a Preliminary oxygen titration CDMT, p. 1, outlining signs and symptoms to consider during assessment to determine whether oxygen titration is required, additional considerations, equipment that may be required/used, and preparatory steps.

Figure 1b Preliminary oxygen titration CDMT, p. 2, presenting titration steps and actions to take depending on patient response: positive (green), negative—caution (yellow), or negative—emergency (red).

Table 3 Summary of Sensibility Questionnaire Data from Questions 1–9

Question	Values		
	Mean (%)	Median	Mode
1	5.9 (84)	6	6
2	6.0 (86)	6	6
3	5.9 (84)	6	5,6
4	6.1 (87)	6	6
5	5.4 (77)	6	6,7
6	6.5 (93)	7	7
7	5.9 (84)	6	7
8	6.0 (86)	6	5,7
9	6.6 (94)	7	7
Global Mean Rating	6.0 (86)	6.0	5,9

factors that should be assessed in determining the need for titration. Our panellists identified specific factors that agree with those used in existing SCDMTs. When asked what elements of a clinical assessment are necessary in determining the need for oxygen titration, the panel reached consensus on factors relating to shortness of breath, signs of respiratory distress, and SpO₂ levels. However, our panel also generated factors covering a wider range of signs, symptoms, and relevant patient information not addressed in current SCDMTs. The preliminary CDMT therefore takes into consideration a baseline history of home oxygen use, surgical procedures that may affect airway patency, and pertinent medical history, including cardiac and neurological conditions; it also considers sequential steps, including pre-titration assessments, special considerations, possible equipment, and preparatory steps, that are not found in existing SCDMTs.

The preliminary CDMT differs from existing SCDMTs in that it does not suggest specific parameters for oxygen titration. Current SCDMTs are used to regulate protocols and procedures, as well as to provide guidance for clinical decision making to improve quality of care.^{3–6} SCDMTs guide HCPs to use clinical reasoning to identify when a patient may benefit from oxygen titration and determine optimal titration values as indicated by best practice and/or experience. Although it is not necessary to include specific parameters, as health care is patient specific and HCPs are expected to reason clinically when providing treatment, the lack of specific parameters does decrease the effectiveness of the tool. It is difficult to indicate whether or not the lack of specific parameters is appropriate for a tool used in health care; however, our intention in this study was to develop a preliminary tool to help students, new graduates, and practising clinicians to determine optimal values or ranges that are most beneficial for their patients. Current SCDMTs indicate specific values for SpO₂, arterial blood gases, and

oxygen and carbon dioxide pressures to monitor, as well as oxygen flow rate to titrate. Although we attempted to gather this information from our panellists, they were unable to reach consensus on any specific parameters for adjusting oxygen flow rate. Comments from panellists suggest that the specific steps of the process and the amount of oxygen to be titrated are patient specific, and this may explain why they were unable to agree on specific parameters for titration methods. It may also be that physiotherapists have different experiences with the act of oxygen titration, as many hospitals had their own protocols for oxygen titration before the 2011 legislative changes. However, the panel was able to reach consensus on the process to be considered before and after adjusting a patient's oxygen, which may be less patient specific.

It is also interesting that although we provided a guiding definition of titration, most of the factors identified by our panellists suggest that physiotherapists associate the term with increasing rather than decreasing the flow of oxygen. The process of titrating oxygen is still new to PT practice, and therefore turning down a patient's oxygen may not be a frequent process. Many of the post-titration factors identified in our study are associated with a negative response that leads to a cautionary or emergency action. In addition, the Considerations section of the preliminary CDMT suggests to the user that oxygen requirements may increase when the patient's activity level is challenged, which again highlights that the perception of titration is often associated with turning up oxygen flow.

The small size of our panel is a limitation, as consensus is easily affected by a difference of one or two responses. We began with only 14 panellists, and 4 were lost to attrition by the end of round 4. Previous studies using the modified Delphi approach have used panels ranging in size from 20 to 2,000.¹⁸ Despite using several recruitment strategies, however, we were not able to meet this quota within our timeframe. Our panel also lacked representation from rural practice settings in Ontario, and our results may therefore not be applicable to all practice settings. Panellists were eligible only if their caseload included ≥50% cardiorespiratory patients; this may have tended to exclude therapists in rural settings, who often have mixed caseloads. Therefore, the preliminary CDMT will need to be refined before it can serve as an SCDMT, and additional research is required to further develop the specific titration steps for adjusting a patient's oxygen. It would be beneficial to further analyze the sensibility of the tool using a new panel of therapists. Finally, a trial in which the CDMT is used by a group of physiotherapists in urban and rural settings may be needed to fully evaluate its usability in a clinical setting and to gather feedback and suggestions from practising clinicians to develop it into a standardized tool.

CONCLUSION

Our study used a modified Delphi method to develop a preliminary CDMT for physiotherapists performing oxygen titration in acutely ill adults. The CDMT is comprehensive in terms of its ability to provide guidance for assessment before titration, identify the need to terminate PT intervention and potentially call for help, and set out key steps to follow after the patient interaction; it is unique in that it was created by experienced cardiorespiratory physiotherapists and takes into account changes in oxygen demands with mobility and exertion, factors particularly relevant to PT practice. Further research is needed to determine the value and applicability of this tool in the clinical setting.

KEY MESSAGES

What is already known on this topic

The 2011 amendments to Ontario's Physiotherapy Act allow physiotherapists in the province to adjust a patient's oxygen level through the act of titration to maintain optimal SpO₂. Current standardized clinical decision-making tools (SCDMT) and clinical practice guidelines for oxygen titration were primarily developed by physicians, respiratory therapists, and nurses and often do not take into consideration patients' oxygen requirements during physical exertion. There is currently no SCDMT created by physiotherapists.

What this study adds

Physiotherapists are responsible for mobilizing patients across the continuum of care, but current SCDMTs do not include specific recommendations regarding oxygen titration during PT treatment. This study was used to develop a preliminary clinical decision-making tool (CDMT) based on the recommendations of a panel of practising cardiorespiratory physiotherapists and academic leaders. Consensus was reached on 89 factors relevant to the act of oxygen titration, including pre-titration assessment and post-titration assessment and actions. These factors were used to develop a two-page preliminary CDMT that includes an initial chart and a flowchart to guide clinicians during the process of titrating oxygen. The panel found the tool comprehensible and agreed that it will be beneficial for use in clinical practice. This tool can serve as the basis for developing an SCDMT for oxygen titration in acutely ill adult patients that is specific to PT practice.

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