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Benefits outweigh the risks: a consensus statement on the risks of physical activity for people living with long-term conditions

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ABSTRACT

Introduction The benefits of physical activity for people living with long-term conditions (LTCs) are well established. However, the risks of physical activity are less well documented. The fear of exacerbating symptoms and causing adverse events is a persuasive barrier to physical activity in this population.
This work aimed to agree clear statements for use by healthcare professionals about medical risks of physical activity for people living with LTCs through expert consensus. These statements addressed the following questions: (1) Is increasing physical activity safe for people living with one or more LTC? (2) Are the symptoms and clinical syndromes associated with common LTCs aggravated in the short or long term by increasing physical activity levels? (3) What specific risks should healthcare professionals consider when advising symptomatic people with one or more LTCs to increase their physical activity levels?

Methods Statements were developed in a multistage process, guided by the Appraisal of Guidelines for Research and Evaluation tool. A patient and clinician involvement process, a rapid literature review and a steering group workshop informed the development of draft symptom and syndrome-based statements. We then tested and refined the draft statements and supporting evidence using a three-stage modified online Delphi study, incorporating a multidisciplinary expert panel with a broad range of clinical specialties.

Results Twenty-eight experts completed the Delphi process. All statements achieved consensus with a final agreement between 88.5%–96.5%. Five 'impact statements' conclude that (1) for people living with LTCs, the benefits of physical activity far outweigh the risks, (2) despite the risks being very low, perceived risk is high, (3) person-centred conversations are essential for addressing perceived risk, (4) everybody has their own starting point and (5) people should stop and seek medical attention if they experience a dramatic increase in symptoms. In addition, eight symptom/syndrome-based statements discuss specific risks for musculoskeletal pain, fatigue, shortness of breath, cardiac chest pain, palpitations, dysglycaemia, cognitive impairment and falls and frailty.

Conclusion Clear, consistent messaging on risk across healthcare will improve people living with LTCs confidence to be physically active. Addressing the fear of adverse events on an individual level will help healthcare professionals affect meaningful behavioural change in day-to-day practice. Evidence does not support routine preparticipation medical clearance for people with stable LTCs if they build up gradually from their current level. The need for medical guidance, as opposed to clearance, should be determined by individuals with specific concerns about active symptoms. As part of a system-wide approach, consistent messaging from healthcare professionals around risk will also help reduce cross-sector barriers to engagement for this population.

INTRODUCTION

The International Society for Physical Activity and Health identified the healthcare sector as one of the eight best investments to combat global population inactivity.[1 2] Consequently, there is much interest in the UK and globally on using healthcare effectively and efficiently to promote physical activity.[3] The translation of this public health objective into clinical practice is notoriously challenging. Barriers are complex and multifactorial. Healthcare professionals cite a lack of the knowledge and skills required to reassure and motivate people with long-term conditions (LTCs) who are concerned that physical activity may aggravate their symptoms or even cause sudden death.[4–7]

In their recently updated physical activity guidelines, the WHO highlighted increasing inactivity levels globally and updated public health recommendations.[8] They explicitly recommend physical activity as beneficial for adults with LTCs,[8] recognising that inactivity levels double in those groups.[9] The WHO Guideline Development Group rated adverse events as critical to clinical decision-making on physical activity. It commissioned an umbrella review reporting on adverse events around physical activity for adults in general, including pregnancy and post partum.[8] However, they excluded evidence reporting on clinical populations with the rationale that the data cannot be generalised to the broader population.[10] They did look specifically at the benefit to some clinical subgroups (cancer, HIV, hypertension and type 2 diabetes mellitus), but data about risk is less well defined and limited to broad comparatives. The WHO concluded that for all people, doing some physical activity is better than none. Medical clearance is generally unnecessary, provided the amount and intensity of physical activity are increased gradually.[8] They recommend people who develop new symptoms should seek medical advice but do not clarify what that advice should be or how it relates to risk.

Epidemiological studies show that multimorbidity is common (62% in the over 65's and 81% in the over 85's) and constitutes most routine clinical presentations.[11] Projections suggest that in the UK, complex presentations of individuals with four or more LTC will double by 2032, emphasising the importance of designing services to support the management of these people.[12] The literature about physical activity in LTCs is predominantly condition-specific (see online supplemental file 1). Previous guidelines and consensus statements on risk have also focused on adverse events in defined conditions making recommendations challenging to implement in a multimorbid population.

In summary, public health bodies and clinical guidelines are clear that physical activity should be central to almost all LTC management. However, a barrier to this is particular patient concerns surrounding risk, which generally relate more to their symptoms than their conditions. As a result, it is unclear how healthcare professionals should address physical activity or share relevant information during routine healthcare interactions. This consensus statement aims to address this evidence gap, to clarify the fundamental safety considerations that will inform the conversations on physical activity between healthcare professionals and symptomatic people with LTCs. It will form a bridge between clinical practice guidelines, public health guidelines and people's lived experience to address valid concerns that increasing physical activity might be unsafe or worsen their symptoms.

AIMS

The aim of this project was to agree clear statements, through expert consensus, about the medical risks of physical activity for all adults, irrespective of age, living with one or more LTC. These statements are for healthcare professionals to support them during clinical practice.

It will address these commonly encountered questions:

- Is increasing physical activity safe for people living with one or more LTC?
- Are the symptoms and clinical syndromes associated with common LTCs aggravated in the short or long term by increasing physical activity levels?
- What specific risks should healthcare professionals consider when advising symptomatic people with one or more LTC to increase their physical activity levels?

METHODS

This is a multistage study with four discrete but related stages, each involving separate multidisciplinary working groups (see table 1). Table 2 demonstrates group roles and recruitment strategies. A complete list of contributors is in online supplemental file 2. This consensus statement has been developed according to the Appraisal of Guidelines for Research and Evaluation tool[13] and will be reviewed in 5 years unless advances in light of new or emerging scientific evidence prompt an earlier update.

Stage 1: preparation

The preparatory stage aimed to understand the opinion and perspectives of healthcare professionals and people living with LTCs on the risks of physical activity and how to address them during routine healthcare visits. Full details of the preparatory stage are in online supplemental file 3.

Patients and the public

We incorporated results from two related but discrete projects to inform our understanding from the patient and public perspective.

1. Patient and public involvement project to explore service users' experiences and views on how the National Health Service could better support their needs.[7]
2. A national consultation with 361 members of the public led by The National Centre for Sport and Exercise Medicine at Sheffield Hallam University in collaboration with Sport England. This related piece of work helped further inform our understanding of patient preferences and successful approaches to improving physical activity support for people with LTCs.[14]

Practitioners

We undertook an open question survey of the practitioner group to better understand risk perception in clinical practice, including barriers and facilitators to implementing and disseminating recommendations.

Stage 2: rapid evidence review

We undertook a rapid review of the literature to establish what is known about the risks of physical activity in people with LTCs. This type of review 'aims to assess what is already known about a policy or practice issue, using systematic review methods to search and critically appraise existing research".[15]

The rapid review aimed to provide an overview of existing guidelines and/or recommendations that address the risks of physical activity for people with LTCs, including:

1. What has previously been done to understand the associated risks?
2. What conclusions or consensus were reached?
3. How were conclusions or consensus reached?

The methods and full search strategy are in online supplemental file 1.

Stage 3: steering group meeting

The terms of reference for the steering group were to agree on core messages, review contraindication advice, develop consensus statement format, identify clinical priorities, approve statement development plan and ratify the delphi protocol.

The steering group appraised the results from the preparation phase and evidence review before a face-to-face workshop in November 2019. The meeting focused on the results of the preparation phase and evidence review, followed by a group discussion focussing on the terms of reference above.

Following the meeting, we reviewed the evidence base and recategorised it into a symptoms/syndrome format. In addition, we extended the literature review to address areas of specific clinical concern identified by the steering group. We then drafted consensus statements reflecting the outcomes of the steering group meeting. The draft statements and updated evidence summaries were then shared with the steering group via email for free-text comments and statements modified accordingly. We developed an online survey testing the content, structure, hierarchy of information and wording of the consensus statements. We piloted the survey with six healthcare professionals not involved in the project to ensure clarity, feasibility, and comprehensibility.

Stage 4: delphi study

We used a modified online version of the Delphi process[16–19] following the Conducting and REporting DElphi Studies guidelines.[18] Online survey rounds used the commercial software 'SurveyMonkey'.[20] Target completion time was below 30 min. Level of agreement used a scale of 1 (strongly disagree) to 6

Table 1 Group objectives and overview of study stages

		Study stage			
		1. Preparation	2. Rapid evidence review	3. Steering group meeting	4. Delphi
Group objectives	Authorship group	▶ Establish a collaborative network of stakeholders ▶ Consider the scope and context of this consensus statement ▶ Understand the perspectives of healthcare professionals and people living with LTCs on the risks of physical activity and relationship with clinical conversations	▶ Undertake a rapid review of published literature to establish what is known about the risk of physical activity in people with LTCs	▶ Coordinate steering group meeting ▶ Recruit delphi panel ▶ Develop questionnaire ▶ Develop draft statements	▶ Lead the evolution of clear statements, through expert consensus, about the medical risks of physical activity for all adults, irrespective of age, living with one or more LTCs
	Stakeholder group	▶ Agree scope of the consensus project ▶ Map cross-sector context ▶ Build collaboration			▶ Review outputs from the delphi study ▶ Establish common terminology and approach to inform subsequent cross-sector work
	Patient and public involvement group	▶ Share service user's views and opinions on physical activity service provision and healthcare system delivery ▶ Generate ideas on what healthcare might do differently to make it easier for people living with a LTC to be active			
	Practitioner group	▶ Provide an overview of the perception of giving advice around risk from physical activity in clinical practice ▶ Outline barriers and facilitators to implementing physical activity recommendations			
	Steering group		▶ Appraise rapid evidence review ▶ Contextualise findings related to clinical practice	▶ Recommend format of statements ▶ Review draft statements for testing in the delphi study	
	Delphi group				▶ Complete all phases of the delphi study required to reach consensus ▶ Test and develop the content, structure and format of the statements and supporting evidence

LTCs, long-term conditions.

(strongly agree) with space for free-text comments and suggestions where appropriate.

If invited participants did not reply to the initial contact, we checked the contact details and made one further effort. For the second and third phases, participants were invited by email. Reminders were sent out for non-responders at 2 weeks, 1 week and 2 days before survey closure. We took implied consent from the willingness to complete the survey. No participants stood to gain financially or otherwise from decisions taken in the delphi study.

