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RESUME JURNAL 1

Judul Artikel : *The Impact of Physical Activity and Exercise Interventions for Physical Health in People with Cystic Fibrosis: Protocol for a Systematic review*

Penulis : Owen W. Tomlinson, Sarah Denford, Alan R. Barker, Jane E. Schneiderman , Emma S. Campisi, Helen Douglas, Sarah Rand, Melitta A. McNarry, Kelly A. Mackintosh and Craig A. Williams

Tahun : 2021

Cystic Fibrosis (CF) adalah kondisi yang diturunkan secara genetik yang mempengaruhi banyak sistem organ. Perkembangan penyakit terutama diamati melalui penurunan fungsi paru-paru. Cystic fibrosis (CF) adalah kondisi yang membatasi hidup yang diwariskan secara genetik, mempengaruhi 90.000 orang di seluruh dunia. Aktivitas fisik / *Physical Activity* (PA) dan latihan merupakan komponen integral dari manajemen CF, dan telah disorot oleh komunitas CF sebagai bidang yang diminati untuk penelitian di masa depan. Ulasan sebelumnya hanya berfokus pada *Physical Activity* (PA) atau rejimen latihan terstruktur tidak tergantung satu sama lain, dan dengan demikian penilaian fisik yang komprehensif manfaat kesehatan dari semua *Physical Activity* (PA), termasuk olahraga, intervensi, selanjutnya dijamin. Oleh karena itu, tujuan dari Review ini adalah untuk mengevaluasi efek PA dan latihan pada hasil kesehatan fisik dan perawatan kesehatan pemanfaatan pada orang dengan CF.

Tinjauan sistematis telah didaftarkan dan dilaporkan sejalan dengan Item Pelaporan Pilihan untuk Tinjauan Sistematis dan pedoman Meta-Analisis-P. Ini akan mencakup uji coba kontrol acak tentang efek PA dan olahraga, relatif terhadap pengobatan biasa, pada orang dengan CF. Hasil utama akan mencakup variabel yang terkaitdengan kebugaran, PA, kesehatan paru-paru, peradangan, komposisi tubuh, kontrol glikemik dan hasil yang dilaporkan pasien. Hasil sekunder akan mencakup efek samping dan pemanfaatan layanan kesehatan. Pencarian akan dilakukan di Ovid. Database MEDLINE, OVID EMBASE, PsychINFO, ERIC, SPORTDiscus, ASSIA, CCTR, CINHAL dan Web of Science, dan akan dicari dari tanggal awal dan seterusnya. Dua peninjau secara independen akan menyaring kutipan dan abstrak, dan

teks lengkap, masing-masing untuk penyertaan dan ekstraksi data. Kualitas metodologis akan dinilai dengan menggunakan Alat Risiko Bias-2 Cochrane. Jika memungkinkan, meta-analisis efek acak akan dilakukan jika sesuai. Analisis tambahan akan mengeksplorasi potensi sumber heterogenitas, seperti usia, jenis kelamin, dan tingkat keparahan penyakit.

Tinjauan sistematis ini akan didasarkan pada penelitian sebelumnya, dengan menilai dampak dari baik PA dan latihan pada kesehatan fisik dan pemanfaatan perawatan kesehatan pada orang dengan CF. Hasil review ini akan digunakan untuk menginformasikan diskusi yang pada akhirnya akan menghasilkan dokumen konsensus tentang dampak fisik aktivitas dan olahraga untuk penderita CF.

RESUME JURNAL 2

Judul Artikel : *Physiotherapy Management for COVID-19 in The Acute Hospital Setting: Clinical Practice Recommendations*

Penulis : Peter Thomas, Claire Baldwin, Bernie Bissett, Ianthe Boden, Rik Gosselink, Catherine L Granger, Carol Hodgson, Alice YM Jones, Michelle E Kho, Rachael Moses, George Ntoumenopoulos, Selina M Parry, Shane Patman, Lisa van der Lee

Tahun : 2020

Dokumen ini menguraikan rekomendasi untuk manajemen fisioterapi untuk COVID-19 di rumah sakit akut pengaturan. Ini mencakup: rekomendasi untuk perencanaan dan persiapan tenaga kerja fisioterapi; sebuah alat skrining untuk menentukan kebutuhan fisioterapi; dan rekomendasi untuk pemilihan perawatan fisio terapi dan alat pelindung diri. Ini dimaksudkan untuk digunakan oleh fisioterapis dan lainnya pemangku kepentingan yang relevan dalam pengaturan perawatan akut yang merawat pasien dewasa yang dikonfirmasi atau dicurigai COVID-19.

Rekomendasi untuk pemberian intervensi fisioterapi , termasuk kriteria alat pelindung diri :

A. Prinsip manajemen fisioterapi - pernapasan

1. Teknik pembersihan jalan nafas

Teknik pembersihan jalan nafas meliputi penentuan posisi, siklus aktif pernapasan, manual dan / atau hiperinflasi ventilator, perkusi dan getaran, terapi tekanan ekspirasi positif (PEP) dan mekanis insuflasi-exsufflation.

2. Ventilasi non-invasif dan pernapasan tekanan positif inspirasi

Fisioterapis dapat menggunakan pernapasan tekanan positif inspirasi (misalnya, untuk pasien dengan patah tulang rusuk). Ventilasi non-invasif mungkin diterapkan sebagai bagian dari strategi pembersihan jalan napas dalam pengelolaan gagal napas atau selama berolahraga.

3. Teknik untuk memfasilitasi pembersihan sekresi

Teknik untuk memfasilitasi pembersihan sekresi termasuk dibantu atau manuver batuk terstimulasi dan penyedotan saluran napas.

4. Lainnya

Fisioterapis meresepkan latihan dan membantu pasien untuk bergerak. Fisioterapis juga memainkan peran integral dalam pengelolaan pasien dengan trakeostomi. COVID-19 menimbulkan pertimbangan signifikan untuk intervensi terapi fisio pernapasan karena prosedur yang menghasilkan aerosol.

Box 3 menguraikan rekomendasi untuk memberikan perawatan pernapasan kepada pasien dengan COVID-19 / *Box 3. Recommendations for physiotherapy respiratory interventions.*

B. Prinsip manajemen fisioterapi - mobilisasi, exercise dan intervensi rehabilitasi

Fisioterapis bertanggung jawab untuk menyediakan muskuloskeletal, tugas rehabilitasi neurologis dan kardiopulmoner, sebagaimana diuraikan di bawah :

1. Range of motion exercises

Passive, active-assisted, active or resisted joint range of motion exercises dapat dilakukan untuk menjaga atau meningkatkan integritas sendi, rentang gerak dan kekuatan otot.

2. Mobilisasi dan Rehabilitasi

Contoh mobilisasi dan rehabilitasi termasuk mobilitas tempat tidur, duduk dari tempat tidur, duduk seimbang, duduk berdiri, berjalan, meja miring, kerekan berdiri, ergometri tungkai atas / bawah dan program latihan. **Box 4** menguraikan rekomendasi untuk menerapkan kegiatan ini pada pasien dengan COVID-19.

C. Pertimbangan alat pelindung diri

Sangat penting bagi fisioterapis untuk memahami langkah-langkah di dalamnya tempat untuk mencegah penularan COVID-19. **Box 5** memberikan rekomendasi untuk ini. Pasien yang dikonfirmasi atau dicurigai COVI-19 akan ditangani dengan droplet atau kewaspadaan yang ditularkan melalui udara. Selain itu, mereka akan ditempatkan di ruang isolasi. Rumah sakit adalah seringkali dapat menampung pasien dengan tetesan atau penyebaran udara di dalam ruang isolasi khusus. Namun, ada sejumlah teluk bertekanan negatif dan pod dan / atau ruangan di seluruh Australia dan Selandia Baru, jadi isolasi di dalam ruangan khusus mungkin tidak mungkin dengan COVID-19 karena volume penerimaan pasien yang besar.

Penting bagi fisioterapis untuk memahami perbedaannya jenis ruang isolasi yang ada di rumah sakit. Box 5 menjelaskan bagaimana perpindahan dari ruang isolasi khusus ke kelompok terbuka mungkin berkembang di dalam ICU.

RESUME JURNAL 3

Judul Artikel : *Effect of Early Mobility as a Physiotherapy Treatment for Pneumonia: A Systematic Review and Meta-Analysis*

Penulis : Tania Larsen, PhD, PT;*{ Annemarie Lee, PhD, BPhysio, MPhysio; Dina Brooks, PhD, PT; Stephanie Michieli, MPT; Meaghan Robson, MPT; Jenna Veens, MPT; Olivia Vokes, MPT; S. Deborah Lucy, PhD, PT

Tahun : 2019

Tujuan artikel yaitu untuk melakukan tinjauan sistematis tentang efek mobilitas dini pada lama rawat inap (LOS), mortalitas, dan hasil klinis sebagai pengobatan untuk orang dewasa. dirawat di rumah sakit karena pneumonia. Dengan menggunakan metode Pencarian elektronik dari empat database dilakukan.

Kriteria inklusi adalah (1) kondisi medis akut pneumonia pada orang dewasa dan (2) intervensi mobilitas dini. Penilaian kualitas dilakukan dengan menggunakan skala Database Bukti Fisioterapi dan Skala Newcastle-Ottawa.

Untuk orang dewasa yang dirawat di rumah sakit dengan komunitas yang didapat pneumonia, mobilitas dini dikaitkan dengan penurunan LOS, tetapi tidak ada perbedaan yang ditemukan pada mortalitas di rumah sakit tingkat penerimaan kembali, atau presentasi gawat darurat tingkat dibandingkan dengan perawatan biasa. Bukti peningkatan kapasitas fisik, penurunan keparahan dispnea, dan peningkatan kualitas hidup terbatas.

Mobilisasi dini sering diberikan untuk menangani komplikasi pasca operasi dan untuk mengobati atelektasis dan retensi sputum, dan dikaitkan dengan pengurangan LOS, meningkatkan fungsi fungsional, mobilitas, dan mempromosikan pembersihan jalan napas. Manfaat mobilisasi awal telah lebih dikenal sebagai mengurangi gejala sisa multisistem yang merugikan dari tirah baring, termasuk kelemahan otot, disfungsi mikrovaskuler, de conditioning, intoleransi aktivitas fisik, dan penurunan kapasitas fungsional pada pasien rawat inap.

Literatur mendukung keamanan dan efektivitas mobilitas dini dan merekomendasikannya sebagai perawatan inti manajemen fisioterapi pasien yang sakit kritis. Pedoman terkini untuk mengelola individu dengan pneumonia yang rumit termasuk mobilisasi, dengan rekomendasi termasuk duduk dari tempat tidur selama 20 menit dalam 24 jam pertama setelah masuk, Selain teknik pembersihan jalan napas

tradisional dan tekanan saluran napas positif terus menerus. Namun, manfaat mobilitas dini sebagai pengobatan untuk pneumonia yang diakibatkan oleh komunitas masih belum jelas.

Artikel ini memberikan dukungan bahwa mobilitas dini mengurangi LOS ketika diberikan kepada orang dewasa yang telah dirawat di rumah sakit dengan pneumonia yang didapat dari komunitas. Meskipun angka kematian tidak berkurang, mobilitas dini berkurang tidak terkait dengan efek merugikan dan karenanya dapat dianggap sebagai pengobatan tambahan untuk pneumonia. Uji coba lebih lanjut memeriksa mobilitas awal, disampaikan sesuai dengan protokol yang ditentukan dari resep latihan dan perkembangan, diperlukan untuk menentukan klinis tambahan manfaat dan kembangkan praktik terbaik, berbasis bukti pedoman. Mobilitas awal telah menunjukkan keberhasilan sebagai pengobatan untuk berbagai kondisi kardiorespirasi, tetapi penyakit penelitian tentang efektivitasnya dalam merawat rawat inap orang dewasa dengan pneumonia yang didapat dari komunitas terbatas.

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Systematic Reviews

PROTOCOL Open Access

The impact of physical activity and exercise interventions for physical health in people with cystic fibrosis: protocol for a systematic review

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Abstract

Background: Cystic fibrosis (CF) is a genetically inherited, life-limiting condition, affecting ~90,000 people globally. Physical activity (PA) and exercise form an integral component of CF management, and have been highlighted by the CF community as an area of interest for future research. Previous reviews have solely focused on PA or structured exercise regimens independent of one another, and thus a comprehensive assessment of the physical health benefits of all PA, including exercise, interventions, is subsequently warranted. Therefore, the purpose of this review is to evaluate the effects of both PA and exercise upon outcomes of physical health and healthcare utilisation in people with CF.

