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Exercise Programs After Pulmonary Rehabilitation for Patients With Chronic Obstructive Pulmonary Disease (COPD): A Rapid Review

Health Quality Ontario

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Evidence Development and Standards Branch at Health Quality Ontario

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Conflict of Interest Statement

All authors in the Evidence Development and Standards branch at Health Quality Ontario are impartial. There are no competing interests or conflicts of interest to declare.

Rapid Review Methodology

Rapid reviews must be completed in a 2- to 4-week time frame. Clinical questions are developed by the Evidence Development and Standards branch at Health Quality Ontario, in consultation with experts, end users, and/or applicants in the topic area. A systematic literature search is then conducted to identify relevant systematic reviews, health technology assessments, and meta-analyses. The methods prioritize systematic reviews, which, if found, are rated by AMSTAR to determine the methodological quality of the review. If the systematic review has evaluated the included primary studies using the GRADE Working Group criteria (http://www.gradeworkinggroup.org/index.htm), the results are reported and the rapid review process is complete. If the systematic review has not evaluated the primary studies using GRADE, the primary studies in the systematic review are retrieved and the GRADE criteria are applied to 2 outcomes. If no systematic review is found, then RCTs or observational studies are included, and their risk of bias is assessed. All rapid reviews are developed and finalized in consultation with experts.

About Health Quality Ontario

Health Quality Ontario is an arms-length agency of the Ontario government. It is a partner and leader in transforming Ontario's health care system so that it can deliver a better experience of care, better outcomes for Ontarians, and better value for money.

Health Quality Ontario strives to promote health care that is supported by the best available scientific evidence. The Evidence Development and Standards branch works with expert advisory panels, clinical experts, scientific collaborators, and field evaluation partners to conduct evidence-based reviews that evaluate the effectiveness and cost-effectiveness of health interventions in Ontario.

Based on the evidence provided by Evidence Development and Standards and its partners, the Ontario Health Technology Advisory Committee—a standing advisory subcommittee of the Health Quality Ontario Board—makes recommendations about the uptake, diffusion, distribution, or removal of health interventions to Ontario's Ministry of Health and Long-Term Care, clinicians, health system leaders, and policy-makers.

Health Quality Ontario's research is published as part of the *Ontario Health Technology Assessment Series,* which is indexed in MEDLINE/PubMed, Excerpta Medica/Embase, and the Centre for Reviews and Dissemination database. Corresponding Ontario Health Technology Advisory Committee recommendations and other associated reports are also published on the Health Quality Ontario website. Visit http://www.hqontario.ca for more information.

About Health Quality Ontario Publications

To conduct its rapid reviews, Evidence Development and Standards and its research partners review the available scientific literature, making every effort to consider all relevant national and international research; collaborate with partners across relevant government branches; consult with expert advisory panels, clinical and other external experts, and developers of health technologies; and solicit any necessary supplemental information.

In addition, Evidence Development and Standards collects and analyzes information about how a health intervention fits within current practice and existing treatment alternatives. Details about the diffusion of the intervention into current health care practices in Ontario add an important dimension to the review. Information concerning the health benefits, economic and human resources, and ethical, regulatory, social, and legal issues relating to the intervention may be included to assist in making timely and relevant decisions to optimize patient outcomes.

Disclaimer

This rapid review is the work of the Evidence Development and Standards branch at Health Quality Ontario, and is developed from analysis, interpretation, and comparison of published scientific research. It also incorporates, when available, Ontario data and information provided by experts. As this is a rapid review, it may not reflect all the available scientific research and is not intended as an exhaustive analysis. Health Quality Ontario assumes no responsibility for omissions or incomplete analysis resulting from its rapid reviews. In addition, it is possible that other relevant scientific findings may have been reported since completion of the review. This report is current as of the date of the literature search specified in the Research Methods section. Health Quality Ontario makes no representation that the literature search captured every publication that was or could be applicable to the subject matter of the report. This rapid review may be superseded by an updated publication on the same topic. Please check the Health Quality Ontario website for a list of all publications: http://www.hqontario.ca/evidence/publications-and-ohtac-recommendations.