Between phase feedback

We prepared individualised feedback for participants following each phase, which compared their response to each question with the group average. We presented a summary of free-text responses with associated modifications to each statement. The Delphi group received the supporting evidence summaries alongside each statement in the survey, and their recommendations informed the evolution of these summaries.

We maintained communication with participants through a project administrator to avoid imposing any opinion bias from the authorship group.[21]

Pre-defined consensus criteria

In keeping with described methods,[17 21] satisfactory agreement for phase 1 required both:

- Average score: >80%.
- All responses >3 (ie, no participant disagreement).

We removed questions meeting these criteria for the second phase of the delphi. Questions with an average score >80%, but with one or more participants scoring 1–3, were interrogated for free-text feedback.

In phase 2, agreement was further stratified with >80% high agreement, satisfactory agreement range between 60% and 80%.

Table 2 Group roles and recruitment

Group	n	Group roles and recruitment
Authorship group	5	The authors form a collaboration between the Faculty of Sport and Exercise Medicine (FSEM) and The Physical Activity for Health Research Centre, University of Edinburgh. The authorship group led all phases of this study.
Stakeholder group	4	External stakeholders from Sport England—health and inactivity, Public Health England—physical activity and healthy weight and the Royal College of General Practitioners (RCGP)—physical activity clinical priority group. The stakeholder group agreed on the remit of the consensus project and reviewed the completed statement. Members of this group were invited to the steering group meeting. This consensus statement will inform the direction of future cross-sector work by these organisations.
Practitioner group	57	We recruited this group of healthcare professionals through stakeholder organisations, including FSEM, RCGP, Chartered Society of Physiotherapy, Royal College of Nursing and Royal College of Physicians. This group participated in an online survey to help us understand opinions and perspectives from a group of healthcare professionals who do not have a specific clinical interest in physical activity but have the opportunity to discuss physical activity with patients routinely.
Patient and public involvement groups	401	We incorporated results from two studies exploring service users' views and experience of physical activity support around risk in healthcare that closely aligned with our objectives. We combined findings from these studies to provide vital insight on how people living with LTCs feel the NHS could better support their physical activity needs.[7 14]
Steering group	13	We recruited multidisciplinary healthcare professionals with extensive clinical and/or academical experience in using physical activity to manage LTCs through professional contacts of the authorship and stakeholder groups. This group reviewed results from the literature review and preparation phases and met with the authorship group at a face-to-face meeting in November 2019 to agree on the approach and direction of the study.
Delphi group	29	Recruitment for the modified Delphi study aimed to generate a heterogeneous group of professionals covering a broad range of professional groups and clinical disciplines to ensure diversity in opinion and expertise. Following introductions from professional organisations and clinical networks, we recruited experts by direct invitation. We used the delphi group to test and develop the structure and content of the statements. For this modified delphi, requiring in-depth feedback and continuity from a range of specialist areas, we set a minimum of 20 participants.

LTCs, long-term conditions; NHS, National Health Service.

The study protocol included a potential third round of the delphi for items not achieving satisfactory agreement. This eventuality would require participants to vote on potential solutions. This approach facilitates timely progression and mitigates risks from survey fatigue.[22]

RESULTS

In this section we report results by study stage followed by the consensus statements themselves.

Stage 1: preparation

Summary recommendations from the preparation phase are in table 3. Full results from the preparation phase are in online supplemental file 3.

Stage 2: rapid evidence review

Seventy-nine relevant reports (reviews, consensus statements, position statements or guidelines) were reviewed, with findings summarised for review at the steering group workshop. See online supplemental file 1 for full rapid evidence review results.

There is considerable heterogeneity around reporting of risk and limited reporting of adverse events. In addition, variability exists within and between LTCs regarding what has been done and the specificity of recommendations or guidance.

Few studies commented on adverse events of physical activity as a primary outcome, with the majority primarily reporting the benefits of physical activity and/or exercise and only some addressing associated risks. There is heterogeneity in the nature of physical activity included in different studies (such as mode, frequency and intensity of physical activity), the specificity of adverse event reporting and inclusion/exclusion criteria for each study. In studies that did not comment on adverse events, it was not always clear whether this meant there were none or if this was not reported as an outcome. These limitations reflect the heterogeneity of LTCs, the variety of symptoms that people may experience and the broad clinical context to which this statement applies.

The evidence base on the risk of physical activity for people with LTCs is almost exclusively presented by condition rather than by symptoms. This may reflect leadership and ambition by condition-specific organisations. Nevertheless, where studies report adverse outcomes, they refer to aggravation of the symptoms of LTCs such as fatigue, breathlessness, chest pain, palpitations, dysglycaemia and so on. Therefore, this consensus statement needed to extrapolate symptom-specific data from disease-specific literature and provide clinical consensus on the generalisability of these findings across/to multimorbidity.

Table 3 Summary recommendations from preparation phase across groups

Recommendation	HCP group n=57	PPI group n=40	NCSEM group n=361
Addressing risk is an essential facilitator for people considering increasing their physical activity levels	✓	✓	✓
Statements supporting risk should be based on symptoms/clinical syndromes rather than LTCs	✓	✓	✓
Cross-sector system support is required to improve the experience of inactive people with LTCs starting to become more physically active	✓	✓	✓
Continuity of advice and simple messages reduce confusion and are therefore empowering for people living with LTCs		✓	
Improved resources are required to support HCP knowledge around risk	✓		✓
Improved resources are required to support HCP knowledge around behavioural change	✓		✓
Removal of the need for medical clearance and implied 'liability' is required			✓

HCP, healthcare professional; LTCs, long-term conditions; NCSEM, National Centre for Sport and Exercise Medicine; PPI, patient and public involvement.

Box 1 Summary recommendations from the steering group meeting

Agree core messages:
- Inactivity poses a high risk to health.
- Physical activity recommendations should consider functional level, symptoms, individual preference and social confidence.
- Address fears related to physical activity.
- The benefits outweigh the risks.
- Safety messages should include contraindications.
- Aim to safely get all patients more active or maintain healthy levels of activity.
- Understanding normal physiological responses to exercise helps individuals to identify if they have a problem.

Review contraindication advice:
- To ensure a safe approach to initiating activity, inactive people should increase activity levels gradually.
- People with unstable medical conditions require investigation.
- Fear of adverse events is a common barrier for patients and professionals.
- Safe advice should include recommendations on symptoms to look out for and where/how to report them.

Develop consensus statement format:
- Focus on risks, not benefits.
- Follow a symptom/syndrome-based rather than diagnosis-based approach.
- Focus on self-directed physical activity.
- Maintain a person-centred approach to increasing physical activity.

Identify clinical priorities:
- Symptoms to address: musculoskeletal pain, fatigue, breathlessness, cardiac suggestive chest pain, palpitations.
- Syndromes to address: cognitive impairment, dysglycaemia, falls and frailty.

Despite this, the evidence consistently reports that the benefits of physical activity outweigh any potential risks, except where explicitly contraindicated. A person-centred approach is essential, with the understanding that there is an injury risk that applies to the whole population, that tolerance of physical activity will vary with symptom severity and that supervision may be appropriate or necessary.

Stage 3: steering group meeting

Box 1 shows summary recommendations from the steering group meeting. Following advice from the steering group, we drafted statements for testing during the Delphi.

Stage 4: delphi

Qualitative feedback and subsequent statement evolution are presented in online supplemental file 4. Twenty-eight participants completed the Delphi study in full (see figure 1). The Delphi recorded high levels of agreement overall (see table 4). Two symptom statements that met agreement criteria in phase 1 (palpitations and falls and frailty) did not require entry into phase 2. Despite meeting agreement criteria in phase 1, we re-entered headline statements 1 and 2 into phase 2 for feedback following formatting changes.

Similarly, we retested the dysglycaemia statement due to substantial rewording. Following phase 2, qualitative feedback informed minor wording edits to the statements. Phase 2 achieved consensus across all domains, so we did not require a third delphi phase.

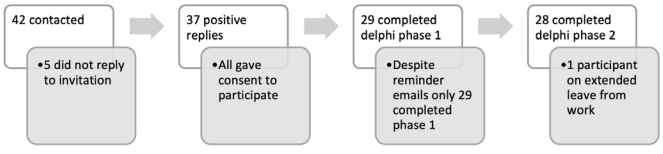

Figure 1 Recruitment of delphi participants.

Consensus statements

We provide five 'impact statements' that every healthcare professional should know about physical activity in people with LTCs. Following this are eight symptom/syndrome-based statements supported by a summary of the relevant evidence base. Figure 2 provides an infographic summary of the results.

Impact statements

The benefits of physical activity far outweigh the risks

Physical activity is safe, even for people living with symptoms of multiple LTCs. Regular physical activity, in combination with standard medical care, has an important role in the management and prevention of many LTCs.

The risk of serious adverse events is very low, but that's not how people feel

People with LTCs are often fearful of worsening their condition or experiencing potentially undesired consequences from physical activity. In fact, when physical activity levels are increased gradually, the risk of serious adverse events is very low. Well informed, person-centred conversations with healthcare professionals can reassure people and further reduce this risk.

It is not as easy as just telling someone to move more

Successful opportunistic brief advice helps build motivation and confidence to become more physically active. This can be consolidated at further healthcare visits to support lasting behaviour change. Advice from healthcare professionals should consider the concerns of individuals and their carers, as well as individual preference, symptoms, functional capacity, psychosocial factors, social support and environmental considerations.

Everyone has their own starting point

Everyone has their own starting point, depending on their current activity level. Help people identify where they are and agree a plan to begin there and build up gradually to minimise the risk of adverse events.

Advise people to stop and seek medical review if…

they experience a dramatic increase in breathlessness, new or worsening chest pain and/or increasing glyceryl trinitrate requirement, a sudden onset of rapid palpitations or irregular heartbeat, dizziness, a reduction in exercise capacity or sudden change in vision.

Symptom/syndrome statements

Musculoskeletal pain

For people who experience musculoskeletal (MSK) pain as part of their medical condition, physical activity will not increase pain in the long term. A temporary increase in pain levels is common when starting a new physical activity, until the body adapts, and people should be counselled to expect this. There is no evidence to suggest this pain correlates with tissue damage or adverse events in the absence of new injury (acute fracture/acute soft tissue injury).