Methods: A systematic review has been registered and reported in line with Preferred Reporting Items for Systematic Reviews and Meta-Analysis-P guidelines. This will include randomised control trials on the effects of PA and exercise, relative to usual treatment, upon people with CF. Primary outcomes will include variables associated with fitness, PA, lung health, inflammation, body composition, glycaemic control and patient-reported outcomes. Secondary outcomes will include adverse events and healthcare utilisation. Searches will be undertaken in Ovid MEDLINE, OVID EMBASE, PsychINFO, ERIC, SPORTDiscus, ASSIA, CCTR, CINHAL and Web of Science databases, and will be searched from date of inception onwards. Two reviewers will independently screen citations and abstracts, and full-texts, for inclusion and data extraction, respectively. Methodological quality will be assessed using the Cochrane Risk of Bias-2 tool. If feasible, random-effects meta-analyses will be conducted where appropriate. Additional analyses will explore potential sources of heterogeneity, such as age, sex, and disease severity.

(Continued on next page)

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(Continued from previous page)
Discussion: This systematic review will build on previous research, by comprehensively assessing the impact of both PA and exercise upon physical health and healthcare utilisation in people with CF. Results of this review will be utilised to inform discussions that will ultimately result in a consensus document on the impact of physical activity and exercise for people with CF.

Systematic review registration: PROSPERO CRD42020184411

Keywords: Pulmonary disease, Movement, Lifestyle, Healthcare

Introduction

Cystic fibrosis (CF) is a genetically inherited condition which affects multiple organ systems. Disease progression is predominantly observed through deteriorating lung function [1]. Currently, there are ~90,000 people globally with CF [2], the majority of whom are in Europe [3] and North America [4, 5]. Substantial growth in the size of the CF population is anticipated [6], accompanied by an increase in life expectancy into the fifth decade of life [7]. Presently, there is no cure for CF, and therefore it is a life-long condition that is 'managed' as opposed to 'cured'. Whilst a number of promising pharmacological advances have been made [8], CF is still fundamentally managed using a combination of medication, nutrition, physiotherapy and physical activity (PA), or more specifically, exercise [9].

The outcomes of a recent patient-driven research priority partnership [10], highlighted the need for research to advance our understanding of the benefits of PA and exercise [11], and simplify treatment burden in CF [10]. Previously, the time spent being physically active [12, 13], as well as the associations between PA and health [13] and the effect of PA [14] and structured exercise interventions [15] for CF, has been systematically reviewed. These reviews have concluded that individuals with CF spent a similar amount of time being physically active relative to non-CF peers [12, 13], and that despite heterogeneity in study designs, interventions and outcomes, there was no evidence to actively discourage PA or exercise in CF [15].

However, despite being reviewed independently previously, PA and exercise are not mutually exclusive constructs. Exercise is a structured subcomponent of PA conducted for the inherent health associations. Nonetheless, evidence suggests that all PA, irrespective of purpose or intensity, is associated with improved health status in CF [12–15]. Therefore, both PA and exercise must be considered when attempting to integrate activity into the daily lives of those with CF, and not solely the prescription of structured exercise per se. Consequently, an updated review that simultaneously, and universally, accounts for all aspects of PA, including exercise, is warranted.

The main objective of this systematic review is to identify the effect of both PA and exercise upon parameters of physical health and healthcare utilisation, relative to usual care, in people with CF. In addition, a secondary objective is to identify if different effects are present in people of differing age, sex, and disease status, and whether certain components of interventions are linked to favourable outcomes in people with CF (e.g. delivery method, modality, intensity, frequency, length).

Methods

This review has been designed by experts in PA, exercise science and the physiotherapy management of CF. The present protocol has been registered on the PROSPERO database (CRD42020184411) and is being reported in accordance with the reporting guidance provided in the Preferred Reporting Items for Systematic Reviews and Meta-Analysis–Protocol (PRISMA-P) statement [16, 17] (see checklist in Additional file 1). If any updates to the protocol are required during the process of undertaking the review, these will be appropriately updated on the PROSPERO database, and detailed in the subsequent systematic review to be published.

Eligibility criteria

Studies will be limited to those published in English. No restrictions will be placed on publication dates. Studies will be included in this systematic review based upon a series of pre-planned inclusion and exclusion criteria for the following domains:

Participants

This review will solely include individuals with a clinical diagnosis of CF [18]. If studies include people with CF as part of a wider population (e.g. people with a pulmonary disease), results will be included in the systematic review provided information for the CF participants can be successfully retrieved in isolation from other non-CF groups. If CF-specific data cannot successfully be retrieved from published manuscripts, study authors will be contacted for data. There is no restriction on age.

Interventions

Studies must include any intervention based on promoting PA, sport, exercise, recreation, or movement. Given that multiple factors can be considered when describing interventions [19], and the generally complex and broad nature of PA and exercise interventions, there exists a possibility of inadvertently excluding studies if explicit interventions are defined in advance. Therefore, no criteria related to time frame, location, setting or delivery provider will be used to limit inclusion and thus maximise potential inclusion of eligible studies. Interventions where PA and/or exercise form a secondary sub-component of a wider intervention (e.g. nutritional, educational, pharmacological) will be excluded from this review if the effects of PA/exercise alone cannot be successfully isolated and retrieved. If exercise-specific data cannot successfully be retrieved from published manuscripts, study authors will be contacted for data.

Comparison

Primarily, interventions will be compared against patients receiving their usual clinical care (i.e. no intervention). Secondly, studies that compare two intervention arms within a single cohort of people with CF (e.g. high intensity vs. low intensity exercise) will also be included in an effort to identify dose-response effects.

Outcomes

Factors associated with physical health and healthcare utilisation will be included in the review, but will not be explicitly searched for upon the basis of the following outcomes. As stated, previous reviews [13, 15] have identified heterogeneity in the variables that have been reported and therefore outcomes will be obtained at the extraction stage, provided that the intervention has met the stated criteria above. It is anticipated that the primary outcomes will be related to (1) fitness: including, but not limited to, muscle strength, aerobic fitness and walking distance; and (2) physical activity (objective and subjective outcomes): including, but not limited to, total energy expenditure, step count and time spent in light, moderate and vigorous physical activity; (3) lung health: including, but not limited to, forced expiratory volume in 1 s (FEV_1), forced vital capacity (FVC), tiffeneau index (FEV_1/FVC), peak expiratory flow (PEF) and lung clearance index (LCI); (4) inflammation: including, but not limited to, C-reactive protein (CRP) and cytokines such as interleukin 6 (IL-6) and 8 (IL-8); (5) body composition: including, but not limited to, fat mass, fat-free mass, body mass index (BMI) and bone mineral density; (6) glycaemic control: including, but not limited to, blood glucose levels such as glycated haemoglobin (HbA1c); (7) patient-reported outcome measures: including, but not limited to, quality of life and its components, breathlessness and fatigue. It is anticipated secondary outcomes will be related to (1) serious adverse events: which may take multiple forms such as sprains, strains, fractures, haemoptysis, exacerbations and desaturation; (2) healthcare utilisation: which may take multiple forms, such as inpatient hospital days, medication usage and healthcare costs.

Study design

This systematic review will be limited to randomised control trials (RCT) comparing PA and/or exercise interventions (as above) to standard CF care (i.e. no intervention), and/or another PA/exercise intervention.

Information sources and search

The following electronic databases will be searched: Ovid MEDLINE, OVID EMBASE, PsychINFO, ERIC, SPORTDiscus, ASSIA, CCTR, CINHAL, and Web of Science. These databases will be searched from respective dates of inception onwards. Grey literature will not be included to ensure quality standards are met. The literature searches will be initially designed by the research team, and conducted by an information specialist, who will also customise the search for each database. The search will include a broad range of terms and keywords related to PA, exercise and RCTs. The search terms have been restricted to 'Population/Intervention/Comparison/Outcome' (PICO) domains of participants, intervention, and study design. Given the wide heterogeneity in outcome variables available, and the way they are reported as has been previously explained, these have been omitted from the search strategy in order to increase returns. A draft search strategy, utilising these domains, is provided in Table 1.

Records will be imported and managed via online evidence synthesis software (Covidence systematic review software, Veritas Health Innovation, Melbourne, Australia).

Data selection and collection process

All articles returned from searches will be screened by two independent researchers. First, titles and abstracts of identified papers will be assessed in relation to aforementioned eligibility criteria. Second, eligible articles will have full-texts retrieved and then screened in full, again against the aforementioned eligibility criteria. If necessary, any disagreements that arise will be resolved via discussion with a third reviewer. A flow chart, detailing inclusion, and exclusion of studies at each stage, will be included in the final, published review.

Data extraction

Data will be extracted independently by two reviewers using a standardised data extraction template designed

Table 1 Draft search strategy

Domain	Terms
Population	cystic fibrosis OR CF
Intervention	physical activ* OR exercis* OR sport* OR recreation* OR move* OR yoga OR Tai Chi OR walk* OR run OR runn* OR play* OR jog* OR cycl* OR game* OR inactive* OR sedentary OR swim* OR hike OR hiking* OR fitness OR gym* OR resistance OR aerobic OR leisure time OR active travel OR jumping OR danc*
Study design	random* OR control trial OR RCT OR clinical trial OR randomly OR groups OR allocat* OR crossover OR (((systematic OR state-of-the-art OR scoping OR literature OR umbrella) ADJ (review* OR overview* OR assessment*)) OR "review* of reviews" OR meta-analy* OR metaanaly* OR ((systematic OR evidence) ADJ1 assess*) OR "research evidence" OR metasynthe* OR meta-synthe*).tw. OR exp Review Literature as Topic/ OR exp Review/ OR Meta-Analysis as Topic/ OR Meta-Analysis/ OR "systematic review"/

for this purpose (Additional file 2). Data will be extracted on the following: intervention design and delivery (including, but not limited to location, modality, intensity, frequency, length of intervention), participant characteristics (sex, age and disease severity of both control and intervention group(s)), and outcomes (variables, and magnitude of change from baseline for continuous data). Disagreements will be resolved via discussion with a third reviewer if necessary. This data extraction will be piloted on five randomly selected papers by two independent authors. If extracted results are in agreement, this extraction template will be uniformly utilised by all authors.

The majority of outcomes produce objective measures, and these will be prioritised over subjective measures where possible. Data will be extracted based upon both (where possible): (1) absolute differences in outcomes at follow up; and (2) differences between groups (i.e. intervention vs. control) at follow-up. This will allow for assessment of data if studies report outcomes in differing formats.

Risk of bias assessment

Risk of bias (RoB) of individual studies will be assessed using the RoB2 Tool for RCTs [20]. Assessments will be made by two reviewers independently, with any disagreements being resolved via discussion with a third reviewer when necessary. Studies identified as being at high risk of bias will be included, although the quality of each study will be presented in results and will also be narratively discussed.

Synthesis

Data synthesis will occur in several stages. Initially, summary tables will be created to detail characteristics of each study included in the final review. This will include the aforementioned data to be extracted using Additional file 2 (intervention design and delivery, participant characteristics and outcomes). Absolute differences in outcomes at follow-up, and mean differences between groups (i.e. intervention vs. control) will be reported in tables, as well as standardised mean differences for outcomes that are reported in more than one way (e.g. FEV_1 as L, or $\%_{predicted}$). Additional narrative discussion will also be provided.

Secondly, meta-analyses will be undertaken for primary outcomes where possible, using data pooled from each study. Since heterogeneity is expected a priori, we will estimate the pooled effect and its 95% confidence interval using the random effects model, which assumes the study effects follow a normal distribution, considering both within- and between-study variation. Pooled effect sizes, using Hedges *g*, will be interpreted with reference to Cohen's thresholds [21]: trivial (<0.2), small (0.2 to <0.5), moderate (0.5 to < 0.8) and large (≥0.8); whereby positive effect size values indicate higher scores of the outcome in favour of the PA/exercise group. All secondary outcomes, and non-continuous primary outcomes (e.g. categorical data), will be reported using Synthesis Without Meta-analysis (SWiM) guidelines [22].