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List of Abbreviations

COPD	Chronic Obstructive Pulmonary Disease
GRADE	Grading of Recommendations Assessment, Development, and Evaluation
HRQOL	Health-related quality of life
PR	Pulmonary rehabilitation
RCT	Randomized controlled trial

Background

As legislated in Ontario's *Excellent Care for All Act*, Health Quality Ontario's mandate includes the provision of objective, evidence-informed advice about health care funding mechanisms, incentives, and opportunities to improve quality and efficiency in the health care system. As part of its Quality-Based Funding (QBF) initiative, Health Quality Ontario works with multidisciplinary expert panels (composed of leading clinicians, scientists, and administrators) to develop evidence-based practice recommendations and define episodes of care for selected disease areas or procedures. Health Quality Ontario's recommendations are intended to inform the Ministry of Health and Long-Term Care's Health System Funding Strategy.

For more information on Health Quality Ontario's Quality-Based Funding initiative, visit www.hqontario.ca.

Objective of Analysis

The objective of this analysis was to determine the effectiveness of exercise programs in maintaining the gains brought about by pulmonary rehabilitation in patients with chronic obstructive pulmonary disease (COPD) or pneumonia.

Clinical Need and Target Population

Description of Disease/Condition

Respiratory diseases and infections have pervasive implications for patients. COPD is characterized by progressive airflow obstruction that cannot be fully reversed with bronchodilator medication. (1) Patients are often limited in their physical activity as a result, or they may self-limit their physical activity to reduce dyspnea (2), though doing so is associated with poorer health-related quality of life (HRQOL), reduced survival, and increased health service use. (3-6)

Technology/Technique

Pulmonary rehabilitation (PR) is a therapeutic intervention that has been shown to improve the poor outcomes associated with COPD, especially immediately following completion of the rehabilitation program. (7-9) The longevity of the gains from PR are known to diminish over the subsequent year (10). What remains uncertain is the effectiveness of exercise programs in maintaining the benefits of PR.

Rapid Review

Research Question

What is the effectiveness of exercise programs for COPD or pneumonia patients following pulmonary rehabilitation on improving exercise capacity and quality of life?

Research Methods

Literature Search

Search Strategy

A literature search was performed on December 10, 2013, using Ovid MEDLINE, Ovid MEDLINE In-Process and Other Non-Indexed Citations, and EBM Reviews for studies published from January 1, 2008, to December 10, 2013. (Appendix 1 provides details of the search strategies.) Abstracts were reviewed by a single reviewer and, for those studies meeting the eligibility criteria, full-text articles were obtained. Reference lists were also examined for any additional relevant studies not identified through the search.

Inclusion Criteria

- English-language full-text publications
- published between January 1, 2008, and December 10, 2013
- systematic reviews, meta-analyses, and health technology assessments
- adult patients with chronic obstructive pulmonary disease (COPD) or pneumonia, who were living in the community
- exercise programs for maintenance or wellness following PR
- reporting 1 or more outcomes of interest

Exclusion Criteria

- studies comparing the effectiveness of types or intensities of exercise
- exercise programs in lieu of PR, or programs not temporally following PR
- COPD patients in institutional or residential settings
- Randomized controlled trials (RCTs), observational studies, case reports, conference abstracts, narrative reviews, clinical practice guidelines

Outcomes of Interest

- exercise capacity
- health-related quality of life (HRQOL)

Expert Panel

In November 2013, an Expert Advisory Panel on Post-Acute Community-Based Care for COPD Patients was struck. Members of the panel included physicians, personnel from the Ministry of Health and Long-Term Care, and representatives from community care organizations.

The role of the expert advisory panel was to provide advice on primary COPD patient groupings; to review the evidence, guidance, and publications related to defined COPD patient populations; to identify and prioritize interventions and areas of community-based care; and to advise on the development of a care pathway model. The role of panel members was to provide advice on the scope of the project, the methods used, and the findings. However, the statements, conclusions, and views expressed in this report do not necessarily represent the views of the expert panel members.

Quality of Evidence

The Assessment of Multiple Systematic Reviews (AMSTAR) measurement tool was used to assess the methodological quality of systematic reviews. (11)

The quality of the body of evidence for each outcome was examined according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) Working Group criteria. (12) The overall quality was determined to be high, moderate, low, or very low using a step-wise, structural methodology.