Table 4 Consensus agreement of the delphi phases

		Phase 1			Phase 2	
		Percentage agreement	Scores <3	Consensus reached?	Percentage agreement	Consensus reached?
Headline messages	Impact Statement 1	95%	0	Yes*	High—95%	Yes
	Impact Statement 2	94%	0	Yes*	High—94%	Yes
	Impact Statement 3	88%	3	No	High—94%	Yes
	Impact Statement 4	N/A			High—89%	Yes
Symptom statements	Musculoskeletal pain	92%	1	No	High—94%	Yes
	Fatigue	91%	2	No	High—93%	Yes
	Shortness of breath	92%	1	No	High—97%	Yes
	Cardiac chest pain	89%	1	No	High—94%	Yes
	Palpitations	95%	0	Yes		
	Dysglycaemia	90%	0	Yes*	High—89%	Yes
	Cognitive impairment	88%	2	No	High—95%	Yes
	Falls and frailty	95%	0	Yes		

*Despite meeting agreement in phase 1, phase 2 re-tested these statements due to substantial wording changes.

Reported evidence demonstrates that, regardless of disease severity, age, pain or level of function, physical activity (aerobic, resistance or range of motion and land or water based) is likely beneficial for reducing pain and improving function in osteoarthritis.[23 24] Reported adverse effects are rare in studies with a physical activity component and usually relate to increased MSK pain with the physical activity intervention.[25–29] Activity modification should be considered during symptomatic exacerbations, or if the activity significantly worsens pain.[30] Studies of physical activity interventions in inflammatory arthropathies refer to minor MSK events, with no serious adverse events.[31–34] There are limited data about adverse events in studies of people with fibromyalgia,[35 36] however some people experience increased pain sensitisation in the short term,[37–42] which should be addressed as part of their holistic management.

Fatigue

Regular physical activity helps reduce fatigue and improves wellbeing and sleep. A temporary increase in fatigue is commonly experienced when starting a new physical activity until the body adapts. People should be counselled to expect this and advised to

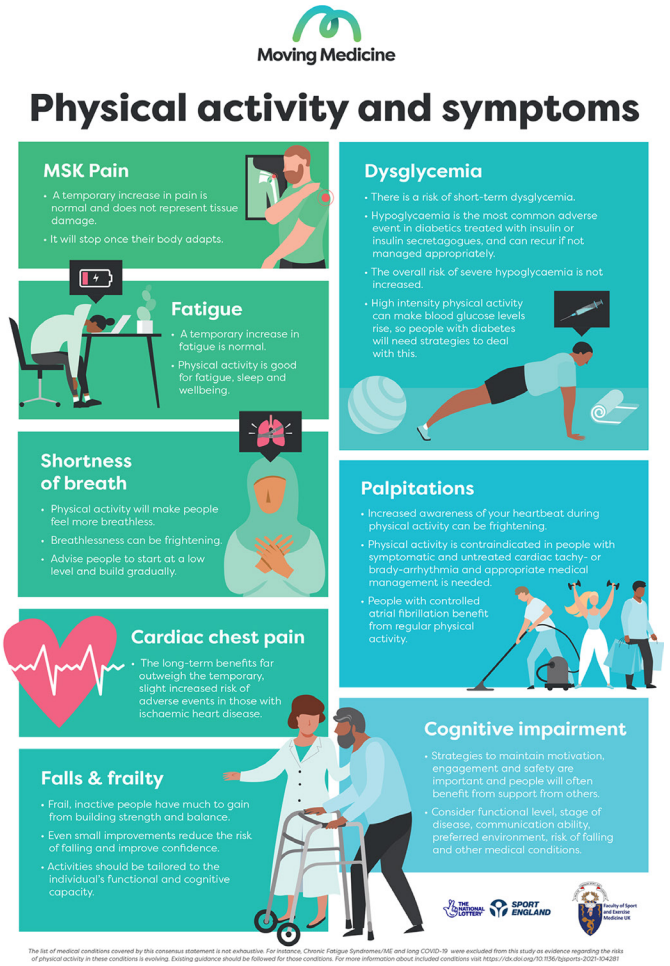

Figure 2 Infographic summary of results.

build up activity gradually. People experiencing fatigue related to chronic fatigue syndromes may benefit from specialist advice.

Increased sedentary behaviour is associated with higher levels of fatigue.[43] Adults who are more physically active report better overall well-being[44 45] and improvements in well-being domains.[46] Physical activity interventions are beneficial for fatigue in a broad range of long-term medical conditions, including rheumatoid arthritis, systemic lupus erythematosus, coronary heart disease (cardiac rehabilitation), inflammatory bowel disease, sarcoidosis, fibromyalgia and multiple sclerosis,[47] and are associated with the greatest overall improvement in cancer-related fatigue (especially when compared with pharmacological treatments).[48]

Shortness of breath

It is normal for all people to feel more breathless when increasing their activity level. The balance of evidence suggests that the risk of adverse events in breathless people when doing physical activity is very low. People should be counselled individually to gradually increase physical activity, taking into account their severity of symptoms and fear of breathlessness.

Shortness of breath in chronic obstructive pulmonary disease (COPD) can result in progressive avoidance of physical activity[49] and worsening breathlessness due to deconditioning. Reduced activity level with increasingly severe breathlessness is an important predictor of mortality.[50] There are very few reported general contraindications to physical activity in individuals with COPD provided the particular activity is tolerated, comorbidities considered and recommendations individualised.[51 52] Increased shortness of breath, muscle cramp and soreness have been reported in physical activity interventions, especially at the beginning of the intervention.[53] The weight of evidence in this area is within pulmonary rehabilitation,[54 55] and although not universally reported, adverse events are rare,[54] including after exacerbations of COPD.[56] The physiological benefits of physical activity in heart failure are well reported[57] and is associated with reduced hospital admission and reduced all-cause and cardiovascular mortality in people with heart failure after adjustment for prognostic predictors.[58] Regular physical activity is associated with fewer adverse events in those with both preserved and reduced ejection fraction compared with sedentary groups.[57] In stable asthma, physical activity is not associated with adverse effects or exacerbation of symptoms, and no severe adverse events have been reported.[59–61] However, good asthma control and preventative strategies are important, as bronchospasm can occur.

Cardiac chest pain

The long-term benefits of increasing regular physical activity far outweigh the temporary, slight increased risk of adverse events even in those experiencing exertional chest pain as a result of ischaemic heart disease (angina). This risk increases with advancing age and exercise intensity, but overall remains very low. People should be counselled individually to gradually increase physical activity, taking into account severity of symptoms and fear of cardiac chest pain. Exercise is a good treatment option for stable angina to stimulate angiogenesis. However, increasing frequency and severity of angina should prompt a medical review with no further increase in physical activity.

In the 6 weeks after an acute cardiac event or cardiac surgery, all physical activity advice should be delivered by specialist services and outside of this document's scope. There is an increased risk of an acute cardiac event in previously sedentary individuals with known cardiovascular disease who undertake unaccustomed vigorous intensity exercise. The increased risk is present both during the activity and for 1–2 hours afterwards. However, the absolute risk of a cardiovascular event during physical activity is very low. The incidence of sudden cardiac death has been reported as 1 in every 1.5 million episodes of vigorous physical activity in men[62] and every 36.5 million hours of moderate/vigorous exertion in women.[63] Reports suggest a 6–17 times increased risk of non-fatal acute myocardial infarction and sudden cardiac death during vigorous-intensity physical activity, compared with being sedentary.[62 64] This risk reduces as physical activity levels are increased and cardiovascular fitness improves.[65] It is essential that levels of physical activity are increased gradually.

Until controlled by appropriate medical management absolute contraindications to physical activity include recent acute cardiac event or ECG changes suggesting significant ischaemia, unstable angina, uncontrolled dysrhythmia causing symptoms or haemodynamic compromise, severe symptomatic aortic stenosis, acute pulmonary embolus or pulmonary infarction, acute myocarditis or pericarditis, suspected or known dissecting aneurysm and acute systemic infection.[66]

Palpitations

An increased awareness of the heartbeat is normal during physical activity but can be frightening. Physical activity is contraindicated in people with symptomatic and untreated cardiac tachy-arrhythmia or brady-arrhythmia. Appropriate medical management should be established prior to recommending physical activity. Individuals with controlled atrial fibrillation (AF) benefit from regular physical activity, which should be started gradually.

With any perception of sudden onset or unusual change in heart rate, individuals should review how they are feeling and consider slowing down or pausing activity to let this settle. Physical activity can have a positive impact on AF both before and after its onset, although the optimal recommended physical activity prescription has not yet been defined.[67] Regular physical activity is associated with a lower risk of all-cause mortality in patients with AF, with no serious adverse events reported.[68 69]

Dysglycaemia

The benefits of physical activity outweigh the risks in both type 1 and type 2 diabetes. There is a risk of short-term dysglycaemia with physical activity. Hypoglycaemia is the most common adverse event associated with physical activity in people with any form of diabetes treated with insulin or insulin secretagogues. This can be recurrent if not managed appropriately. Guidelines are available to help reduce the risk of hypoglycaemia. Evidence suggests that the overall risk of severe hypoglycaemia is not increased in those who are more physically active. People with diabetes should be made aware that high intensity physical activity can cause a rise in blood glucose and offered strategies to combat this.

People with type 1 or type 2 diabetes should not start physical activity if they feel unwell or have had an episode of hypoglycaemia within the previous 24 hours.[70]

Type 1 diabetes

Hypoglycaemia is rare but reported as an important adverse event.[71–73] People should have their blood glucose monitor with them and be vigilant with monitoring, carry diabetes identification and have a carbohydrate available.[74] There may be increased risk of hypoglycaemia for 24 hours after exercise including risk of nocturnal hypoglycaemia, especially with afternoon activity.[75] People should not start physical activity while ketones are abnormal, and the underlying cause should be found.[76] Ketones may rise in endurance exercise, without a significant rise in serum glucose. After vigorous physical activity, hyperglycaemia may occur, so caution regarding overcorrection (potentially leading to hypoglycaemia) is required. Those with advanced neuropathy, autonomic dysfunction, end-stage renal failure or severe proliferative/non-proliferative retinopathy may require specialist advice.