If studies have two CF groups (e.g. different exercise intensities or protocols), multilevel models will be used as their data will be analysed independently with the control group, thus yielding multiple effect sizes for those studies and outcomes. Both research study and intra-study groups will be included as random effects in the model. Cluster robust estimates will be produced, weighted by inverse sampling variance to account for the within- and between-study variance (tau-squared). Restricted maximal likelihood estimation will be used in all models.

Finally, meta-regression will be utilised to determine differences between sub-groups based upon disease severity ($FEV_{1\%}$ categories: ≥70, 40-69, <40), age (<18 years, ≥18 years) and sex (male, female), all of which are significant predictors for long-term outcomes and survival in CF [7, 23]. Moreover, the impact of differing delivery methods, modalities, intensities, frequencies, and lengths of interventions will also be investigated via meta-regression. Analyses will be contingent on a sufficient number of studies (≥10) being found [24]. These analyses will use age, sex and disease severity as moderators of PA or exercise. If appropriate (i.e. a sufficient ratio of studies to co-variates are found), multilevel models will be produced for each sub-group (e.g. sex,

age, FEV_1 category) and a fixed-effects with moderators model used to compare the models to ascertain whether there was a significant difference ($p<0.05$). Sensitivity analyses will be performed using the leave-one-out method to examine the impact of removal of individual effect sizes. Heterogeneity will again be examined through the I^2 statistic, with $I^2>50\%$ indicating 'substantial' heterogeneity [24]. If meta-regression is not possible due to insufficient power, the sub-group analyses will be undertaken, based upon aforementioned categories of disease severity, age and sex. If quantitative syntheses are not possible for determining differences between sub-groups and intervention methods, the aforementioned SWiM guidelines [22] will be utilised to report findings.

All meta-analyses will be undertaken using RevMan (Review Manager v5.4; The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark) and Stata (Stata v16; StataCorp LLC, College Station TX, USA) software programmes.

Meta-bias

To determine whether publication bias is present, it will be examined using Egger's linear regression test for funnel plot asymmetry [25], and graphically presented by contour-enhanced funnel plots with Duval and Tweedie's trim and fill used.

Grading of evidence

Certainty of evidence for outcomes will be judged using Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology [26, 27]. This will be undertaken by two independent reviewers, who will examine the study limitations, publication bias, imprecision, inconsistency and indirectness. The evidence will then be classified as high, moderate, low or very low.

Discussion

It is well established that PA and exercise, are integral components in the management of CF [9], and consultation with the CF community has identified exercise as a research priority [10]. However, the specific effects of PA and/or exercise interventions on physical markers of health in CF have not been fully quantified to date. Indeed, previous reviews have solely focused on structured exercise [15]. Whilst such reviews are useful, it is important to ensure that all interventions that target improvements in habitual PA, exercise programmes that do not have set structures, or generalised increases in movement away from a prescriptive framework, are incorporated. Therefore, the results of this systematic review will pool findings of high-quality studies, by only extracting RCTs, to determine true effects of PA and exercise interventions in this patient population. Whilst RCTs tend to result in higher quality evidence, by only including RCTs within the protocol and therefore omitting observational and non-randomised control studies, it is feasible that the effect of PA, or exercise, on some markers of physical health and healthcare utilisation may not be established. Moreover, the broad range of ways in which PA and exercise interventions can be implemented, such as differing modalities, locations, frequency, intensity, materials and procedures [19] may result in an under-powering of meta-analyses due to an inability to pool data from independent studies. Whilst this may initially be perceived as a limitation, this could simultaneously provide the impetus for researchers and clinicians to standardise future interventions to determine true effects of each component of delivery.

Whilst this systematic review is focused on outcomes related to physical health and healthcare utilisation, the importance of PA, or exercise, for mental health in CF should not be ignored or understated. Therefore, a separate systematic review has been developed to establish the effects of PA and exercise upon parameters of mental health in CF (PROSPERO: CRD42019151034). The results of these systematic reviews, focusing on physical and mental health outcomes, will then be utilised to inform discussions amongst an international panel of experts in exercise and CF, to create a consensus document on the impact of PA and exercise for people with CF. Both the findings of the present systematic review, and the anticipated consensus document, will be disseminated via conference presentations and peer-reviewed academic journals.

In summary, by establishing the effect, and the associated magnitude, of any PA, or exercise intervention, findings can influence guidelines and consensus documents that are utilised by clinical teams in daily practice. Thus, ultimately, such a systematic process can, in turn, enhance the care of people with CF.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13643-021-01614-8.

Additional file 1. PRISMA-P Checklist.

Additional file 2. Data Extraction Form.

Abbreviations

BMI: Body mass index; CF: Cystic fibrosis; CRP: C-reactive protein; FEV_1: Forced expiratory volume in 1 s; FVC: Forced vital capacity; GRADE: Grading of Recommendations Assessment, Development and Evaluation; HbA1c: Glycated haemoglobin; IL-6: Interleukin 6; IL-8: Interleukin 8; LCI: Lung clearance index; PEF: Peak expiratory flow; PICO: Population/Intervention/Comparison/Outcome; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analysis; PA: Physical activity; RoB: Risk of Bias; RCT: Randomised control trial; SWiM: Synthesis Without Meta-analysis; 95% CI: 95% confidence interval

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Authors' contributions
Concept and design: OT, SD, CW. Initial draft: OT. Internal review: OT, SD, AB, JS, EC, HD, SR, MM, KM, CW. Approval of final document: OT, SD, AB, JS, EC, HD, SR, MM, KM, CW.

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Invited Topical Review

Physiotherapy management for COVID-19 in the acute hospital setting: clinical practice recommendations

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KEY WORDS

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ABSTRACT

This document outlines recommendations for physiotherapy management for COVID-19 in the acute hospital setting. It includes: recommendations for physiotherapy workforce planning and preparation; a screening tool for determining requirement for physiotherapy; and recommendations for the selection of physiotherapy treatments and personal protective equipment. It is intended for use by physiotherapists and other relevant stakeholders in the acute care setting caring for adult patients with confirmed or suspected COVID-19. **[Thomas P, Baldwin C, Bissett B, Boden I, Gosselink R, Granger CL, Hodgson C, Jones AYM, Kho ME, Moses R, Ntoumenopoulos G, Parry SM, Patman S, van der Lee L (2020) Physiotherapy management for COVID-19 in the acute hospital setting: clinical practice recommendations. *Journal of Physiotherapy* 66:73–82]**

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a new coronavirus that emerged in 2019 and causes coronavirus disease 2019 (COVID-19).[1,2] SARS-CoV-2 is highly contagious. It differs from other respiratory viruses in that it appears that human-to-human transmission occurs approximately 2 to 10 days prior to the individual becoming symptomatic.[2–4] The virus is transmitted from person to person through respiratory secretions. Large droplets from coughing, sneezing or rhinorrhoea land on surfaces within 2 m of the infected person. SARS-CoV-2 remains viable for at least 24 hours on hard surfaces and up to 8 hours on soft surfaces.[5] The virus is transferred to another person through hand contact on a contaminated surface followed by touching the mouth, nose or eyes. Aerosol airborne infected particles created during a sneeze or cough remain viable in the air for $\leq$ 3 hours.[5] These airborne particles of SARS-CoV-2 can then be inhaled by another person or land on the mucosal membranes of the eyes.

Individuals with COVID-19 can present with an influenza-like illness and respiratory tract infection demonstrating fever (89%), cough (68%), fatigue (38%), sputum production (34%) and/or shortness of breath (19%).[4] The spectrum of disease severity ranges from asymptomatic infection or mild upper respiratory tract illness through to severe viral pneumonia with respiratory failure and/or death. Current reports estimate that 80% of cases are asymptomatic or mild; 15% of cases are severe (infection requiring oxygen); and 5% are critical requiring ventilation and life support.[2]

Preliminary reports indicate that chest radiographs may have diagnostic limitations in COVID-19.[6] Clinicians need to be aware that lung computed tomography (CT) scan findings often include multiple mottling and ground-glass opacity.[7] Lung ultrasound is also being used at the bedside with findings of multi-lobar distribution of B-lines and diffuse lung consolidation.[8]

The current mortality rate is 3 to 5%, with new reports of up to 9%, which is in contrast to influenza at around 0.1%.[2] The rates of admission to an intensive care unit (ICU) are approximately 5%.[4] Around 42% of patients admitted to hospital will require oxygen therapy.[4] Based on emerging data, individuals at highest risk of developing severe COVID-19 disease requiring hospitalisation and/or ICU support are those who are older, male, have at least one

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Box 1. Physiotherapy workforce planning and preparation recommendations.

1.1	Plan for an increase in the required physiotherapy workforce. For example: • allow additional shifts for part-time staff • offer staff the ability to electively cancel leave • recruit a pool of casual staff • recruit academic and research staff, staff who have recently retired or are currently working in non-clinical roles • work different shift patterns (eg, 12-hour shifts, extended evening shifts)
1.2	Identify potential additional staff who could be deployed to areas of higher activity associated with COVID-19 admissions (eg, infectious disease ward, ICU and/or high dependency unit and other acute areas). Prioritise staff for deployment who have previous cardiorespiratory and critical care experience.
1.3	Physiotherapists are required to have specialised knowledge, skills and decision-making to work within ICU. Physiotherapists with previous ICU experience should be identified by hospitals and facilitated to return to ICU.[12]
1.4	Physiotherapists who do not have recent cardiorespiratory physiotherapy experience should be identified by hospitals and facilitated to return to support additional hospital services. For example, staff without acute hospital or ICU training may facilitate rehabilitation, discharge pathways or hospital avoidance for patients without COVID-19.
1.5	Staff with advanced ICU physiotherapy skills should be supported to screen patients with COVID-19 assigned to physiotherapy caseloads and provide junior ICU staff with appropriate supervision and support, particularly with decision-making for complex patients with COVID-19. Hospitals should identify appropriate physiotherapy clinical leaders to implement this recommendation.
1.6	Identify existing learning resources for staff who could be deployed to ICU. For example: • eLearning packages (eg, Clinical Skills Development Service for Physiotherapy and Critical Care Management)[18] • local physiotherapy staff ICU orientation • PPE training
1.7	Keep staff informed of plans. Communication is crucial to the successful delivery of safe and effective clinical services.
1.8	Staff who are judged to be at high risk should not enter the COVID-19 isolation area. When planning staffing and rosters, the following people may be at higher risk of developing more serious illness from COVID-19 and should avoid exposure to patients with COVID-19. This includes staff who: • are pregnant • have significant chronic respiratory illnesses • are immunosuppressed • are older (eg, > 60 years) • have severe chronic health conditions such as heart disease, lung disease, diabetes • have immune deficiencies, such as neutropenia, disseminated malignancy and conditions or treatments that produce immunodeficiency[12] It is recommended that staff who are pregnant avoid exposure to COVID-19. It is known that pregnant women are potentially at increased risk of complications from any respiratory disease due to the physiological changes that occur in pregnancy. There is not enough currently available information on the impact of COVID-19 on a pregnant woman or her baby.
1.9	Workforce planning should include consideration for pandemic-specific requirements such as additional workload from donning and doffing PPE, and the need to allocate staff to key non-clinical duties such as enforcing infection control procedures.[12]
1.10	Consider organising the workforce into teams that will manage COVID-19 versus non-infectious patients. Minimise or prevent movement of staff between teams. Liaise with local infection control services for recommendations.
1.11	Be aware of and comply with relevant international, national, state and/or hospital guidelines for infection control in healthcare facilities. For example, World Health Organization 'Guidelines for infection prevention and control during health care when novel coronavirus infection is suspected'.[19]
1.12	Senior physiotherapists should be involved in determining the appropriateness of physiotherapy interventions for patients with confirmed or suspected COVID-19 in consultation with senior medical staff and according to a referral guideline.
1.13	Identify hospital-wide plans for allocation/cohorting patients with COVID-19. Utilise these plans to prepare resource plans that may be required. For example, Table 2 below is an example of a resource plan for ICU physiotherapy.
1.14	Identify additional physical resources that may be required for physiotherapy interventions and how the risk of cross-infection can be minimised (eg, respiratory equipment; mobilisation, exercise and rehabilitation equipment; and equipment storage).
1.15	Identify and develop a facility inventory of respiratory, mobilisation, exercise and rehabilitation equipment and determine the process of equipment allocation as pandemic levels increase (ie, to prevent movement of equipment between infectious and non-infectious areas).
1.16	It should be recognised that staff will likely have an increased workload with a heightened risk of anxiety both at work and home.[12] Staff should be supported during and beyond the active treatment phases (eg, via access to employee assistance programs, counselling and facilitated debriefing sessions).
1.17	Consider and/or promote debriefing and psychological support; staff morale may be adversely affected due to the increased workload, anxiety over personal safety and the health of family members.[12]

COVID-19 = coronavirus disease 2019, ICU = intensive care unit, PPE = personal protective equipment.

co-existing comorbidity, higher severity of illness scores (measured via SOFA scores), elevated D-dimer levels and/or lymphocytopenia.[2,4,9–11]

Purpose

This document has been prepared to provide information to physiotherapists and acute care healthcare facilities about the potential role of physiotherapy in the management of hospital-admitted patients with confirmed or suspected COVID-19.