Study design was the first consideration; the starting assumption was that RCTs are high quality, whereas observational studies are low quality. Five additional factors—risk of bias, inconsistency, indirectness, imprecision, and publication bias—were then taken into account. Limitations in these areas resulted in downgrading the quality of evidence. Finally, 3 main factors that may raise the quality of evidence were considered: large magnitude of effect, dose response gradient, and accounting for all residual confounding factors. (12) For more detailed information, please refer to the latest series of GRADE articles. (12)

As stated by the GRADE Working Group, the final quality score can be interpreted using the following definitions:

High	High confidence in the effect estimate—the true effect lies close to the estimate of the effect
Moderate	Moderate confidence in the effect estimate—the true effect is likely to be close to the estimate of the effect, but may be substantially different
Low	Low confidence in the effect estimate—the true effect may be substantially different from the estimate of the effect
Very Low	Very low confidence in the effect estimate—the true effect is likely to be substantially different from the estimate of effect

Results of Rapid Review

The database search yielded 613 citations published between January 1, 2008, and December 10, 2013 (with duplicates removed). Articles were excluded based on information in the title and abstract. The full texts of potentially relevant articles were obtained for further assessment.

No relevant articles on pneumonia were identified. One systematic review on COPD patients met the inclusion criteria. The reference list of the included study and health technology assessment websites were hand-searched for other relevant studies, and no additional citations were identified.

A systematic review by Beauchamp and colleagues (13) evaluated the effectiveness of post-PR supervised exercise programs compared with usual community-based care at 6 and 12 months. The PR programs that preceded the maintenance programs ranged from 7 to 12 weeks in duration. The primary outcomes were exercise capacity and HRQOL. Table 1 shows an overview of the 7 included studies reporting on 6 RCTs pooled in the review.

Table 1: Pooled Analysis of RCTs on Post-PR Supervised Exercise Programs

Number of RCTs	Number Randomized	Mean Age, years	COPD Severity (FEV_1 predicted)	Range of Exercise Program Duration, months
6	619	67	32%–59%	9–15

Abbreviations: COPD, chronic obstructive pulmonary disease; FEV_1, forced expiratory volume; PR, pulmonary rehabilitation; RCT, randomized controlled trial.
Source: Beauchamp et al, 2013 (13)

One study administered the maintenance exercise program by integrating patients into local physiotherapy groups in the community (14) whereas all other programs were delivered in hospital-based outpatient settings. The frequency of exercise sessions ranged from once per month to 3 sessions per week. All maintenance exercise interventions included aerobic exercise, and 4 also included strength training of upper and/or lower extremities (14-17). Participants in all the studies were encouraged to also exercise at home.

Loss to follow-up was an issue in all of the studies, so much so that Elliot et al (14) could not analyze the results of the exercise program in their study and the results could not be subsequently included in the meta-analysis. The summary of the effects of the programs at 6 and 12 months follow-up are in Table 2.

Table 2: Exercise Capacity and Health-Related Quality of Life Following Maintenance Exercise Interventions Post-Pulmonary Rehabilitation at 6 and 12 Months

	6 months			12 months		
Outcome	**SMD (Number Pooled, n)**	**95% CI**	***P* value**	**SMD (Number Pooled, n)**	**95% CI**	***P* value**
Exercise Capacity[a]	−0.20 (433[b])	−0.39 to −0.01	0.04*	−0.09 (385[b])	−0.29 to 0.11	0.37
HRQOL[c]	−0.07 (336[b])	−0.29 to 0.14	0.50	−0.15 (416 [b])	−0.42 to 0.13	0.30

Abbreviations: CI, confidence intervals; HRQOL, health-related quality of life; RCT, randomized controlled trial; SMD, standard mean difference.
[a]Measured by the 6-minute walk test in 5 trials (14-18) and endurance shuttle walk test in 2 trials (17;19)
[b]Data from one trial (14) not included in meta-analysis due to high attrition.
[c]Measured by the Chronic Respiratory Questionnaire in 4 trials (16-18;20) and St. George's Respiratory Questionnaire in 2 trials (18;19)
*Statistical significance at $P < 0.05$.
Source: Beauchamp et al, 2013 (13)

The meta-analysis found a significant benefit to supervised exercise programs post-PR compared with usual care only for exercise capacity at 6 months. Although there was no significant statistical heterogeneity in any of the pooled analyses, there were differences in frequency of follow-up, outcome measurement, and interventions in terms of exercise composition and intensity, frequency of sessions, and inclusion of non-exercise components in the program. The authors comment that the absence of the latter program components may have contributed to the lack of effect of such programs on HRQOL. The raw data were not available and thus sub-grouped meta-analysis could not be run. It remains unknown if or to what extent excluding trials that did not adhere to the intention-to-treat principle would influence the overall effect given the high rate of drop-outs from the programs. Similarly, it is unclear if the duration or components of the PR program preceding the exercise program would influence the outcomes.