Type 2 diabetes

There are very few contraindications to physical activity in people with type 2 diabetes.[77] Coexisting comorbidities should be considered. People taking insulin or insulin secretagogues have an increased risk of hypoglycaemia with physical activity. No significant adverse effects were reported in a systematic review of randomised controlled trials in people with type 2 diabetes undertaking physical activity interventions (aerobic, fitness or progressive resistance training) compared with inactive control groups.[78] Minor adverse events include MSK symptoms and skin irritation.[79] While those with peripheral neuropathy should be closely monitored for complications, they are no longer advised to avoid weight-bearing activities.[80] Risk of skin breakdown should be considered, and well-fitted footwear that distributes load evenly is beneficial.[79] No increased risk of falls, pain or neuropathic symptoms has been demonstrated in individuals with diabetic peripheral neuropathy undertaking weight-bearing activities.

Cognitive impairment

The benefits of physical activity in people with cognitive impairment far outweigh the associated risks. Strategies to maintain motivation, engagement and safety are important and people will often benefit from support from others. Strategies should consider level of function, stage of disease, communication ability (including visual and hearing impairment), preferred environment, risk of falling and other health conditions.

Reports of serious adverse effects in physical activity intervention studies are rare in people with cognitive impairment. While most report no serious adverse events,[81 82] others include falls, MSK pain and chest pain after physical activity.[83–85] Despite this, strength and functional training has been associated with reduced risk of falls in those with mild–moderate cognitive impairment.[86] Support and supervision may be required due to cognitive impairment, balance, gait and proprioception,[30 87] so appropriate equipment and safety are important, and participation may be limited by motivation, emotional control, orientation and impaired judgement.

Falls and frailty

Frail, inactive people have much to gain from increasing physical activity levels and building strength and balance, including those with osteoporosis. Even small improvements in strength and balance can reduce a frail individual's risk of falling and improve their confidence. Recommendations for physical activity should be tailored to the functional and cognitive capacity of each individual. This can be further supported by environmental aids and adaptation, such as seated exercise plans, and it may be helpful for physical activity to be accompanied.

Fear of falling is a common concern for both patients and carers, both in the community[88] and in hospitals.[89] Falls are a common cause of morbidity and mortality.[90] Evidence from a recent systematic review demonstrates that physical activity reduced the rate of injuries from falls, including injuries requiring medical care or hospital admission.[91] A large study of physical activity interventions for falls prevention in the community mainly reported non-serious adverse events (commonly MSK) and two serious adverse events.[92] No serious adverse outcomes were reported in a systematic review of falls prevention classes in residential care.[93] Although adverse event reporting in physical activity interventions is highly variable, a systematic review and meta-analysis of frailty management strategies[94] reported that, although physical activity interventions were associated with higher rates of adverse events than other interventions, overall rates of serious adverse events (hospital admission, death, acute myocardial infarction and fracture) were lower. Non-severe events included MSK issues, exacerbation of osteoarthritis, falls, fatigue, skin rash and vertigo.

DISCUSSION

This study aimed to develop, through expert consensus, clear statements about the medical risks of physical activity for people living with LTCs for use by healthcare professionals. Five 'impact statements' conclude that (1) for people living with LTCs, the benefits of physical activity far outweigh the risks, (2) despite the risks being very low, perceived risk is high, (3) person-centred conversations are essential for addressing perceived risk, (4) everybody has their own starting point and (5) people should stop and seek medical attention if they experience a dramatic increase in symptoms. In addition, eight symptom/syndrome-based statements discuss specific risks for MSK pain, fatigue, shortness of breath, cardiac chest pain, palpitations, dysglycaemia, cognitive impairment and falls and frailty.

Previous recommendations around the risk of prescribing physical activity in clinical practice have focused on cardiovascular risk, including the risk of sudden death.[65 95–98] This risk is low in both the general population and people living with LTCs, although the latter is less well described.[62 63 99 100] Despite this, fear of adverse events and worsening symptoms remains a significant barrier for people with LTCs to building self-efficacy and initiating successful behavioural change.[5 6 101]

Preparticipation algorithms aim to help risk stratification and improve continuity between the health and physical activity and sports sectors.[96–98 102] However, substantial limitations exist to the utility and effectiveness of preparticipation screening tools in the effort to balance appropriate risk identification and avoid excessive physician referrals.[66 103] Since the risk of sudden death and serious adverse events to inactive people is minimal if physical activity is initiated at an appropriate level and then increased gradually,[65 95 100] we support the WHO recommendation that routine medical screening of people with LTCs is unnecessary.[8] In the event that individuals present to healthcare professionals with symptomatic concerns, successful behavioural change is unlikely unless they feel their particular concerns have been adequately addressed.[29]

A challenge for this study is that the risk of physical activity-related adverse events in people living with LTCs is seldom reported and poorly quantified. Much of the relevant literature is condition-specific, addressing the benefits of physical activity and heterogeneously reporting adverse events as secondary outcomes.[100] The relationship between risk and clinical symptoms or syndromes is not transparent, so expert clinical consensus has been relied on to interpret this data. A limitation in the scope of this statement is that the list of medical conditions covered is not exhaustive. For instance, we do not include chronic fatigue syndrome and long COVID-19 since evidence on physical activity risk is limited and actively evolving in these areas. We cannot be sure that our symptom-specific statements translate effectively to clinical practice and subsequently to people living with these conditions. This is an important area for future research. Identifying safe and scalable strategies in healthcare to support sustainable behavioural change in the day-to-day lives of inactive people with LTCs will be a powerful asset to population approaches on physical activity.[1]

Operationalising effective physical activity advice in routine healthcare is a challenge in the UK and other parts of the world.[104 105] Despite a willingness from patients to receive advice from trusted healthcare professionals,[106] support

for patients around physical activity in preventing and managing LTCs remains inadequate.[107] Although healthcare professionals generally feel physical activity is important, a disparity is observed between intentions to engage people with LTCs in conversations on physical activity and confidence in their skills and knowledge.[108–110] This consensus statement will help support healthcare professional uncertainty on specific physical activity advice around risk for particular LTCs.[111 112] Providing succinct information in an accessible format will support time-sensitive conversations in clinical practice.[109 111 113] To support this aim and improve dissemination and accessibility, we will present our results in an open-access interactive format on the 'Moving Medicine' initiative website.[104 114 115] This website hosts a range of practical, person-centred consultation tools to support healthcare professionals having conversations on physical activity with people living with LTCs in clinical practice. This approach is in keeping with the WHO recommendation to deliver 'practice-based evidence' to narrow the gap between research and impactful public health initiatives.[116]

In England, this consensus statement forms part of a broader programme of work led by Sport England, Public Health England and the Royal College of General Practitioners and wider partners to improve the physical activity experience for people living with LTCs. Sport England will, in collaboration with others, explore how this consensus statement can support the removal of systemic physical activity barriers for people living with LTC's. This includes encouraging discussions with a range of partners, including the physical activity and leisure sector insurers, and supporting a review of preparticipation protocols used by health, physical activity and sport partners, including the need for medical clearance. In addition, FSEM, Sport England and the Richmond Group of Charities, alongside others, will work together to consider how we use the statements to challenge patient's perceptions about risk and physical activity including evolving them into public-facing resources that empower people's decision making and connect to wider support.

We recommend research and evaluation into the feasibility, acceptability and efficacy of implementing these statements in healthcare. Can these statements improve the knowledge and confidence of healthcare professionals to empower people with the knowledge of what symptomatic change requires medical attention? Subsequently, understanding how best to promote cross-sector integration to remove systemic barriers to physical activity participation for people living with LTCs is critical to population-wide success. We welcome further research into conditions not covered in this study and call for routine reporting of risk and adverse events in all physical activity studies of people living with LTCs.

CONCLUSION

For people living with stable LTCs, the far-reaching benefits of physical activity outweigh associated risks. We present five headline and eight symptom/syndrome specific statements to help healthcare professionals talk to people living with LTCs to address the commonly perceived fear of adverse events on an individualised basis.

We challenge recommendations that individuals with stable LTCs require medical clearance before autonomously increasing their physical activity levels. We suggest that routine preparticipation screening in this group poses an unnecessary barrier to self-directed physical activity and engagement with the physical activity, sport and leisure sectors. Our findings suggest that the need for medical guidance, as opposed to clearance, should be determined by individuals with specific concerns about active symptoms.

In isolation, better support from healthcare practitioners will not be enough to make substantial change to the physical activity levels of people with LTCs. We call for healthcare and related sectors to work together to provide continuity of advice and support through clear and consistent messaging. This consensus statement provides a starting point for developing a common language around the specific issue of risk from physical activity.

Correction notice This paper has been corrected since it was published online. Figure 2 has been replaced with an updated version and the Editor's note has also been replaced and collaborators statement updated.

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Contributors NJ and HR conceptualised, planned and led the delivery of this consensus statement. NJ led stakeholder engagement. PK and SAT delivered the rapid evidence review. AJR led the translation of the rapid review into symptom-based evidence statements. HR and AJR led the Delphi study. NJ and HR led the infographic development. All authors contributed to the write-up of this manuscript.

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Supplementary file 1. Rapid evidence review

SUMMARY OF EVIDENCE REVIEW PROCESS

A rapid review of the literature was done to establish what is known about the risks of physical activity (PA) and exercise in people with long-term conditions (LTCs). This was presented to the steering group during the consultation phase. Once the symptom-based approach and clinical priorities for the consensus statement were established by the steering group, this review was used in the creation of the symptom-specific evidence statements.

AIMS OF EVIDENCE REVIEW

Provide an overview of existing guidelines and/or recommendations that address the risks of PA for people with long-term conditions, including:

1. What has previously been done to understand the associated risks?
2. What conclusions or consensus were reached?
3. How were conclusions or consensus reached?

Where possible, and using the findings from Aim 1, summarise the nature and incidence of recognised risks (morbidity and mortality) from physical activity by long-term conditions.

METHODS

The approach adopted for this review was a Rapid Evidence Review. This reflected both the nature of the question, and the time and resources available.

In terms of selecting relevant literature the following AGREE II criteria were used:

- Target population: adults (18-64 years) and older adults (65 years+), patients with one or more chronic condition undertaking physical activity;
- Study designs: position statements', 'consensus statements', 'guidelines' and 'recommendations';
- Comparisons: not applicable;
- Outcomes: quantified or qualified risks of physical activity;
- Language: Available in English;
- Context: not applicable.