Physiotherapists who work in primary healthcare facilities are likely to have a role in the management of patients admitted to hospital with confirmed or suspected COVID-19. Physiotherapy is an established profession throughout the world. Globally, physiotherapists often work in acute hospital wards and ICUs. In particular, cardiorespiratory physiotherapy focuses on the management of acute and chronic respiratory conditions and aims to improve physical recovery following an acute illness. Physiotherapy may be beneficial in the respiratory treatment and physical rehabilitation of patients with COVID-19. Although a productive cough is a less common symptom (34%),[4] physiotherapy may be indicated if patients with COVID-19 present with copious airway secretions that they are unable to clear independently. This may be evaluated on a case-by-case basis and interventions applied based on clinical indicators. High-risk patients may also benefit, for example: patients with existing comorbidities that may be associated with hypersecretion or ineffective cough (eg, neuromuscular disease, respiratory disease and cystic fibrosis). Physiotherapists who practise in the ICU environment may also provide airway clearance techniques for ventilated patients

Box 2. Whom should physiotherapists treat?

2.1	The respiratory infection associated with COVID-19 is mostly associated with a dry and non-productive cough; lower respiratory tract involvement usually involves pneumonitis rather than exudative consolidation.[20] In these cases, respiratory physiotherapy interventions are not indicated.
2.2	Respiratory physiotherapy interventions in hospital wards or ICU may be indicated for patients who have confirmed or suspected COVID-19 and concurrently or subsequently develop exudative consolidation, mucous hypersecretion and/or difficulty clearing secretions.
2.3	Physiotherapists will have an ongoing role in providing interventions for mobilisation, exercise and rehabilitation (eg, in patients with comorbidities creating significant functional decline and/or (at risk of) ICU-acquired weakness).
2.4	Physiotherapy interventions should only be provided when there are clinical indicators, so that staff exposure to patients with COVID-19 is minimised. Unnecessary review of patients with COVID-19 within their isolation room/areas will also have a negative impact on PPE supplies.
2.5	Physiotherapists should meet regularly with senior medical staff to determine indications for physiotherapy review in patients with confirmed or suspected COVID-19 and screen according to set/agreed guidelines (Table 1 provides a suggested framework).
2.6	Physiotherapy staff should not be routinely entering isolation rooms, where patients with confirmed or suspected COVID-19 are isolated or cohorted, just to screen for referrals.
2.7	Options for screening patients via subjective review and basic assessment whilst not being in direct contact with the patient should be trialled first whenever possible (eg, calling the patient's isolation room telephone and conducting a subjective assessment for mobility information and/or providing education on airway clearance techniques).

COVID-19 = coronavirus disease 2019, ICU = intensive care unit, PPE = personal protective equipment.

who show signs of inadequate airway clearance and they can assist in positioning patients with severe respiratory failure associated with COVID-19, including the use of prone position to optimise oxygenation.[12]

Given the intensive medical management for some COVID-19 patients – including prolonged protective lung ventilation, sedation and use of neuromuscular blocking agents – those who are admitted to ICU may be at high risk of developing ICU-acquired weakness;[13]

Table 1
Screening guidelines for physiotherapy involvement with COVID-19.

Physiotherapy intervention	COVID-19 patient presentation (confirmed or suspected)	Physiotherapy referral
Respiratory	Mild symptoms without significant respiratory compromise (eg, fever, dry cough, no chest x-ray changes)	Physiotherapy interventions are not indicated for airway clearance or sputum samples[20] No physiotherapy contact with patient
	Pneumonia presenting with features: • a low-level oxygen requirement (eg, oxygen flow $\leq$ 5 l/min for $SpO_2 \geq 90\%$) • non-productive cough • or patient coughing and able to clear secretions independently	Physiotherapy interventions are not indicated for airway clearance or sputum samples No physiotherapy contact with patient
	Mild symptoms and/or pneumonia AND co-existing respiratory or neuromuscular comorbidity (eg, cystic fibrosis, neuromuscular disease, spinal cord injury, bronchiectasis, chronic obstructive pulmonary disease) AND current or anticipated difficulties with secretion clearance	Physiotherapy referral for airway clearance Staff use airborne precautions If not ventilated, where possible, the patient should wear a surgical mask during any physiotherapy
	Mild symptoms and/or pneumonia AND evidence of exudative consolidation with difficulty clearing or inability to clear secretions independently (eg, weak, ineffective and moist sounding cough, tactile fremitus on chest wall, wet sounding voice, audible transmitted sounds)	Physiotherapy referral for airway clearance Staff use airborne precautions If not ventilated, where possible, the patient should wear a surgical mask during any physiotherapy
	Severe symptoms suggestive of pneumonia/lower respiratory tract infection (eg, increasing oxygen requirements; fever; difficulty breathing; frequent, severe or productive coughing episodes; chest x-ray, CT or lung ultrasound changes consistent with consolidation)	Consider physiotherapy referral for airway clearance Physiotherapy may be indicated, particularly if weak cough, productive, evidence of pneumonia on imaging and/or secretion retention Staff use airborne precautions If not ventilated, where possible, the patient should wear a surgical mask during any physiotherapy Early optimisation of care and involvement of ICU is recommended
Mobilisation, exercise and rehabilitation	Any patient at significant risk of developing or with evidence of significant functional limitations • eg, patients who are frail or have multiple comorbidities impacting their independence • eg, mobilisation, exercise and rehabilitation in ICU patients with significant functional decline and/or (at risk of) ICU-acquired weakness	Physiotherapy referral Use droplet precautions Use airborne precautions if close contact required or possible aerosol generating procedures If not ventilated, where possible, the patient should wear a surgical mask during any physiotherapy

COVID-19 = coronavirus disease 2019, CT = computed tomography, ICU = intensive care unit, SpO_2 = oxyhaemoglobin saturation.

Table 2
Example of an ICU physiotherapy resource plan.

Phase	Bed capacity	Description and location of patients	Physiotherapy staffing	Equipment for respiratory care, mobilisation, exercise and rehabilitation
Business as usual	22 ICU beds and six HDU beds	All patients within existing ICU and HDU physical resources	Four FTE	• six stretcher chairs • 10 high-back sitting chairs • three rollators • one tilt table • two cycle ergometers • steps/blocks • bariatric equipment
Tier 1	Expansion with additional number of ICU beds provided (eg, opening previously non-commissioned beds)	Fewer than four patients with COVID-19 Patients with COVID-19 only allocated to beds with reverse flow isolation rooms There is limited availability of reverse flow rooms within most hospitals	Additional one FTE per four ICU beds[21] One senior physiotherapist will screen patients with COVID-19 in consultation with an ICU medical consultant Patients will be provided treatment in isolation rooms	If needed, one stretcher chair allocated and quarantined for use One tilt table quarantined for use with COVID patients. Quarantined in room, or cleaned and located for storage in isolation Additional respiratory equipment
Tier 2	Further expansion to maximum ICU capacity	The number of patients with COVID-19 exceeds the availability of isolation rooms, necessitating the care of infectious patients outside the confines of a negative pressure room Infectious patients will be cohorted on the open ward of the ICU Normal ICU admission/non-infectious patients located in a separate part of ICU	Calculation for additional FTE as above Infections ICU Pod physiotherapists allocated, including one senior physiotherapist Non-infections ICU Pod physiotherapists allocated, including one senior physiotherapist Infectious and non-infectious staff allocated, including weekends	Additional chair resources may be required Keep separate sets of chairs, tilt tables, etc, for infectious and non-infectious patients
Tier 3	Additional ICU beds created outside of ICU (eg, in anaesthetic areas)	Surge in patients with COVID-19 exceeds the capacity of the allocated infectious area Bed allocation for patients with COVID-19 allocated across the entire ICU Non-infectious satellite ICU will be established in a separate location	Calculation for additional FTE as above	Additional chair resources may be required Keep separate sets of chairs, tilt tables, etc, for infectious and non-infectious patients
Tier 4	Additional beds created across clinical areas in other parts of the hospital (eg, cardiology, operating theatres)	Large-scale emergency	Calculation for additional FTE as above	Additional chair resources may be required Keep separate sets of chairs, tilt tables, etc, for infectious and non-infectious patients

COVID-19 = coronavirus disease 2019, FTE = full-time equivalent, HDU = high dependency unit, ICU = intensive care unit.

Table 3
Specific respiratory interventions.

Aerosol-generating procedures	The following procedures create an airborne risk of transmission of COVID-19: • intubation/extubation • bronchoscopy • high-flow nasal oxygen use • non-invasive ventilation • tracheostomy • cardiopulmonary resuscitation prior to intubation[12,22] Additional aerosol-generating procedures related to physiotherapy techniques are outlined in Box 3.
High-flow nasal oxygen	This is a recommended therapy for hypoxia associated with COVID-19, as long as staff are wearing optimal airborne PPE.[12] At flow rates 40 to 60 l/min, high-flow nasal oxygen does carry a small risk of aerosol generation. The risk of airborne transmission to staff is low when optimal PPE and other infection control precautions are being used.[23] Negative pressure rooms are preferable for patients receiving high-flow nasal oxygen.[12] Respiratory support via high-flow nasal oxygen should be restricted to patients in airborne isolation rooms only. Limiting the flow rate to no more than 30 l/min might reduce potential viral transmission.
Non-invasive ventilation	Routine use is not recommended[12] because current experience with COVID-19 hypoxic respiratory failure has a high associated failure rate. If used (eg, with a patient with chronic obstructive pulmonary disease or post-extubation), it must be provided with strict airborne PPE.[12]
Oxygen therapy	Treatment targets may vary depending on the presentation of the patient. • For patients presenting with severe respiratory distress, hypoxaemia or shock, $SpO_2 > 94\%$ is targeted.[23] • Once a patient is stable, the SpO_2 target is $> 90\%$ in non-pregnant adults[24] and 92 to 95% in pregnant patients.[23] • In adults with COVID-19 and acute hypoxaemic respiratory failure, the SpO_2 target should not be maintained $> 96\%$.[22]
Nebulisation	The use of nebulised agents (eg, salbutamol, saline) for the treatment of non-intubated patients with COVID-19 is not recommended because it increases the risk of aerosolisation and transmission of infection to healthcare workers in the immediate vicinity. Use of metered-dose inhalers or spacers is preferred where possible.[12] If a nebuliser is required, liaise with local guidelines for directions to minimise aerosolisation (eg, use of a Pari Sprint with inline viral filter). Use of nebulisers, non-invasive ventilation, high-flow nasal oxygen and spirometry should be avoided and agreement to their use sought from senior medical staff.[20] If deemed essential, airborne precautions should be used.

COVID-19 = coronavirus disease 2019, FTE = full-time equivalent, HDU = high dependency unit, ICU = intensive care unit, PPE = personal protective equipment, SpO_2 = oxyhaemoglobin saturation.

this may worsen their morbidity and mortality.[14] It is therefore essential to initiate early rehabilitation after the acute phase of respiratory distress in order to limit the severity of ICU-acquired weakness and promote rapid functional recovery. Physiotherapy will have a role in providing exercise, mobilisation and rehabilitation interventions to survivors of critical illness associated with COVID-19 in order to enable a functional return to home.