Conclusions

There was no evidence found on exercise programs for pneumonia patients.

Despite some methodological flaws, based on 1 meta-analysis of 6 randomized controlled trials (RCTs) on COPD patients that evaluated a variety of types of exercise programs following PR:

- There was a significant benefit to exercise capacity for those enrolled in a maintenance exercise program compared to those in usual care at 6 months follow-up (GRADE: Low) but not 12 months follow-up. (GRADE: Low).
- There was no difference in HRQOL between those enrolled in a maintenance exercise program compared to those in usual care at 6 months follow-up (GRADE: Low) or 12 months follow-up. (GRADE: Very low).

Acknowledgements

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Health Quality Ontario's Expert Advisory Panel on Post-Acute Community-Based Care for COPD Patients

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Lisa Droppo	Ontario Association of Community Care Access Centers (OACCAC)	Chief Care Innovations Officer
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Mary-Jane Herlihey	ParaMed Home Health Care Ottawa	Clinical Consultant
Suzy Young	St. Mary's General Hospital	Nurse Practitioner Primary Health Care SWCCAC Intensive Health Care Team Certified Respirator Educator

Appendices

Appendix 1: Literature Search Strategies

Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to October 2013>, EBM Reviews - ACP Journal Club <1991 to November 2013>, EBM Reviews - Database of Abstracts of Reviews of Effects <4th Quarter 2013>, EBM Reviews - Cochrane Central Register of Controlled Trials <November 2013>, EBM Reviews - Cochrane Methodology Register <3rd Quarter 2012>, EBM Reviews - Health Technology Assessment <4th Quarter 2013>, EBM Reviews - NHS Economic Evaluation Database <4th Quarter 2013>, Ovid MEDLINE(R) <1946 to November Week 3 2013>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <December 09, 2013>

Search Strategy:

#	Searches	Results
1	exp Patient Discharge/	19905
2	exp Aftercare/ or exp Convalescence/	10298
3	"Continuity of Patient Care"/ or exp "Recovery of Function"/	49411
4	((patient* adj2 discharge*) or after?care or post medical discharge* or post?discharge* or convalescen*).ti,ab.	37891
5	exp Heart Failure/	93131
6	(((cardia? or heart) adj (decompensation or failure or incompetence or insufficiency)) or cardiac stand still or ((coronary or myocardial) adj (failure or insufficiency))).ti,ab.	135925
7	exp Pulmonary Disease, Chronic Obstructive/	26667
8	exp Emphysema/	11099
9	(copd or coad or chronic airflow obstruction* or (chronic adj2 bronchitis) or emphysema).ti,ab.	60068
10	(chronic obstructive adj2 (lung* or pulmonary or airway* or airflow* or respiratory or bronchopulmonary) adj (disease* or disorder*)).ti,ab.	37815
11	exp Pneumonia/	78260
12	(pneumoni* or peripneumoni* or pleuropneumoni* or lobitis or ((pulmon* or lung*) adj inflammation*)).ti,ab.	147382
13	or/1-12	513261
14	exp Exercise Tolerance/	9966
15	exp Exercise/	127308
16	exp Rehabilitation/	162816
17	exp Rehabilitation Nursing/	1136
18	exp "Physical and Rehabilitation Medicine"/	19975
19	exp Rehabilitation Centers/	12881
20	exp Physical Therapy Modalities/	136983
21	(rehabilitat* or (physical* adj (fit* or train* or therap* or activit*)) or ((exercise* or fitness) adj3 (treatment or intervent* or program*)) or (train* adj (strength* or aerobic or exercise*)) or wellness program* or ((pulmonary or lung* or respirat* or cardiac) adj2 (physiotherap* or therap* or rehabilitat*)) or angina plan* or heart manual*).ti,ab.	235554
22	or/14-21	536336
23	Meta Analysis.pt.	52738
24	Meta-Analysis/ use mesz or exp Technology Assessment, Biomedical/ use mesz	61456
25	(meta analy* or metaanaly* or pooled analysis or (systematic* adj2 review*) or published studies or	211340

	published literature or medline or embase or data synthesis or data extraction or cochrane).ti,ab.	
26	((health technolog* or biomedical technolog*) adj2 assess*).ti,ab.	2746
27	or/23-26	227857
28	13 and 22 and 27	1230
29	limit 28 to (english language and yr="2008 -Current") [Limit not valid in CDSR,ACP Journal Club,DARE,CCTR,CLCMR; records were retained]	773
30	remove duplicates from 29	613