The online search was conducted in September-October 2019 using four major databases including PubMed, Google Scholar, Scopus and Web of Science. The chronic conditions listed on the Moving Medicine website were used as search terms, and included: 'cancer', 'COPD' ('chronic obstructive pulmonary disease'), 'dementia', 'depression', 'falls' and 'frailty', 'inflammatory rheumatic disease', 'ischaemic heart disease', 'musculoskeletal pain', 'type 2 diabetes mellitus'. Additional search terms including 'mental health', 'rheumatoid arthritis', 'heart disease' and 'cardiovascular disease' were used to ensure that publications were not excluded due to different nomenclature used in different countries.

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Furthermore, the search also included conditions/symptoms that are typically associated with the chronic conditions listed on the Moving Medicine website; including 'Parkinson's disease', 'Alzheimer's disease', 'osteoarthritis', 'high blood pressure', 'hypertension', 'obesity', 'lower back pain'. The search terms 'adults' and 'older adults' were used to assess risk of physical activity under the heading of 'primary prevention'. Papers that reported on children and adolescents exclusively were excluded, as well as publications that exclusively covered conditions including fibromyalgia, HIV/AIDs and palliative care.

The search was targeted to 'position statements', 'consensus statements', 'guidelines' and 'recommendations' regarding PA and exercise prescription within each condition mentioned above. Search statements used (though not limited to) included: 'position statement on physical activity in (*insert condition*)', 'risks associated with being physically active', 'risks with physical activity prescription', 'risks with exercise prescription', 'practical considerations exercise prescription in (*insert condition*)' and 'consensus on the risks associated with physical activity'.

For publications where an academic body or organisation (such as the American Diabetes Association, ADA; or American College of Sports Medicine, ACSM) had more than one guideline or position statement, the most recent version was used.

In addition to the search for peer-reviewed publications and towards the end of the review process, an additional search for foundations, charities, and organisations that provide PA guidance for people with chronic conditions in the United Kingdom (UK) was conducted. Search statements for this component of the review process included, but were not limited to, statements such as '(*insert condition*) and physical activity UK', exercise and (*insert condition*) UK' and 'exercise prescription in (*insert condition*) UK'. It is important to note that the organisations and foundations identified in this component of the search process do not always give recommendations or discuss risk based on sound scientific evidence. For this reason, the results of this search are kept separate from the results generated from the primary search described above.

SUMMARY OF RESULTS

The findings of this rapid review suggest that there are condition-specific risks associated with the prescription of PA and/or exercise. However, these risks are outweighed by the benefits of PA for all conditions covered by this review. There is variability between conditions in terms of what has been done, and the specificity of recommendations or guidance.

The evidence is supportive of good prescription practice that involves a patient-centred approach, whereby PA and exercise prescription is tailored to the needs of the patient. A patient-centred approach can be demonstrated in several ways, such as:

- Knowing if and when supervised PA/exercise is required;
- Understanding the condition of the patient according to their symptoms, and not according to their diagnosis or disease exclusively;
- Considering the level of function of a patient according to their physical capabilities within their disease, and not according to their disease exclusively.

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RESULTS IN RESPONSE TO AIMS

a) What has previously been done to understand the associated risks of physical activity in people with long-term conditions?

Seventy-nine relevant reports (reviews, consensus statements, position statements or guidelines) from around the globe were identified as relevant to this question. An overview of the work reviewed is shown in Table 1. It is worth noting that several references consider more than one condition. An overview of the search for foundations and/or organisations that provide PA guidance for people with chronic conditions is also shown in Table 1.

The majority of reports screened for this review primarily emphasise and report on the benefits of PA and/or exercise, and only some addressed the associated risks. When risks are addressed, (i) they are treated as secondary to the benefits; and (ii) they are not always specific to the condition in question.[1]

b) What conclusions or consensus were reached?

When risk is reported, it is discussed in one of three main ways:

1. The risks of PA are weighed against benefits, and the benefits of PA are usually stated to be greater than any potential risks;
2. Generic risks of PA or exercise-induced injury, that would also apply to a healthy population, are reported more often than condition specific risks;[2]
3. The risks of PA are addressed in a way that is not necessarily backed by empirical scientific evidence, but rather using a 'common sense' approach.

Specific risks and considerations as outlined in the various documents are summarised by condition in Table 1.

c) How were conclusions or consensus reached?

For the publications and documents included in this review, conclusions and consensus has been reached in the following ways:

1. For review papers (where recommendations are made following the either systematic or non-systematic review of evidence) the statements are "evidence based" though not always condition specific;
2. For consensus statements, position statements or guidelines, the consensus has been reached following panel discussions. The panels are either made up of medical professionals/clinicians, researchers/academics or a combination. No statements based on Delphi methods have been identified in this review;
3. For some publications including guidelines and position statements, the conclusion has been drawn based on expert opinions. These experts are professionals/clinicians, researchers/academics or a combination

Table 1: Overview of literature reviewed and findings, shown by disease.

Condition and references	Summary of findings	Additional PA considerations	Relevant UK Organisations
Cancer [3–13]	There is no evidence to suggest that PA may worsen the condition of an individual with cancer or undergoing cancer treatment. The risks associated with cancer largely depend on the type and site of cancer (e.g., physical activity following a surgery close to the arms may need to be adjusted). Overall, individuals with cancer are encouraged to exercise as tolerated, and to pay attention to signs/symptoms and the state of their immune system. Specific signs/symptoms or considerations to be aware of include lymphoedema, pain, and chemotherapy-induced peripheral neuropathy. Exercising while supervised may be required.	-Presence of lymphoedema -History of surgery -Presence of pain -Presence of chemotherapy-induced peripheral neuropathy -Be aware of the area affected by the cancer – particularly for bone cancer (for risk of fracture) -Exercise as tolerated (presence of signs/symptoms and state of immune system is particularly important) -Supervision may be required	-Cancer Research UK Exercise Guidelines -The BASES Expert Statement on Exercise and Cancer Survivorship -MacMillan Cancer Support Guidance -NHS – Guys and Thomas -Pancreatic Cancer UK Information and Support -Prostate Cancer UK Guidance -Lymphoma Action UK Guidance -Breast Cancer Now Information
COPD [3,4,6,7,14–21]	An important consideration for patients with COPD is the severity of the condition. As the severity of the condition increases, the level of risk increases. For high-risk, symptomatic COPD patients, PA should be replaced with pulmonary rehabilitation, in which case supervision may be required. There is evidence that PA should be avoided due to increased risk in COPD patients during an infective episode or if the patient is in the immediate recovery phase of an exacerbation. If a COPD patient exercises as tolerated and in a manner that is tailored to their condition, and in an environment that is not polluted, there is no evidence to suggest that PA may worsen the condition of an individual with COPD.	-Timing of exacerbations -Risk of infections -Co-morbidities -Exercise as tolerated (presence of symptoms is particularly important) -Supervision may be required -Prescription of exercise should be tailored	-British Lung Foundation Support -NHS Inform Living with COPD
Dementia [3,4,6,7,22–24]	There is no evidence to suggest that PA may worsen the condition of an individual with dementia. However, exercise and/or PA should be made safer for individuals with dementia, as these individuals tend to have issues related to forgetfulness, balance, gait, and proprioception. Furthermore, these issues can worsen as the disease progresses and therefore the stage of the disease is an important consideration. Prescription of PA should be tailored to the needs of the individual and should be supervised when needed.	-Forgetfulness during activities -Safety related to balance, gait and proprioception -Stage of the disease is important -Tailored prescription as per the needs of an older adults (where applicable -Supervision may be required	-Alzeimer's Society United Against Dementia Guidance -Department of Health: 'Nothing Ventured, Nothing Gained': Risk guidance for people with dementia

Depression [6,7,25–29]	There is evidence that a low risk of 'physical activity dependence' exists in the general population, and this risk may be somewhat higher for people with depression. However, this is extremely rare overall. There is also evidence that PA should not be prescribed to an underweight depressed individual as there is a potential link with disordered eating. Provided that an individual with depression exercises or is physically active in an environment or setting that is not related to the source or trigger of the depression (e.g., avoiding group activities for someone with social phobia) and is not underweight due to an eating disorder, there is no evidence to suggest that PA may worsen the depressive condition of an individual with depression.	-Source of depression (linked to self-esteem and also eating disorders) -Link timing of PA and exercise to depressive symptoms -Exercise dependence (and therefore a negative motivation)	-Mind Tips -Mental Health Foundation Guidance
Falls and Frailty [3,4,16,30–37]	There is evidence that anyone who exercises or engages in PA incurs some risk for an adverse event (including a fall with fracture), but this is at any age. Exercise and PA prescription should be tailored according to the individual's physical condition, level of function and presence of other disease(s) or disability. Supervision may be required for some individuals, and risk may be attenuated by making exercise and/or PA safe through changes to the home environment, selecting appropriate exercise equipment and footwear.	-Exercise (in general) increases acute risk of falls (and potentially fractures) -Presence of other diseases (Multi-morbidity) -Older adulthood is a special consideration and level of function is important -Supervision may be required -Safety (in terms of the home, exercise equipment and footwear) should be considered.	-Age UK guidance for older adults and guidance for falls prevention -National Osteoporosis Society / Royal Osteoporosis Society and British Geriatrics Society Consensus statement
Inflammatory Rheumatic Disease [3,4,6,16,38–42]	There is risk of harming a joint if improper technique is used when stretching, exercising and being physically active, especially if there is existing inflammation. In this regard, supervision may be required. Exercise and/or PA should be tailored according to the individual's physical condition (including the weight status of the patient), level of disability, the degree of pain and inflammation present in the joints needing exercise, as well as the personal preference of the patient. Another potential consideration is that of drug therapy (and the interactions with PA). It is necessary for post-exercise discomfort and pain to inform following exercise sessions. While some muscle soreness (or stiffness) is expected for an individual who is untrained, prescription should change if symptoms of the disease worsen.	-Supervision may be required -Presence of joint pain -Footwear is potentially important -Tailor exercise as per the needs and preference of patient, as well as disease activity (inflammation) -Be aware of medications and interactions with PA -Discomfort and pain post-exercise is important to inform following exercise sessions -Overweight or obesity may limit choice of PA/exercise	-National Rheumatoid Arthritis Society Guidance -ARMA: Arthritis and Musculoskeletal Alliance Guidance -Versus Arthritis, Arthritis Research UK Policy Position