Scope

This document focuses on the adult acute hospital setting. The recommendations for physiotherapists are outlined below in two sections: workforce planning and preparation, including screening to determine indications for physiotherapy; and delivery of physiotherapy interventions, including both respiratory and mobilisation/rehabilitation as well as personal protective equipment (PPE) requirements.

It is recognised that physiotherapy practices vary across the world. When using these recommendations, the scope of practice within the local context should be considered.[a]

Methods

Consensus approach

A group of international experts in cardiorespiratory physiotherapy came together to rapidly prepare clinical recommendations for physiotherapy management of COVID-19. The author group initially convened on 20 March 2020 to discuss the urgent need for worldwide acute care physiotherapy guidance in relation to COVID-19. Efforts were quickly prioritised to develop specific guidance for physiotherapists in the acute care settings.

The AGREE II framework[15] was used to guide development, and recognising the expediency of this work required pragmatic and transparent reporting. Conduct was modelled after the GRADE Adolopment Process[16] and Evidence to Decision framework[17] for recommendations and decision-making. Expertise includes ICU and acute inpatient physiotherapy (all), rehabilitation interventions in the ICU (all), physiotherapy administration (PT, IB, RG, AJ, RM, ShP), systematic reviews (PT, CB, CG, RG, CH, MK, SP, ShP, LV), guideline methodology (PT, IB, RG, CH, MK, RM, ShP, LV), and epidemiology (CH, MK).

Through a web search and personal files, recently developed guidelines for COVID-19 management of critically ill patients were identified from international agencies (eg, World Health Organization), critical care professional societies or groups (eg, Australia and New Zealand Intensive Care Society, Society of Critical Care Medicine/European Society of Intensive Care Medicine), or physiotherapy professional societies up to 21 March 2020. These guidelines were used to inform the consensus recommendations developed in conjunction with expert opinion of the authorship group.

A priori it was decided to develop consensus recommendations, given the time-sensitive nature of the guidance. It was agreed that a $\geq$ 70% agreement was required for a recommendation. On Friday 20 March 2020 the lead author (PT) circulated draft recommendations to all authors. All authors independently returned comments to the lead author. The lead author (PT) collated all comments for further discussion. All recommendations were discussed in a teleconference on 22 March 2020. Fourteen people participated in the development process and 66 recommendations were developed. A consensus of $> 70\%$ was achieved for all items. Further discussion was focused on greater clarity in wording and/or reduction of items where overlap occurred.

Endorsement for the recommendations was sought from physiotherapy societies, physiotherapy professional groups and the World Confederation for Physical Therapy. The recommendations were circulated to these groups on 23 March 2020, requesting endorsement; endorsements will be updated as they are confirmed.

Strengths and limitations

This document has several strengths. It responds to an urgent need for clinical guidance for acute care physiotherapists worldwide.

Table 4
Additional respiratory interventions in the ICU.

Intubation and mechanical ventilation	Patients with worsening hypoxia, hypercapnia, acidaemia, respiratory fatigue, haemodynamic instability or those with altered mental status should be considered for early invasive mechanical ventilation if appropriate.[12] The risk of aerosol transmission is reduced once a patient is intubated with a closed ventilator circuit.[12]
Recruitment manoeuvres	Although current evidence does not support the routine use of recruitment manoeuvres in non-COVID-19 ARDS, they could be considered in patients with COVID-19 on a case-by-case basis.[12]
Prone positioning	Anecdotal reports from international centres dealing with large numbers of critically ill patients with COVID-19-related ARDS suggest that prone ventilation is an effective strategy in mechanically ventilated patients.[12] In adult patients with COVID-19 and severe ARDS, prone ventilation for 12 to 16 hours per day is recommended.[22,23] It requires sufficient human resources and expertise to be safely performed, to prevent known complications including pressure areas and airway complications.
Bronchoscopy	Bronchoscopy carries a significant risk of aerosol generation and transmission of infection. The clinical yield is thought to be low in COVID-19 and unless there are other indications (such as suspected atypical/opportunistic superinfection or immunosuppression) it is strongly advised to avoid the procedure.[12]
Suctioning	Closed inline suction catheters are recommended.[12]
Sputum samples	In a ventilated patient, tracheal aspirate samples for diagnosis of COVID-19 are sufficient and bronchoalveolar lavage is not usually necessary.[12] Any disconnection of the patient from the ventilator should be avoided to prevent lung decruitment and aerosolisation. If necessary, the endotracheal tube should be clamped and the ventilator disabled (to prevent aerosolisation).[12]
Tracheostomy	Tracheostomy could be considered in suitable patients to facilitate nursing care and expedite ventilator weaning, but is an aerosolising procedure and this must be considered in clinical decision making.[12]

ARDS = acute respiratory distress syndrome, COVID-19 = coronavirus disease 2019, ICU = intensive care unit.

Guidance was based on the most recent and relevant COVID-19 clinical practice guidelines from highly-respected organisations, national physiotherapy organisations and peer-reviewed studies; these sources were transparently reported. The authors represent an international group of physiotherapists, with extensive clinical experience in the ICU and on the wards. They are also academic physiotherapists with experience in the leadership, conduct and execution of rigorous systematic reviews, clinical studies (including prospective cohort studies and international multi-centre trials), and clinical practice guidelines. The recommendations have been endorsed by international physiotherapy organisations.[b] Translations of the recommendations are available in Appendix 1 on the eAddenda.

There are also some limitations. Given the recent presentation of COVID-19, clinical guidance may change as more is learnt about the natural history of this disease. Recommendations were extrapolated based on best evidence for current management of critically ill patients and long-term outcomes in critical illness survivors. No patient was included in the author group. While the recommendations apply to physiotherapy interventions in the acute-care setting, longer-term follow-up of survivors is needed.

Recommendations for physiotherapy workforce planning and preparation

COVID-19 is placing significant demands on healthcare resources throughout the world. Box 1 outlines recommendations to assist the physiotherapy workforce to plan and respond to this demand. Box 2 and Table 1 provide recommendations for determining whom physiotherapists should treat when patients have confirmed or suspected COVID-19. Table 2 provides an example of a resource plan for ICU physiotherapy from Tier 0 (business as usual) through to Tier 4 (large-scale emergency). Local context, resources and expertise should be considered when utilising this example resource plan.

Medical management of COVID-19

It is important for physiotherapists to be aware of the medical management for patients with COVID-19. Table 3 summarises some of the recommendations available from medical guidelines developed by professional societies (as listed in Appendix 2 on the eAddenda).

For patients admitted to ICU, additional strategies may be used; these are summarised in Table 4. With increasing acuity, there is an increased risk of dispersion of aerosolised virus into the healthcare environment due to the nature of critical illness, higher viral load and the performance of aerosol-generating procedures. It is recommended that airborne PPE precautions should be used to care for all patients with COVID-19 in ICU.[12]

Recommendations for the delivery of physiotherapy interventions, including personal protective equipment requirements

Physiotherapy management principles – respiratory care

Examples of physiotherapy-led respiratory interventions (or chest physiotherapy) are provided below.

Airway clearance techniques

Airway clearance techniques include positioning, active cycle of breathing, manual and/or ventilator hyperinflation, percussion and vibrations, positive expiratory pressure therapy (PEP) and mechanical insufflation-exsufflation.

Non-invasive ventilation and inspiratory positive pressure breathing

Physiotherapists may use inspiratory positive pressure breathing (eg, for patients with rib fractures). Non-invasive ventilation may be applied as part of airway clearance strategies in the management of respiratory failure or during exercise.

Techniques to facilitate secretion clearance

Techniques to facilitate secretion clearance include assisted or stimulated cough manoeuvres and airway suctioning.

Other

Physiotherapists prescribe exercise and assist patients to mobilise. Physiotherapists also play an integral role in the management of patients with a tracheostomy.

COVID-19 poses significant considerations for respiratory physiotherapy interventions due to their aerosol-generating procedures. Box 3 outlines recommendations for providing respiratory care to patients with COVID-19.

Box 3. Recommendations for physiotherapy respiratory interventions.

Personal protective equipment	
3.1	It is strongly recommended that airborne precautions are utilised during respiratory physiotherapy interventions.
Cough etiquette	
3.2	Both patients and staff should practise cough etiquette and hygiene. During techniques that may provoke a cough, education should be provided to enhance cough etiquette and hygiene: • Ask the patient to cover their cough by coughing into their elbow or sleeve or into a tissue. Tissues should then be disposed and hand hygiene performed. • In addition, if possible, physiotherapists should position themselves $\geq$ 2 m from the patient and out of the likely path of dispersion.
Aerosol-generating procedures	
3.3	Many respiratory physiotherapy interventions are potentially aerosol-generating procedures. While there are insufficient investigations confirming the aerosol-generating potential of various physiotherapy interventions,[25] the combination with cough for airway clearance makes all techniques potentially aerosol-generating procedures. These include: • cough-generating procedures (eg, cough or huff during treatment) • positioning or gravity-assisted drainage techniques and manual techniques (eg, expiratory vibrations, percussion and manually assisted cough) that may trigger a cough and sputum expectoration • use of positive pressure breathing devices (eg, inspiratory positive pressure breathing), mechanical insufflation-exsufflation devices, intra/extra pulmonary high-frequency oscillation devices (eg, The Vest, MetaNeb, Percussionaire) • PEP and oscillating PEP devices • bubble PEP • nasopharyngeal or oropharyngeal suctioning • manual hyperinflation • open suction • saline instillation via an open-circuit endotracheal tube • inspiratory muscle training, particularly if used with patients who are ventilated and disconnection from a breathing circuit is required • sputum inductions • any mobilisation or therapy that may result in coughing and expectoration of mucus Therefore, there is a risk of creating an airborne transmission of COVID-19 during treatments. Physiotherapists should weigh up the risk versus benefit in completing these interventions and use airborne precautions.
3.4	Where aerosol-generating procedures are indicated and considered essential they should be undertaken in a negative-pressure room, if available, or in a single room with the door closed. Only the minimum number of required staff should be present and they must all wear PPE, as described. Entry and exit from the room should be minimised during the procedure.[12] This may not be able to be maintained when cohorting is required because of the volume of patients presenting with COVID-19.
3.5	BubblePEP is not recommended for patients with COVID-19 because of uncertainty around the potential for aerosolisation, which is similar to the caution the WHO places on bubble CPAP.[23]
3.6	There is no evidence for incentive spirometry in patients with COVID-19.
3.7	Avoid the use of mechanical insufflation/exsufflation, non-invasive ventilation, inspiratory positive pressure breathing devices or high-flow nasal oxygen devices. However, if clinically indicated and alternative options have been ineffective, consult with both senior medical staff and infection prevention and monitoring services within local facilities prior to use. If used, ensure that machines can be decontaminated after use and protect machine with viral filters over machine and patient ends of circuits: • Use disposable circuits for these devices. • Maintain a log of devices that includes patient details for tracking and infection monitoring (if required). • Use airborne precautions.
3.8	Where respiratory equipment is used, whenever possible, use single-patient-use disposable options (eg, single-patient-use PEP devices). Re-usable respiratory equipment should be avoided where possible.
3.9	Physiotherapists should not implement humidification, non-invasive ventilation or other aerosol-generating procedures without consultation and agreement with a senior doctor (eg, medical consultant).
Sputum inductions	
3.10	Sputum inductions should not be performed.
Requests for sputum samples	
3.11	In the first instance, ascertain whether the patient is productive of sputum and able to clear sputum independently. If so, physiotherapy is not required for a sputum sample. If physiotherapy interventions are required to facilitate a sputum sample, full airborne PPE should be worn. The handling of sputum samples should adhere to local policies. Generally, once a sputum sample has been obtained the following points should be followed: • All sputum specimens and request forms should be marked with a biohazard label. • The specimen should be double-bagged. The specimen should be placed in the first bag in the isolation room by a staff member wearing recommended PPE. • Specimens should be hand-delivered to the laboratory by someone who understands the nature of the specimens. Pneumatic tube systems must not be used to transport specimens.
Saline nebulisation	
3.12	Do not use saline nebulisation. It should be noted that some UK guidelines allow use of nebulisers, but this is currently not recommended in Australia.
Manual hyperinflation	
3.13	As it involves disconnection/opening of a ventilator circuit, avoid manual hyperinflation and utilise ventilator hyperinflation if indicated (eg, for suppurative presentations in ICU and if local procedures are in place).