Appendix 2: Evidence Quality Assessment

Table A1: AMSTAR Score of Included Systematic Review

Author, Year	AMSTAR Score	(1) Provided Study Design	(2) Duplicate Study Selection	(3) Broad Literature Search	(4) Considered Status of Publication	(5) Listed Excluded Studies	(6) Provided Characteristics of Studies	(7) Assessed Scientific Quality	(8) Considered Quality in Report	(9) Methods to Combine Appropriate	(10) Assessed Publication Bias	(11) Stated Conflict of Interest
Beauchamp et al, 2013 (13)	8	✓	✓	✓			✓	✓	✓	✓		✓

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; RCT, randomized controlled trial.
[a]Maximum possible score is 11. Details of AMSTAR score are described in Shea et al. (11)

Table A2: GRADE Evidence Profile for Comparison of Supervised Exercise Programs Following Pulmonary Rehabilitation and Usual Care

Number of Studies (Design)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Upgrade Considerations	Quality
Exercise Capacity at 6 months follow-up							
5 (RCTs)	Serious limitations (–1)[a]	No serious limitations	No serious limitations	Serious limitations (–1)[b]	No serious limitations	None	⊕⊕ Low
Exercise Capacity at 12 months follow-up							
5 (RCTs)	Serious limitations (–1)[a]	No serious limitations	No serious limitations	Serious limitations (–1)[c]	No serious limitations	None	⊕⊕ Low
HRQOL at 6 months follow-up							
4 (RCTs)	Serious limitations (–1)[a]	No serious limitations	No serious limitations	Serious limitations (–1)[c]	No serious limitations	None	⊕⊕ Low
HRQOL at 12 months follow-up							
5 (RCTs)	Serious limitations (–1)[a]	Serious limitations (–1)[d]	No serious limitations	Serious limitations (–1)[b]	No serious limitations	None	⊕ Very Low

Abbreviations: CI, confidence interval; GRADE, Grading of Recommendations Assessment, Development, and Evaluation; HRQOL, health-related quality of life; RCT, randomized controlled trial.
[a]RCT evidence starts as high quality. However, adequate allocation concealment was a concern in all trials except 2 (16;17). Due to the nature of the intervention no studies blinded participants, and drop-outs were an issue across trials.
[b]The pooled sample size is relatively small for detecting even small effect sizes, the 95% CIs span both benefit and harm, and all CIs cross 0 except for one study (18).
[c]The pooled sample size is relatively small for detecting even small effect sizes, the 95% CIs span both benefit and harm, and all CIs cross 0.
[d]Although there was no statistically significant heterogeneity, the 5 point estimates differed considerably with 2 trials favouring exercise programs (18;20), 2 favouring usual care (17;19), and 1 finding no effect (16).

Table A3: Risk of Bias Among Randomized Controlled Trials for the Comparison of Supervised Exercise Programs Following Pulmonary Rehabilitation and Usual Care

Author, Year	Allocation Concealment	Blinding	Complete Accounting of Patients and Outcome Events	Selective Reporting Bias	Other Limitations
Foy et al., 2001 (20) and Berry et al., 2003 (15)	Serious Limitations[a]	No Limitations[b]	No Limitations[c]	No limitations	No limitations
Brooks et al., 2002 (18)	Serious Limitations[a]	No Limitations[b]	No Limitations[c]	No limitations	No limitations
Ries et al., 2003 (16)	No Limitations	No Limitations[b]	Serious Limitations[d]	No limitations	No limitations
Elliott et al., 2004 (14)	Serious Limitations[a]	Serious Limitations[e]	Serious Limitations[d]	No limitations	No limitations
Ringbaek et al., 2010 (19)	Serious Limitations[a]	Serious Limitations[e]	Serious Limitations[d]	No limitations	No limitations
Spencer et al., 2010 (17)	No Limitations	Serious Limitations[e]	No Limitations[c]	No limitations	No limitations

Abbreviations: RCT, randomized controlled trial.
[a]Unclear use or method of allocation concealment.
[b]Outcome assessors and/or clinical staff blinded to participant treatment group. Infeasible to blind participants due to nature of the intervention.
[c]Loss to follow-up was not significantly different between groups and was in the order of 15%–30% however, intention-to-treat analysis was used.
[d]Loss to follow-up was not significantly different between groups and was in the order of 18%–30% and it was unclear if intention-to-treat principle was adhered to in the analysis.
[e]Extent or use of blinding unclear.

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