Ischaemic Heart Disease [3,4,6,7,16,43–49]	Supervision during exercise and/or PA is recommended for patients with heart disease, especially higher-risk patients, who may also require monitoring throughout their PA and/or exercise. It is important to be aware of medications and the interactions with PA (e.g., beta-blockers attenuate heart rate response). Hypertensive patients should avoid the Valsalva manoeuvre during resistance training, and exercise should be avoided in the case of systolic BP >180 mmHg and/or diastolic BP >105 mmHg. There is evidence that anyone who exercises or engages in PA incurs some risk for an adverse event. However, the evidence suggests that it is unlikely that a cardiac event that occurs during or soon after exercise is because of the exercise. Rather, it is likely that the individual had an underlying condition that was exacerbated by exercise. Exceeding the recommended dose of exercise or PA may increase the risk for recurrent cardiovascular events. Provided that a heart disease patient exercises within their limitations and are risk-stratified correctly, there is no evidence to suggest that PA may worsen the condition of an individual with heart disease.	-Supervision is recommended -Acute risk of adverse event -Higher-risk patients need supervision and monitoring -Be aware of medications and interactions with PA -Presence of other diseases and conditions (particularly hypertension and obesity) -Hypertensive patients should avoid the Valsalva manoeuvre during resistance training. Exercise to be avoided in the case of systolic BP >180 mmHg or diastolic BP >105 mmHg	-Heart UK (Cholesterol Society) Guidance -Cardiomyopathy UK Guidance -British Heart Foundation Information
Musculo-skeletal pain [3,4,6,7,16,50–53]	For lower back pain specifically, it is important to determine whether the pain is acute or chronic. Thus, obtaining an accurate diagnosis is important before prescribing exercise or PA. Exercise should not be prescribed for individuals with acute lower back pain. Abdominal bracing may cause further harm in some back conditions and is therefore not recommended. Walking downhill may aggravate symptoms in individuals with spinal stenosis. For individuals with other forms of musculoskeletal pain, the evidence suggests that appropriate PA (that is tailored to the individual) is unlikely to cause harm.	-Differences between pain that is acute vs. chronic. Exercise not always indicated for acute back pain. Diagnosis is important before prescribing exercise or PA -Tailored prescription of exercise -Abdominal bracing may cause further harm in some back conditions -Walking downhill may aggravate symptoms in individuals with spinal stenosis. -Risk of increasing damage -Risk of increasing pain	-ARMA: Arthritis and Musculoskeletal Alliance Guidance -Versus Arthritis, Arthritis Research UK Policy Position
Type 2 Diabetes [3,4,6,16,44,54–63]	For type 2 diabetic patients, supervision is recommended depending on symptom severity. Tailored PA and/or exercise prescription is necessary. The evidence suggests that diabetic individuals with neuropathy (autonomic and peripheral) and retinopathy may be at an increased risk of injury during PA and/or	-Supervision is recommended -Tailored prescription necessary -Presence of peripheral neuropathy (footwear is important in this regard) -Presence of autonomic neuropathy	-Diabetes UK Guidance -My Diabetes, My Way Scotland NHS Guidance

	exercise. For patients presenting with retinopathy, the Valsalva manoeuvre during resistance training, and high-impact vigorous exercise, should be avoided. Footwear is important for diabetic patients. Additionally, diabetic individuals with poorly controlled glycaemia may need to modify their PA and exercise, as well as note their carbohydrate intake. Patients with diabetes are often overweight or obese and so it is important to note the presence of other diseases, and to also be aware of prescribed medications. Provided that a patient with diabetes is examined effectively (to determine the optimal dose when weighing risks versus benefits, e.g., running may be better for biological outcomes but may increase risk of injury), there is no evidence to suggest that PA may worsen the diabetic condition of an individual.	-Presence of retinopathy (patients should avoid the Valsalva manoeuvre during resistance training, and high-impact vigorous exercise) -Risk of hypo- and hyper-glycaemia -Be aware of medications and interactions with PA (also note carbohydrate intake) -Presence of other diseases and conditions (particularly obesity)	
Primary Prevention [1–3,64–77]	For adults and older adults that are 'apparently healthy', there is an acute risk of adverse event during vigorous exercise. There is also a general risk of (musculoskeletal) injury during vigorous activity for all healthy people, and this is reduced by proper warming-up, stretching, strength training, and balance training. It is important to note that the risk of injury is relative to the size of the increase in PA and that older age, as well as previous injury, increases risk of further injury. There is evidence that there is an attenuation (and perhaps a reversal) of benefits in the case of too much PA is a risk. However, "too much" is defined as being at the extreme of the PA continuum (e.g., people who participate in ultra-endurance events and who reserve little time for adequate rest).	-Acute risk of adverse event during vigorous exercise -General risk of injury (musculoskeletal injury) for all healthy people exists. Reduced by warming-up, stretching, strength training, and balance training. The risk of injury is related to the size of the increase in activity. -Previous injury increases risk of further injury -In older adults, risk of injury is increased (by comparison to adults due to limited functional ability, previous inactivity, previous illness) -Too much PA is a risk: there is an attenuation (and perhaps a reversal) of benefits at the extreme of the PA continuum (people who participate in ultra-endurance events and/or reserve little time for adequate rest)	-
Multi morbidity [6,78]		-Tailored prescription necessary -Be aware of any competing diseases.	-

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Supplementary file 2. List of contributors by group

Authorship group (n=5)

Name	Institution	Role
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Stakeholder group (n=4)

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Sarah Ruane	Sport England	Strategic Health Lead
Dr Mike Brannan/Mr Jamie Blackshaw	Public Health England	National Leads for Diet, Obesity and Physical Activity
Dr Andrew Boyd	Royal College of General Practitioners, Clapham Park Group practice	GP Partner and RCGP Clinical Priority Champion, physical activity & lifestyle

PHYSICAL ACTIVITY RISK CONSENSUS GROUP MEMBERS

Steering Group (n=13)

Name	Role	Institution
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Muir Gray	Consultant in Public Health	The Optimal Ageing Programme	Consultant in Public Health providing knowledge to support our aging population to live better via www.livelongerbetter.net. Additional special interest in teenagers with long term conditions.
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Paula Manning	Physiotherapist	Derbyshire Healthcare NHS Trust	Physiotherapist, working in mental health inpatients hospital and as a Physical Activity Clinical Champion for PHE, delivering free training to HCPs to encourage themselves and their patients to be more physically active.

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Scarlett McNally	Consultant Orthopaedic Surgeon, Deputy Director of the Centre for Perioperative Care	Eastbourne District General Hospital	Consultant Orthopaedic Surgeon, Eastbourne D.G.H. since 2002. Elected council member of the Royal College of Surgeons of England, 2011-21. Lead author of 'Exercise the miracle cure and the role of the doctor in promoting it'. Other published work on the link with the economy and social care – we need environments and expectations to change to support everybody to be more active which would reduce need for social care (and improve mental and physical health). Deputy Director of the Centre for Perioperative Care (www.cpoc.org.uk aimed at getting people fitterbettersooner around an operation). Papers on www.scarlettmcnally.co.uk. Twitter @scarlettmcnally
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Rebecca Appelboam	Consultant in Intensive Care Medicine	Royal Devon and Exeter NHS Foundation Trust	Consultant in Intensive Care Medicine, involved in the follow up of survivors of intensive care in multidisciplinary clinics which patients are invited to 3 months after discharge from hospital. We tackle the psychological cognitive, and physical deficits that survivors experience, and provide support and advice to aid rehabilitation
Diana Greenfield	Consultant Nurse in Late Effects (of cancer treatments) and Honorary Professor in Cancer Survivorship	Consultant Nurse at Sheffield Teaching Hospital, Honorary Professor of The University of Sheffield	Consultant Nurse in Late Effects (of cancer treatments) and Honorary Prof in Cancer Survivorship. Diana Greenfield is a National Institute for Health Research (NIHR) Senior Nurse Research Leader. The views expressed in this article are those of the author and not necessarily those of the NIHR, or the Department of Health and Social Care.
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Julia Newton	Clinical Academic and Consultant in Rheumatology/Sport and Exercise Medicine	Oxford University Hospitals NHS Foundation Trust	Clinical Academic and Consultant in Rheumatology/Sport and Exercise Medicine
Sally Retallick	Lead nurse in Weald PCN	West Kent Health NHS	Practice Nurse in West Kent caring for a range of patients including those with long term conditions. Lead nurse in Weald PCN and Physical Activity Clinical Champion for PHE, delivering free training to HCPs to encourage themselves and their patients to be more physically active.
Andrew Murray	GP and Consultant in Sport and Exercise Medicine	The University of Edinburgh	GP and Consultant in SEM. Previous employment working full time in Public Health policy (Scottish Government). Current Vice-President Ramblers Scotland.
James Hull	Consultant respiratory physician	Royal Brompton & Harefield Hospitals Specialist Care	Consultant Respiratory physician with expertise in asthma, chronic lung disease and impact of exercise in this context
Marie Murphy	Professor of Exercise and Health, Dean of Postgraduate Research and Director of the Ulster Doctoral College.	Ulster University	Professor of Exercise and Health, Dean of Postgraduate Research and Director of the Ulster Doctoral College. Marie's research focuses on the effect of physical activity and exercise, in particular walking, on health and uses multidisciplinary approach that has included outcome measures ranging from the behavioural to the biochemical.
Tracy Barnett	Lead Physiotherapist, Physical Activity Pilot	Oxford University Hospitals NHS Foundation Trust	Senior Physiotherapist with a particular interest in neuro-rehabilitation. Physical Activity Champion for the Active Hospital Project at Oxford University Hospitals Foundation Trust. The project was commissioned by Public Health England to explore ways in which physical activity could be embedded into pathways in secondary care. Extensive work within Frailty pathways as part of this project.
Neil Heron	Consultant in Sport and Exercise Medicine; GP; Clinical Lecturer	Queen's University Belfast	Consultant in Sport and Exercise Medicine; GP; Clinical Lecturer with expertise in physical activity promotion.

Amit Mistry	Consultant in General Adult & Old Age Psychiatry; Honorary Lecturer	Oxford Health NHS Foundation Trust, Queen Mary University of London	General Adult and Old Age Psychiatry and Sports Psychiatry. Chair of the Royal College of Psychiatrists (RCPsych) Sport & Exercise Psychiatry Special Interest Group.

Supplementary file 3: Preparatory stage

This supplementary file details the three parts of the preparatory stage (1) practitioner consultation (2) Patient and Public Involvement project and (3) national service user survey.