(*Continued on next page*)

Box 3. Continued	
Positioning, including gravity-assisted drainage	
3.14	Physiotherapists can continue to advise on positioning requirements for patients.
Prone positioning	
3.15	Physiotherapists may have a role in the implementation of prone positioning in the ICU. This may include leadership within ICU 'prone teams', providing staff education on prone positioning (eg, simulation-based education sessions) or assisting in turns as part of the ICU team.
Tracheostomy management	
3.16	The presence of a tracheostomy and related procedures are potentially aerosol generating: • Cuff deflation trials and inner tube changes/cleaning can be aerosol generating. • Closed, in-line suction is recommended. • Inspiratory muscle training, speaking valves and leak speech should not be attempted until patients are over the acute infection and the risk of transmission is reduced. • Airborne precautions are recommended with infectious patients with COVID-19 with a tracheostomy.

COVID-19 = coronavirus disease 2019, CPAP = continuous positive airway pressure, ICU = intensive care unit, PEP = positive expiratory pressure, PPE = personal protective equipment, WHO = World Health Organization.

Box 4. Recommendations for physiotherapy mobilisation, exercise and rehabilitation interventions.	
Personal protective equipment	
4.1	Droplet precautions should be appropriate for the provision of mobilisation, exercise and rehabilitation in most circumstances. However, physiotherapists are likely to be in close contact with the patient (eg, for mobilisation, exercise or rehabilitation interventions that require assistance). In these cases, consider use of a high filtration mask (eg, P2/N95). Mobilisation and exercise may also result in the patient coughing or expectorating mucus, and there may be circuit disconnections with ventilated patients. Refer to local guidelines regarding ability to mobilise patients outside of their isolation room. If mobilising outside of the isolation room, ensure that the patient is wearing a surgical mask.
Screening	
4.2	Physiotherapists will actively screen and/or accept referrals for mobilisation, exercise and rehabilitation. When screening, discussion with nursing staff, the patient (eg, via phone) or family is recommended before deciding to enter the patient's isolation room. For example, to try to minimise staff who come in to contact with patients with COVID-19, physiotherapists may screen to determine an appropriate aid to trial. A trial of the aid may then be performed by the nursing staff already in an isolation room, with guidance provided, if needed, by the physiotherapist who is outside the room.
4.3	Direct physiotherapy interventions should only be considered when there are significant functional limitations, such as (risk of) ICU-acquired weakness, frailty, multiple comorbidities and advanced age.
Early mobilisation	
4.4	Early mobilisation is encouraged. Actively mobilise the patient early in the course of illness when safe to do so.[23]
4.5	Patients should be encouraged to maintain function as able within their rooms: • Sit out of bed. • Perform simple exercises and activities of daily living.
Mobilisation and exercise prescription	
4.6	Mobilisation and exercise prescription should involve careful consideration of the patient's state (eg, stable clinical presentation with stable respiratory and haemodynamic function).[26,27]
Mobility and exercise equipment	
4.7	The use of equipment should be carefully considered and discussed with local infection monitoring and prevention service staff before being used with patients with COVID-19 to ensure that it can be properly decontaminated.
4.8	Use equipment that can be single patient use. For example, use elastic resistance bands rather than distributing hand weights.
4.9	Larger equipment (eg, mobility aids, ergometers, chairs and tilt tables) must be easily decontaminated. Avoid use of specialised equipment, unless necessary, for basic functional tasks. For example, stretcher chairs or tilt tables may be deemed appropriate if they can be decontaminated with appropriate cleaning and are indicated for progression of sitting/standing.
4.10	When mobilisation, exercise or rehabilitation interventions are indicated: • Plan well. • Identify/use the minimum number of staff required to safely perform the activity.[26] • Ensure that all equipment is available and working before entering rooms. • Ensure that all equipment is appropriately cleaned or decontaminated. • If equipment needs to be shared among patients, clean and disinfect between each patient use.[23] • Specific staff training for cleaning of equipment within isolation rooms may be required. • Whenever possible, prevent the movement of equipment between infectious and non-infectious areas. • Whenever possible, keep dedicated equipment within the isolation zones, but avoid storing extraneous equipment within the patient's room.
4.11	When performing activities with ventilated patients or patients with a tracheostomy, ensure that airway security is considered and maintained (eg, a dedicated airway person to prevent inadvertent disconnection of ventilator connections/tubing).

COVID-19 = coronavirus disease 2019, ICU = intensive care unit.

Box 5. Recommendations regarding personal protective equipment for physiotherapists.

5.1	All staff must be trained in correct donning and doffing of PPE, including N95 'fit-checking'. A registry of staff who have completed PPE education and fit checking should be maintained.
5.2	'Fit testing' is recommended when available, but the evidence for fit testing effectiveness is limited and the variation in supply of N95 mask types may make any recommendation on fit testing difficult to implement from a practical perspective.[12]
5.3	Staff with beards should be encouraged to remove facial hair to ensure good mask fit.[24]
5.4	For all confirmed or suspected cases, **droplet precautions** should be implemented, at a minimum. Staff must wear the following items: • surgical mask • fluid-resistant long-sleeved gown • goggles or face shield • gloves[22]
5.5	Recommended PPE for staff caring for COVID-19-infected patients includes added precautions for patients with significant respiratory illness, when aerosol-generating procedures are likely and/or prolonged or very close contact with the patient is likely. In these cases, **airborne precautions** are followed, including: • an N95/P2 mask • fluid-resistant long-sleeved gown • goggles or face shield • gloves[24]
5.6	In addition, the following can be considered: • hair cover for aerosol-generating procedures • shoes that are impermeable to liquids and can be wiped down Recurrent use of shoe covers is not recommended, as repeated removal is likely to increase the risk of staff contamination.[12]
5.7	PPE must remain in place and be worn correctly for the duration of exposure to potentially contaminated areas. PPE (particularly masks) should not be adjusted during patient care.[24]
5.8	Use a step-by-step process for donning and doffing PPE as per local guidelines.[24]
5.9	Check local guidelines for information on laundering uniforms and/or wearing uniforms outside of work if exposed to COVID-19. For example, changing into scrubs may be recommended in local guidelines[12] and/or staff may be encouraged to get changed out of their uniform before leaving work and to transport worn uniforms home in a plastic bag for washing at home.
5.10	Minimise personal effects in the workplace. All personal items should be removed before entering clinical areas and donning PPE. This includes earrings, watches, lanyards, mobile phones, pagers, pens, etc. Stethoscope use should be minimised.[12] If required, use dedicated stethoscopes within isolation areas.[19,23] Hair should be tied back out of the face and eyes.[24]
5.11	Staff caring for infectious patients must apply correct PPE, irrespective of physical isolation. For example, in ICU, if patients are cohorted into a Pod with open rooms, staff working within the confines of the ICU Pod but not directly involved in patient care should also wear PPE. The same applies once infectious patients are nursed on an open ward. Staff then use plastic aprons, a change of gloves and hand hygiene when moving between patients in open areas.
5.12	When a unit is caring for a patient with confirmed or suspected COVID-19, it is recommended that all donning and doffing are supervised by an additional appropriately trained staff member.[12]
5.13	Avoid sharing equipment. Preferably only use single-use equipment.
5.14	Wear an additional plastic apron if a large volume of fluid exposure is expected.[24]
5.15	If reusable PPE items are used (eg, goggles), these must be cleaned and disinfected prior to re-use.[24]

COVID-19 = coronavirus disease 2019, ICU = intensive care unit, PPE = personal protective equipment.

Physiotherapy management principles – mobilisation, exercise and rehabilitation interventions

Physiotherapists are responsible for providing musculoskeletal, neurological and cardiopulmonary rehabilitation tasks, as outlined below.

Range of motion exercises

Passive, active-assisted, active or resisted joint range of motion exercises may be performed to maintain or improve joint integrity, range of motion and muscle strength.

Mobilisation and rehabilitation

Examples of mobilisation and rehabilitation include bed mobility, sitting out of bed, sitting balance, sit to stand, walking, tilt table, standing hoists, upper/lower limb ergometry and exercise programs. Box 4 outlines recommendations for implementing these activities in patients with COVID-19.

Personal protective equipment considerations

It is imperative that physiotherapists understand the measures in place to prevent transmission of COVID-19. Box 5 provides recommendations for this. Patients with confirmed or suspected COVID-19 will be managed with either droplet or airborne precautions.[12] Additionally, they will be placed in isolation. Hospitals are often able to contain patients with droplet or airborne spread within dedicated isolation rooms. However, there are a limited number of negative pressure bays and pods and/or rooms across Australia and New Zealand,[12] so isolation within dedicated rooms may not be possible with COVID-19 because of the large volume of patient admissions.

It is important for physiotherapists to understand the different types of isolation rooms that exist in hospitals. Class S rooms (standard single rooms, no negative pressure capability), which can be used for isolating patients capable of transmitting infection by droplet or contact routes[12] and Class N rooms (single negative pressure isolation rooms), which are beneficial in isolating patients with transmissible airborne infections.[12] The preference would be for patients with confirmed or suspected COVID-19 to be isolated in Class N rooms.[12] If this is not possible, Class S single rooms with clearly designated areas for donning and doffing PPE are recommended.[12] In the event of all single Class N and S rooms being fully occupied, the recommendation is for patients with COVID-19 to be separately

cohorted to patients without COVID-19 within the hospital.[12] In an open ICU or ward-cohorted areas with one or more patients with COVID-19, it is recommended that staff members in the whole area are required to use airborne PPE precautions.[12] Box 5 describes how the movement from dedicated isolation rooms to open cohorting might evolve within an ICU.

Footnotes: [a] An international team of expert researchers and clinicians within the intensive care and acute cardiorespiratory fields have developed these recommendations. The recommendations are intended for use in adults only. This document has been constructed using existing medical guidelines, relevant literature and expert opinion. The authors have made considerable effort to ensure that the information contained with the recommendation is accurate at time of publication. Further iterations of these recommendations will be published as new information arises. The information provided in this document is not designed to replace local institutional policies and should not replace clinical reasoning for individual patient management. The authors are not liable for the accuracy, information that may be perceived as misleading, or completeness of information in this document. The author group will review and update this guidance within 6 months, or if important new evidence emerges that changes the recommendations herein. [b] These recommendations have been endorsed by: Australian Physiotherapy Association, Canadian Physiotherapy Association, Association of Chartered Society of Physiotherapists in Respiratory Care UK, Associazione Riabilitatori dell' Insufficienza Respiratoria, Koninklijk Nederlands Genootschap voor Fysiotherapie, International Confederation of Cardiorespiratory Physical Therapists, World Confederation for Physical Therapy, AXXON Physical Therapy in Belgium, and Société de Kinésithérapie de Réanimation.

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Effect of Early Mobility as a Physiotherapy Treatment for Pneumonia: A Systematic Review and Meta-Analysis

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ABSTRACT

Purpose: We conducted a systematic review of the effect of early mobility on length of stay (LOS), mortality, and clinical outcomes as a treatment for adults hospitalized with pneumonia. ***Method:*** An electronic search of four databases was conducted. Inclusion criteria were (1) acute medical condition of pneumonia in adults and (2) early mobility intervention. Quality appraisal was conducted using the Physiotherapy Evidence Database scale and the Newcastle-Ottawa Scale. ***Results:*** Four studies (three randomized controlled trials and one retrospective cohort study) met the inclusion criteria. Meta-analysis demonstrated that early mobility did not reduce the risk of mortality compared with usual care (risk ratio 0.9 [95% CI: 0.27, 2.97]; $p = 0.86$) but did reduce the mean LOS (–1.1 days [95% CI: 2.21, –0.04]; $p = 0.04$). Early mobility also did not affect the rate of hospital readmissions or emergency department visits. One study demonstrated an improvement in functional exercise capacity and quality of life related to physical function and faster completion of a measure of activities of daily living. ***Conclusions:*** Early mobility reduced LOS in adults hospitalized with community-acquired pneumonia, although there was no effect on mortality or rate of hospital readmissions. Further research is needed to determine the effect of early mobility in this population and establish guidelines.

Key Words: early mobilization; hospitalization; pneumonia; treatment; systematic review.

RÉSUMÉ

Objectif : analyse systématique de l'effet de la mobilité précoce sur la durée d'hospitalisation (DH), la mortalité et les résultats cliniques dans le traitement des adultes hospitalisés à cause d'une pneumonie. ***Méthodologie :*** recherche dans quatre bases de données. Les critères d'inclusion étaient 1) une pneumonie aiguë chez l'adulte et 2) une intervention de mobilité précoce. Les chercheurs ont procédé à l'évaluation de la qualité au moyen de l'échelle de la base de données de la physiothérapie fondée sur les preuves et de l'échelle de Newcastle-Ottawa. ***Résultats :*** quatre études (trois essais cliniques aléatoires et une étude de cohorte rétrospective) respectaient les critères d'inclusion. La méta-analyse a démontré que la mobilité précoce ne réduisait pas le risque de mortalité par rapport aux soins habituels (risque relatif de 0,9 [IC à 95 % : 0,27, 2,97]; $p = 0,86$), mais réduisait la DH moyenne (−1,1 jour [IC à 95 % : 2,21, −0,04]; $p = 0,040$). Par ailleurs, la mobilité précoce n'avait pas d'incidence sur le taux de réhospitalisations ou de consultations à l'urgence. Une étude a démontré une amélioration de la capacité fonctionnelle à l'exercice et à la qualité de vie liée à la fonction physique ainsi qu'une exécution plus rapide des mesures d'activités de la vie quotidienne. ***Conclusion :*** la mobilité précoce réduisait la DH chez les adultes hospitalisés à cause d'une pneumonie extra-hospitalière, mais n'avait pas d'effet sur la mortalité ni sur le taux de réhospitalisations. Avant d'établir des lignes directrices, il faudra réaliser d'autres recherches pour déterminer l'effet de la mobilité précoce auprès de cette population.

Medical research has described community-acquired pneumonia as a lower respiratory tract infection characterized by cough, fever, chills, fatigue, dyspnoea, rigors, and pleuritic chest pain, which may be accompanied by new infiltrates on chest radiography.[1,2] It is a leading cause of morbidity and mortality and an economic burden worldwide.[2–4] Pneumonia is a leading infectious cause of hospitalization and death among adults in the United States,[5,6] with medical costs exceeding $10 billion (US) in 2011.[7] Mortality is highest in the United States for patients with pneumonia requiring hospitalization, with a 30-day mortality rate of 23%.[8] In addition, the average length of stay (LOS) for patients admitted with pneumonia is 5.2 days, and 10%–20% of patients require admission to an intensive care unit.[9]

In addition to antimicrobial therapy prescribed to manage pneumonia,[10] evidence supports early mobility as part of treatment.[11] Early mobilization is frequently prescribed to manage postoperative complications and to treat atelectasis and sputum retention, and it is

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associated with reducing LOS, improving functional mobility, and promoting airway clearance.[12–17] The benefits of early mobilization have been further recognized as mitigating adverse multisystem sequelae of bedrest, including muscle weakness, microvascular dysfunction, deconditioning, physical activity intolerance, and decline in functional capacity in hospitalized patients.[18,19]

The literature supports the safety and effectiveness of early mobility and recommends it as a core treatment in the physiotherapy management of critically ill patients.[18–20] Current guidelines for managing individuals with complicated pneumonia incorporate mobilization, with recommendations including sitting out of bed for 20 minutes within the first 24 hours after admission, in addition to traditional airway clearance techniques and continuous positive airway pressure.[21] However, the benefits of early mobility as a treatment for community-acquired pneumonia remain unclear.

The aim of this systematic review was to evaluate the effectiveness of early mobility on primary outcome measures—LOS and mortality—and secondary outcomes—rates of hospital readmission, emergency department visits, physical function, exercise capacity, dyspnoea, and quality of life—in adults with community-acquired pneumonia. This review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[22]

METHODS

Inclusion criteria

We considered randomized controlled trials (RCTs) and observational studies that compared an in-patient-based early mobility intervention with a control treatment. All participants were adults (aged 17 y or older) and were diagnosed with an acute medical condition of community-acquired pneumonia but were not intubated or ventilated. *Early mobility* was defined as movement out of bed, with a change from the horizontal to the upright position for at least 20 minutes during the first 24 hours after hospitalization; this definition is consistent with guidelines for managing complicated pneumonia,[21] with movement progressing each subsequent day during hospitalization.[23] The word *early* reflects recommendations that mobility be initiated immediately after physiological stabilization in acutely ill patients with the requisite cognitive function and that early mobilization activities need to be sufficient to challenge the cardiopulmonary, musculoskeletal, and neuromuscular systems.[18,20]

Exclusion criteria

We excluded studies in which participants had been diagnosed with acute medical conditions other than pneumonia, including pulmonary embolism, pleural effusion, pneumothorax, congestive heart failure, lung neoplasm, acute respiratory distress syndrome, lung abscess, acute respiratory failure, acute bronchitis, chest trauma (including rib fractures), and acute myocardial infarction. We also excluded studies if they had not been published in English and if they included physiotherapy interventions administered to patients only in a recumbent position.

Outcome measures

The primary outcome measures were LOS and mortality. The secondary outcome measures were rate of hospital readmission and emergency visits and measures of physical function, exercise capacity, symptoms, and quality of life.

Search strategy

We conducted an electronic search of PUBMED, CINAHL, MEDLINE, and EMBASE for studies published before July 2015. An updated search was performed in January 2017. Keywords used were pneumonia AND adult AND treatment AND hospital OR ICU or CCU or critical care OR acute care or intensive care AND physical therapy OR physiotherapy OR rehabilitation. An example of the completed search strategy on PUBMED is included in the Appendix.

Selection of studies and data extraction

Two groups of two reviewers each (MR and JV, OV and SM) independently assessed abstracts, full text, or both as necessary to identify relevant articles on the basis of the specified inclusion and exclusion criteria. Kappa values were calculated to determine interrater agreement for the included and excluded studies. Any discrepancies between the reviewers in a group were resolved by another independent reviewer (TL). Data for participant description, intervention description, severity and type of pneumonia, and outcome measures were extracted using a standardized template.

Assessment of risk of bias

Two independent reviewers conducted quality appraisal on the selected studies on the basis of the Physiotherapy Evidence Database (PEDro) scale (for the RCTs)[24] or the Newcastle-Ottawa Scale (for the nonrandomized studies).[25] The Newcastle-Ottawa Scale contains eight items categorized into three dimensions of selection, comparability, and outcome, with scores ranging from 0 to 9.[25] Any differences were resolved by another independent reviewer (TL).

Data analysis

Meta-analysis was planned for two or more studies that were considered clinically homogeneous (having a similar model of intervention and outcome tools).[26] Data were entered using Review Manager, version 5.3 (Cochrane Collaboration, Copenhagen). The pooled estimate of treatment effect for LOS was reported as mean difference, and mortality was reported using a risk ratio (RR),

with random effects analysis applied. Forest plots were generated to depict results, and heterogeneity was tested according to the overlap in confidence intervals, interpretation of the χ^2 test, and the I^2 statistic, with substantial heterogeneity represented by an I^2 greater than 50%.[27] The reviewers attempted to contact the authors of two studies to determine mean LOS and received a response from the authors of one.[28] When study findings could not be combined, a narrative format was used to report the results.

RESULTS

A total of 600 original articles were retrieved from the four electronic databases. Of these, 16 abstracts met the inclusion criteria, warranting full-text investigation; 12 articles were excluded because they did not meet the early mobility intervention inclusion criteria.[23] Four trials met the inclusion criteria (see Figure 1): three RCTs conducted in the United States,[23] Brazil,[28] and Spain,[29] respectively, and one retrospective cohort study from Japan.[30]

The characteristics of the participants in the included studies and the comparison of within-group outcomes are outlined in Table 1. In total, 69,492 (RCTs 908, retrospective cohort 68,584) patients (32,961 male) were included. Patients ranged in age from 17 to 103 years. The diagnostic criteria for pneumonia were based on consensus guidelines in one study,[28] based on set criteria in two studies,[23,29] or were according to the *International Statistical Classification of Diseases.*[30] Two studies reported the severity of pneumonia:[23,29] in these studies, 405 patients had mild, 316 patients had moderate, and 138 patients had severe pneumonia.

The specifics of the mobility interventions applied in the included studies are described in Table 1. Two studies defined *early mobility* as movement from bed, with a change from the horizontal to the upright position for at least 20 minutes during the first 24 hours of hospitalization, with subsequent progression.[23,29] Momosaki and colleagues[30] applied physical therapy interventions, which included early ambulation and adaptive or assistive exercises within 3 days of admission for at least 7 days. One study prescribed a daily session of aerobic exercise (ground-based walking) to a targeted intensity and peripheral muscle resistance training at an initial workload of 70% maximal peripheral muscle strength for 8 days.[28]

Risk of bias

All three RCTs used randomization processes, although concealed allocation was applied in only two of the studies.[28,29] Participants, therapists, and assessors were not consistently blinded. The mean PEDro score for the three RCTs[23,28,29] was 7.3 of 10 (see Table 2). For the cohort study,[30] the Newcastle-Ottawa Scale scores for the three domains were selection 3, comparability 1, and outcome 2, for a total score of 6 out of 9.

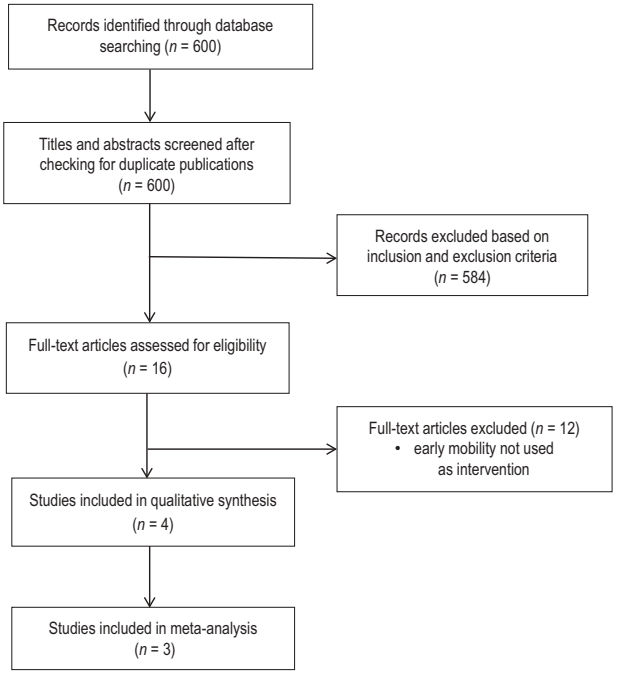

Figure 1 Flowchart of studies undergoing review.

Effects of intervention

Length of stay

Two studies were pooled for meta-analysis, with early mobility significantly reducing mean LOS: mean difference –1.13 days (95% CI: –2.21, –0.04 days; $p = 0.040$; see Figure 2).[23,28] Carratala and colleagues[29] (see Table 1) also reported a significantly reduced median LOS of 3.9 days for early mobility versus 6.0 days for the usual-care group ($p < 0.001$). One study found no difference in median LOS (12 vs. 13 days),[28] whereas Momosaki and colleagues[30] found a longer mean LOS (shown in Table 1) among those undergoing early rehabilitation (34.2 (SD 34.5) days vs. 26.2 (SD 37.4) days; $p < 0.001$).