1. PRACTITIONER CONSULTATION

Aim

To gain insight into the concerns and requirements of Healthcare Professionals (HCPs) around advice on risk when talking about Physical Activity (PA) to people living with long term conditions (LTC).

Methods

We distributed an online survey using the commercial Survey Monkey software[1] to two national primary care networks in the UK and the Moving Medicine ambassador network between October-November 2019. The Moving Medicine ambassador network is a network of multidisciplinary HCPs who have expressed an interest in the role of physical activity in the management of long-term conditions. The survey contained six open questions with free-text responses. Two questions collected data about respondent job role and place of work, and four around the perception and experience of risk when discussing physical activity with patients. The survey was tested with two HCPs not involved in the project prior to distribution. Responses were analysed through thematic analysis.

Results

57 responses were received (Doctor 42%, Physiotherapist 33%, Nurse 9%, other 16%). 53% worked in primary care, 28% in secondary care and 19% in other care settings. Responders were asked to select more than one answer for questions 3-6. Leading themes that emerged from the consultation are presented in table 1. Full results are presented in table 2 with subgroup analyses in tables 3 and 4.

Table 1. Summary of leading themes

Question		Theme 1	Theme 2	Theme 3
1	What risks are you concerned about when recommending physical activity to patients	Exacerbation of symptoms, causing complications	Demotivating or 'putting off' the patient	Appropriate recommendation of physical activity, tailored to the individual
2	Have you encountered any specific clinical issues or symptoms, related to physical activity, in your patients with long term conditions?	Psychological motivation, patient willingness to change	Worsening of symptoms	Patient concerns regarding worsening of another pre-existing condition
3	What have your patients with long term conditions asked you about their risks of physical activity?	Concerns about risk of worsening of current symptoms	Concerns regarding perceived barriers due to	General safety and development of new symptoms/ events eg pain/myocardial infarction

			other symptoms	
4	What information/ resources/ other would help you to manage risk in clinical practice, when recommending physical activity to people with long term conditions?	Advice regarding specific long-term conditions and safe prescription of physical activity	General advice to give patients about the benefits of physical activity	Leaflets/Posters/Online Resource/Mobile App for patients

Table 2. All results from practitioner survey

Question	Theme	Rank	Number of comments
1. What risks are you concerned about when recommending physical activity to patients?	Exacerbation of symptoms, causing complications	1	29
	Demotivating or 'putting off' the patient	2	9
	No concerns about risk	3	7
	Appropriate recommendation of physical activity, tailored to the individual	4	6
	Adequate support for the clinician recommending physical activity	5	4
	Patients own ability to be physically active	6	2
	Other[a]	7	1
2. Have you encountered any specific clinical issues or symptoms, related to physical activity, in your patients with long-term conditions?	No issues	1	17
	Psychological motivation, patient willingness to change	2	15
	Worsening of symptoms	3	12
	Patient concerns regarding worsening of another pre-existing condition	4	7
	Other[b]	5	7
	Fatigue	6	3
	Physical activity advice from non-clinical practitioners	7	2
3. Have you encountered any specific clinical issues or symptoms, related to physical activity, in your	No issues	1	17
	Psychological motivation, patient willingness to change	2	15
	Worsening of symptoms	3	12

patients with long-term conditions?	Patient concerns regarding worsening of another pre-existing condition	4	7
	Other[c]	5	7
	Fatigue	6	3
	Physical activity advice from non-clinical practitioners	7	2
4. What have your patients with long-term conditions asked you about their risks of physical activity?	Concerns about risk of worsening of current symptoms	1	21
	No questions from patients	2	17
	Concerns regarding perceived barriers due to other symptoms	3	10
	General safety of physical activity	4	8
	Development of new symptoms or risks[3]	5	4
	Other[d]	6	2
5. What information/resources/other would help you to manage risk in clinical practice, when recommending physical activity to people with long-term conditions?	Advice regarding specific long-term conditions and safe prescription of physical activity	1	15
	General advice to give patients about the benefits of physical activity	2	10
	Leaflets/Posters/Online Resource/Mobile App for patients	3	10
	When to refer to a physical activity specialist	4	5
	Specific guidelines or algorithms for recommendation of physical activity	5	4
	Not required	6	6
	Other[e]	7	6

[a] "fully understanding their individual barriers to exercise"
[b] "minor injury"; "screening tools used to access physical activity"; "people requiring support to get changed, eg for swimming – volunteers don't tend to want to support in this area and cost of carers makes a swimming session prohibitively expensive"; "exercise progression and the ability to access further information"; "improvement in physical fitness that translates into better function, or prolonged function in the face of decline; build friendships, confidence, sleep better etc"; "falls off bikes on roads – fractures clavicle, concussion"; "access to facilities, cost or transport problems"
[c] When stated – "will I have a heart attack"; "death, MI"; "heart attack"; "falls, joint pain"
[d] "can't motivate themselves to do any PA"; "do the risks of being physically active outweigh the risk of staying as I am?"
[e] "I think it would be really useful to understand how to manage symptoms rather than being disease specific. We tend to work in chronic diseases whereas what the patient worries about is the symptoms of the disease, this can be tricky with multi morbidity"; "supervised structured classes with time to make friendships"; "some of my SU's can't read, struggle to understand written messages"; "support from local ambassadors and motivators"; "history taking"; "some generic disclaimer type documents"

Subgroup Analyses

Table 3. Subgroup analysis of concerns around worsening of symptoms

Specific symptom of concern	Number of concerns
Respiratory	6
Musculoskeletal/ joint pain	5
Cardiac[a]	2
Medication related[b]	2
Dizziness	2
Blood glucose control	1
Falls	1
Psychological issues	1
Not specified	1

[a] When specified – hypertension; hypotension; angina
[b] Considerations with antipsychotic medication prescription; fluctuations of heart rate on chemotherapy

Table 4. Subgroup analysis of patient concerns regarding worsening of another pre-existing condition

Condition of concern	Number of concerns
Musculoskeletal/ joint pain	5
Blood glucose control	1
Not specified	1

Conclusion

This survey corroborates published data showing the HCPs feel they lack knowledge and skills to discuss PA with patients with LTCs. HCPs expressed a significant level of concern about discussing PA with people with LTC. Fear of aggravating symptoms was a common concern. Primum, non nocere (first, do no harm) is an important driver of medical practice and fear of conflicting with this was commonly expressed. Further to this HCPs felt that they lacked skills to discuss PA in a constructive way with patients and were concerned that they might demotivate patients further. HCPs highlighted the need for specific resources to help them discuss risk with patients.

2. PATIENT AND PUBLIC INVOLVEMENT

This Patient and Public involvement (PPI) project was undertaken in 2016.[2] Results and insight closely aligned with the objectives of this project and were therefore used to inform the development of this consensus statement.

Aim

To explore service users' views on how the National Health Service (NHS) could better support their needs.

Methods

The PPI team recruited forty participants living with multiple LTC's through hospital-based patient support networks across a range of conditions in the UK. Patients were interviewed either individually or in groups (patient preference) by semi-structured interviews. Interviews were recorded and transcribed and thematic analysis of interview transcripts was carried out.

Results

The participants' age range was 60-92, and the mean age was 74 (SD 7.4). There were four ethnic groups represented. 55% of the participants were female, and 45% were male. The mean number of co-morbidities was 2.85(SD 2.9). The analysis identified that although participants overwhelmingly stated they wanted to become more active, fear of exacerbating the symptoms of health conditions was a major barrier in keeping with published studies examining barriers to PA in multimorbid groups.[3–5] Symptoms of concern included breathlessness, fatigue, muscle weakness and anxiety about falling or 'getting stuck'.

'it is a bit like trusting a parachute; you get up there and trust the silk, you will find the most wonderful thing in the world, but actually doing it is hard'

Participants reported conflicting advice from HCPs about the risk of adverse events from PA.

'they told me I should never bend forward, never'

The following primary themes emerged from qualitative analysis: [2]

- Patients generally present concerns based on their symptoms or syndromes, not their underlying LTC's.
- Continuity of advice and simple messages reduce confusion and are therefore empowering for people living with LTC's.
- Addressing risk is an essential facilitator for people considering increasing their PA levels
- Cross-sector system support is required to improve the experience of inactive people with LTC's starting to become more physically active.

3. NATIONAL CONSULTATION

Stakeholder consultation with Sport England further informed our understanding of patient preferences through a related piece of work in the UK. In 2019, The National Centre for Sport and Exercise Medicine (NCSEM) at Sheffield Hallam University in collaboration with Sport England and RCGP clinical priority group engaged 361 participants in a national online consultation to inform approaches to improving physical activity support for people with LTCs.[6]

A frequently reported barrier to participation in PA initiatives was getting medical 'sign-off' to participate.

> *"People who are fit and healthy are told they need to see their GP prior to being able to exercise and this sends the* wrong *message … Patients who have a health condition but are safe and well managed should not be asked to see their GP."*

Triage processes are often unclear, with a lack of system support for the 'sign-off' process.

> *"…most aren't qualified to assess the risk for an individual of exercising and the current system doesn't give them the confidence to signpost or refer without fear of them being liable"*

People over 50 were more likely to have individual concerns with getting sign-off before participation in PA. Those under 50 emphasised the importance of HCPs having the knowledge, confidence and the right attitudes to have conversations about sport and PA with people with LTC's.

> *"If you have a health condition, it can be difficult to get medical clearance to participate in certain physical activities. Often this requires sign-off from a health professional, for a fee, who may not even feel qualified or confident to do this."*

Finally, our conclusions from our patient and public insight were presented to the Richmond Group of Charities who have done extensive patient facing work in this areas including the 'We are undefeatable' campaign in collaboration with Sport England. The Richmond group confirmed that key themes identified through our consultation process matched commonly held concerns heard reported by their membership groups.