Mortality

The meta-analysis of two RCT trials,[23,29] using random RR analysis, indicated that early mobility did not significantly lower the risk of mortality compared with usual care in adults with pneumonia (RR 0.90 [95% CI: 0.27, 2.97]; $p = 0.86$; see Figure 3). In the single retrospective cohort study (see Table 1), early rehabilitation was associated with a lower 30-day in-hospital mortality rate (5.1%) than usual care (7.1%).[30]

Table 1 Study Characteristics and Outcome Comparisons between Groups

Study	Participants	Intervention	Outcome comparisons
Randomized clinical trials			
Mundy et al.[23]	n = 458 (44% male) Age, range, min–max: 17–103 y Pneumonia criteria: new infiltrate on CXR and 1 major criterion (cough, sputum, temperature >37.8°C) or 2 minor criteria (pleuritic chest pain, dyspnoea, altered mental status, pulmonary consolidation on examination, leukocyte count >12,000/μL)	Experimental: early mobility (movement out of bed, with a change from horizontal to upright position, for at least 20 min during the first 24 h of hospitalization, with progressive movement each d) Control: usual care	LOS: reduced with early mobility compared with usual care (mean 5.8 vs. 6.9 d) Mortality (hospital and 90 d): no difference (hospital: 2.2% vs. 3.9%; 90 d: 9.7% vs. 8.7%) Hospital re-admission: no difference Emergency visits (30 d and 90 d): no difference
Carratala et al.[29]	n = 401 (35% male) Age, range, min–max: 18–97 y Pneumonia criteria: infiltrate on chest radiograph plus ≥1 of fever (≥38.0°C) or hypothermia (<35.0°C), new cough ± sputum production, pleuritic chest pain, dyspnoea, altered breath sounds on auscultation	Experimental: early mobility (movement out of bed, with a change from horizontal to upright position, for at least 20 min during the first 24 h of hospitalization, with progressive movement each d) Control: usual care	LOS: reduced with early mobility compared with usual care (median 3.9 d vs. 6.0 d; mean difference 2.1 (95% CI: –2.7, –1.7); $p < 0.001$ Mortality: no difference Hospital re-admission (30 d): no difference
Jose & Dal Corso[28]	n = 49 (55% male) Age: mean 55 (SD 20) y Pneumonia criteria: diagnosis of community-acquired pneumonia according to consensus guidelines*	Experimental: mobility training (warm up, stretching, resistance exercises, aerobic walking training) 50 min/d × 8 d Control: usual care: 50 min/d × 8 d	LOS: no difference in median (IQR) d (mobility: 12 [10–18] d; usual care: 13 [11–25] d) Glittre Activities of Daily Living test: mean (SD) time improved more with mobility training (52 [SD 40] sec) than with usual care (12 [SD 26] sec) ISWT distance: mean (SD) distance improved more with mobility training than with usual care (162 [SD 110] min vs. 33 [SD 71] min) Dyspnoea: decreased more in mobility training than in usual care group (mean difference –0.9 [95% CI: –1.4, –0.4]) SF-36: "physical functioning" domain improved more for mobility group (mean difference 14 points [95% CI: 1, 28]); no difference in any other domain
Retrospective cohort study			
Momosaki et al.[30]	n = 68,584 (50% male) Population: frail elderly Age: mean 85 (SD 7) y Pneumonia criteria: diagnosis of aspiration pneumonia according to *International Statistical Classification of Diseases*	Experimental: early rehabilitation by physical therapists (early ambulation, strengthening and endurance exercises initiated within 3 d of admission and done for at least 7 d) Control: no rehabilitation	LOS: increased in early vs. no-rehabilitation group (mean 34.2 [SD 34.5] d vs. 26.2 [SD 37.4] d; $p < 0.001$) Mortality (hospital 30 d): lower in early vs. no-rehabilitation group (5.1% vs. 7.1%; $p < 0.001$)

*Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults.
CXR = chest X-ray; LOS = length of stay; ISWT = incremental shuttle walk test; SF-36 = Short Form Health Survey (36 items).

Hospital readmission rates

Early mobility did not alter the rate of hospital readmissions[23,29] or the number of emergency department visits[23] compared with usual care (see Table 1).[23,29]

Physical function, exercise capacity, symptoms, and quality of life

Our study findings for physical function, exercise capacity, symptoms, and quality of life could not be

Table 2 Detailed PEDro Scores for Included Randomized Clinical Trials

Study	Random allocation	Concealed allocation	Groups similar at baseline	Participant blinding	Therapist blinding	Assessor blinding	< 15% dropouts	Intention-to-treat analysis	Between-group difference reported	Point estimate and variability reported	Total (0–10)
Mundy et al.[23]	Y	N	Y	Y	N	Y	Y	Y	Y	Y	8
Carratala et al.[29]	Y	Y	Y	N	N	N	Y	Y	Y	Y	7
Jose & Dal Corso[28]	Y	Y	Y	N	N	N	Y	Y	Y	Y	7

PEDro = Physiotherapy Evidence Database; Y = yes; N = no.

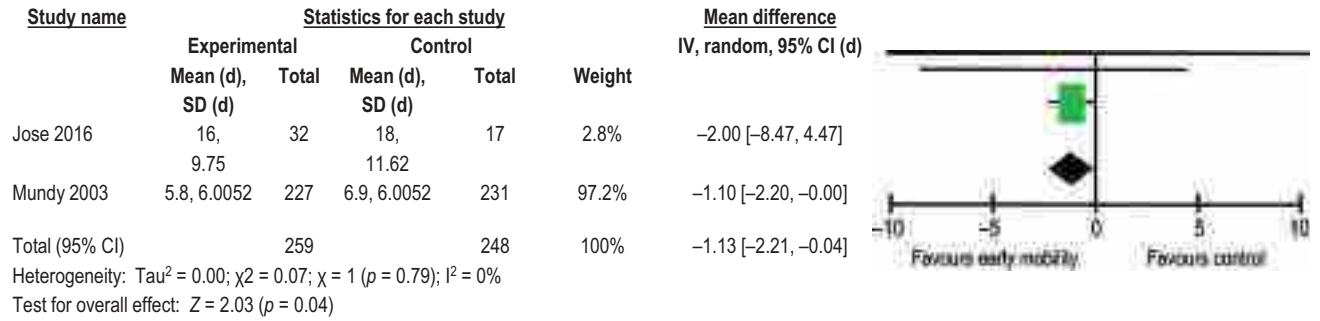

Figure 2 Mean difference (95% CI) of the effect of early mobility versus usual care on hospital length of stay (in days) by pooling data from two studies (n = 507).

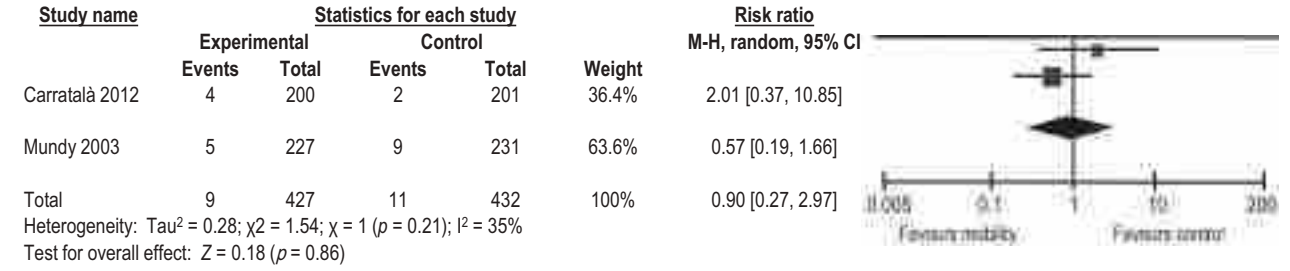

Figure 3 Risk ratio (95% CI) of the impact of early mobility versus usual care on mortality by pooling data from two studies (n = 859).

subjected to meta-analysis because they were reported only in narrative format (see Table 1).[28] Early mobility improved the incremental shuttle walking distance compared with usual care (mean difference 130 m [95% CI: 77, 182]).[28] The early mobility group completed the Glittre Activities of Daily Living test faster by 39 seconds (95% CI: 20, 59).[28] Early mobility also improved the physical function domain of the SF-36 quality of life questionnaire (mean difference 14 points [95% CI: 1, 28]) and reduced the severity of dyspnoea to a greater extent (mean difference 0.9 points [95% CI: 0.4, 1.4]).[28]

DISCUSSION

For adults hospitalized with community-acquired pneumonia, early mobility was associated with a reduced LOS, but no difference was found in mortality, hospital readmission rate, or emergency department presentation rate compared with usual care. The evidence for improved physical capacity, reduced severity of dyspnoea, and improved quality of life is limited.

The pooled findings of a reduced LOS with early mobility[23,28] were supported by the lower LOS also reported by Carratala and colleagues.[29] Although this result contrasts with the findings of Momosaki and colleagues,[30] it may be related to the study design. In that retrospective analysis of consecutive patients admitted to 1,161 acute-care hospitals across Japan over a 2-year time period,[30] other factors may have influenced LOS (e.g., undetermined consistency of physical therapy–led early rehabilitation programmes across settings) or the

criteria for discharge, and they may differ from the other included trials conducted in the United States,[23] Brazil,[28] and Spain.[29]

In particular, Momosaki and colleagues noted that in their study LOS depended on multiple factors apart from clinical criteria such as patient economic status, ability to pay for antibiotics, and variable aspects of hospital administration.[30] The type of early mobility prescription differed between the included studies, which may also influence the findings for LOS. A reduced LOS is a positive outcome: a difference of 24 hours of hospitalization can potentially save the health care system between $2,273 and $2,373 (US) for people with community-acquired pneumonia.[31] In addition to this economic benefit, lower rates of hospitalization can improve patient outcomes because there is a 2% increased risk of infection and 0.5% risk of adverse drug reactions with each additional night a patient spends in hospital.[32]

Although meta-analysis did not reveal a decrease in mortality with early mobility, investigators noted that it was not associated with increased adverse outcomes.[23,29] Multiple factors will influence the rate of mortality from community-acquired pneumonia, including functional status at the time of hospital admission,[33] age, and residence status.[34] The lack of change in hospital readmission rates and emergency department presentations may be influenced by the level of mobility sustained by participants beyond hospitalization. However, because no studies commented on this point, it is difficult to determine the effect of this factor.

Our review has several limitations. The first is the clinical heterogeneity with respect to the mobility interventions and usual care among the included studies. Across the studies, early mobility was delivered by nurses, suggested to patients by physicians, or provided by physiotherapists.[23,28–30] Although each study met the inclusion criteria for early mobility, differing exercise prescriptions and treatment frequencies were applied, and the method of exercise and mobility progression beyond the initial session likely varied among the studies. Only one study commented on the criteria for exercise progression, and this may account for the clinical changes in exercise capacity and quality of life reported.[29] Regardless, mobility was only one component of a three-treatment pathway; as such, it was not possible to determine the independent effects of early mobility.[29]

Second, each study was conducted in a different country, with different usual care, which was poorly defined. Although study outcomes were favourable to early mobility, further study with more rigorous documentation of mobilization procedures and progression is required to confirm these clinical benefits. Despite these limitations, the clinical benefits lend additional support to the recommendations outlined by Bott and colleagues[21] for early mobility for individuals with community-acquired pneumonia.

A final limitation of our review was the exclusion of studies not published in English. The three RCTs we included were of moderate to high methodological quality on the basis of PEDro score,[13] with the use of randomization procedures and allocation. The lack of blinding for procedures and assessments, however, increases the risk of bias. Future studies of high quality are required to confirm these initial results regarding the clinical benefits of early mobility.

CONCLUSION

This article provides support that early mobility reduces LOS when provided to adults who have been hospitalized with community-acquired pneumonia. Although mortality was not reduced, early mobility was not associated with any detrimental effects and therefore can be considered as an adjunct treatment for pneumonia. Further trials examining early mobility, delivered according to a defined protocol of exercise prescription and progression, are required to determine additional clinical benefits and develop best-practice, evidence-based guidelines.

KEY MESSAGES

What is already known on this topic

Early mobility has demonstrated success as a treatment for various cardiorespiratory conditions, but the research on its effectiveness in treating hospitalized adults with community-acquired pneumonia is limited.

What this study adds

Our systematic review reveals that the evidence for the effectiveness of early mobility as a treatment for patients with pneumonia is limited; this situation warrants further investigation.

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APPENDIX: EXAMPLE SEARCH STRATEGY FOR PUBMED

((((rehabilitation) OR ("physical therapy modalities"[MeSH Terms] OR "physical therapy modalities"[All Fields] OR "physiotherapy"[All Fields])) OR ("physical therapy modalities"[MeSH Terms] OR "physical therapy modalities"[All Fields] OR "physical therapy"[All Fields]))) AND ((((((((((hospital) OR "acute care"[All Fields]) OR ("critical care"[MeSH Terms] OR "critical care"[All Fields])) OR icu) OR "intensive care"[MeSH Terms] OR "intensive care"[All Fields]) OR CCU)) AND treatment) AND adult) AND english) AND pneumonia