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Supplementary file 4. Delphi survey qualitative feedback

Feedback themes are presented alongside actions taken alongside statement progression

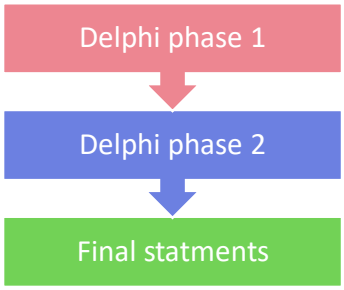
General feedback

Theme	Actions taken
Simplify wording & frame messages more positively	Messages reduced in length, statement wording simplified and standardised. Single sentence 'impact statements' added to headline statements to simplify messages and improve readability.
Reduce medical language	The use of 'patients' has been changed to 'people' or 'individuals'. Medical language simplified, but since this is a medical statement and not aimed at the general public or fitness professionals some medical language remains where it has been felt to provide extra clarity.
Remove the comment that there is 'no evidence' from several of the symptom statements	Wording of symptom statements amended to better reflect the balance of evidence.
Include more about benefits of physical activity in the symptom statements	The benefits of physical activity are not the main focus of this paper, so are not emphasised in this consensus statement.

Feedback on headline messages

Theme	Actions taken
consider order of the messages: start with patient barriers, address these and then describe benefits/what can be offered by healthcare professionals	this was not been changed, as consensus reached – however, bullet point headlines have added as suggested
shorten headlines and then give further information in a paragraph underneath	in response to overarching themes about safety considerations, we are now testing an additional 4th statement (see below) to directly address these concerns in the headline messages

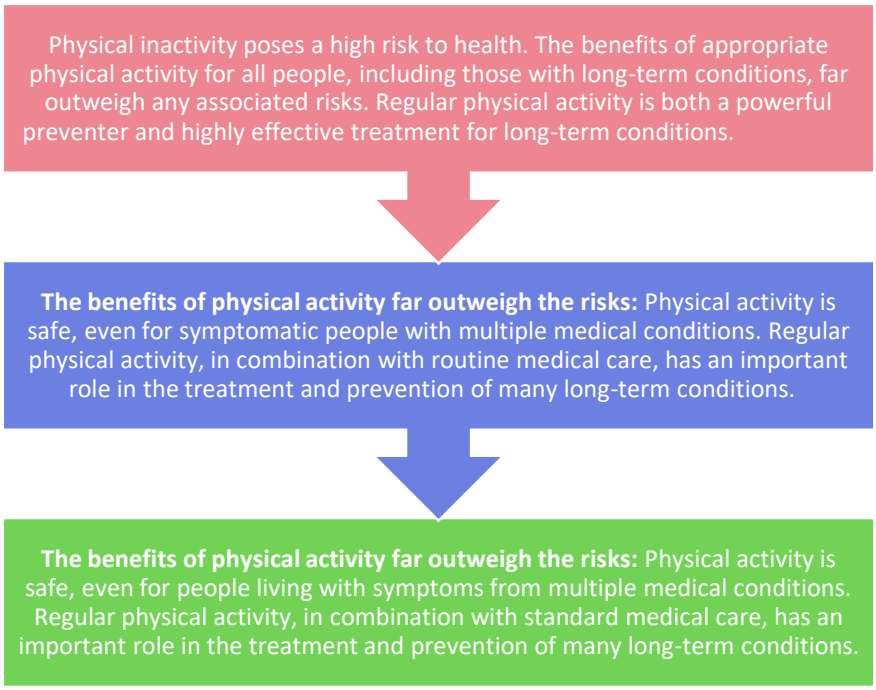
Evolution of each statement is subsequently presented in the following format:



HEADLINE 1

	Feedback themes	Actions taken
Headline Message 1	this message reassures that physical activity is appropriate/beneficial to all	statement simplified to reflect feedback
	simplify language and use physical activity, rather than inactivity	mental health is not specifically included, as this is not commonly reported as a specific risk in physical activity interventions
	some long-term conditions may not be preventable, although physical activity can help in their management	
	include mental health	
	it is important to reassure healthcare professionals that physical activity in those with long-term conditions is not dangerous	
	message reinforces the importance of discussion about physical activity between healthcare providers & those with long-term conditions	

Evolution of statement



HEADLINE 2

	Feedback themes	Actions taken
Headline Message 2	clarify 'tolerance'	statement simplified
	it is important to emphasise that increase in physical activity should be gradual	'tolerance' removed
	simplify language	
	this is a very important message emphasise low risk of physical activity	

Evolution of statement

There is a very low risk of serious adverse events when physical activity is gradually increased, according to tolerance, in symptomatic individuals with long-term conditions. This risk is mitigated by appropriate, well informed conversations between patients and their healthcare provider, and subsequently, where applicable, by patients and physical activity providers.

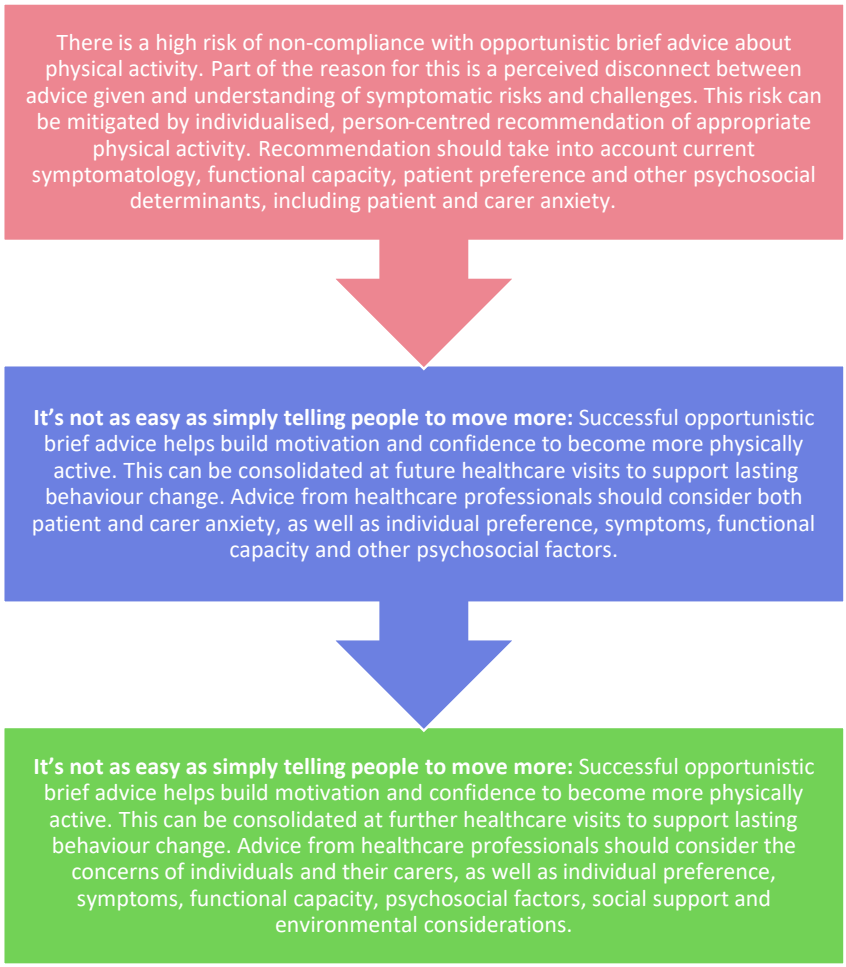
The risk of serious adverse events is very low, but that's not how people feel: People with long-term conditions are often fearful of potential undesired consequences from physical activity. However, when physical activity levels are gradually increased, the risk of serious adverse events is very low indeed. Well informed, person-centred conversations with healthcare professionals can reassure people and further reduce this risk.

The risk of serious adverse events is very low, but that's not how people feel: People with long-term conditions are often fearful of worsening their condition or experiencing potentially undesired consequences from physical activity. In fact, when physical activity levels are increased gradually, the risk of serious adverse events is very low. Well informed, person-centred conversations with healthcare professionals can reassure people and further reduce this risk.

HEADLINE 3

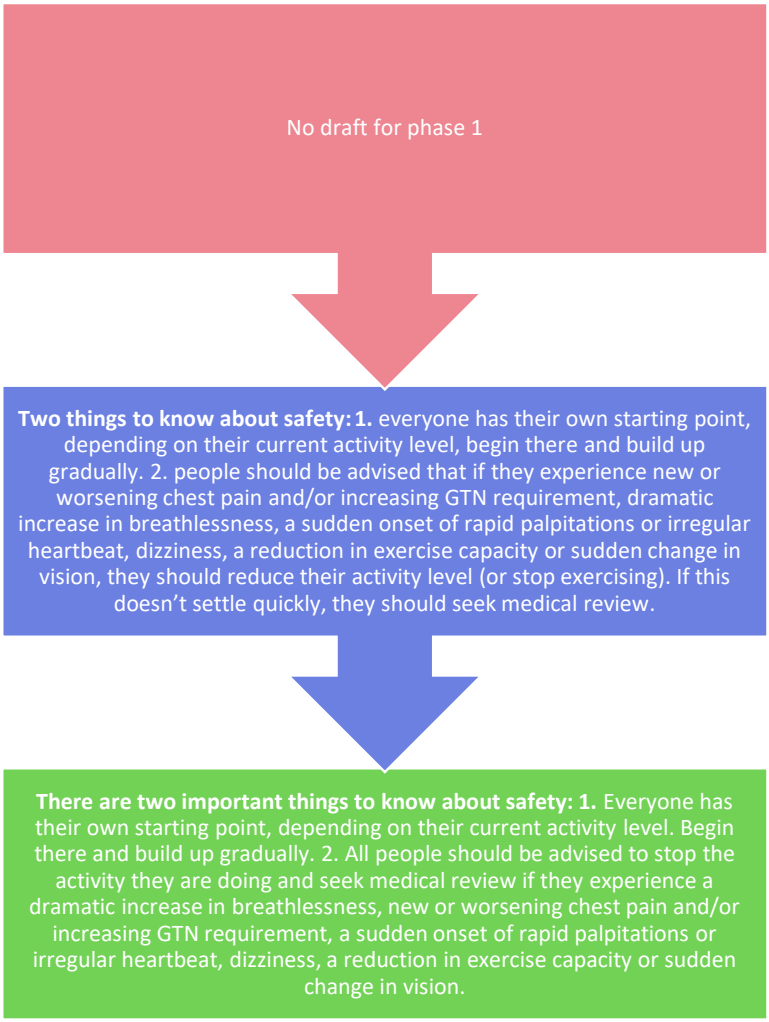
	Feedback themes	Actions taken
Headline 3	avoid use of 'non-compliance'	'non-compliance' removed
	simplify statement	message simplified
	a very important part of the overall message	
	important to emphasise the personalised/individualised aspects of conversations between healthcare professionals & individuals with long-term conditions	

Evolution of statement



HEADLINE 4

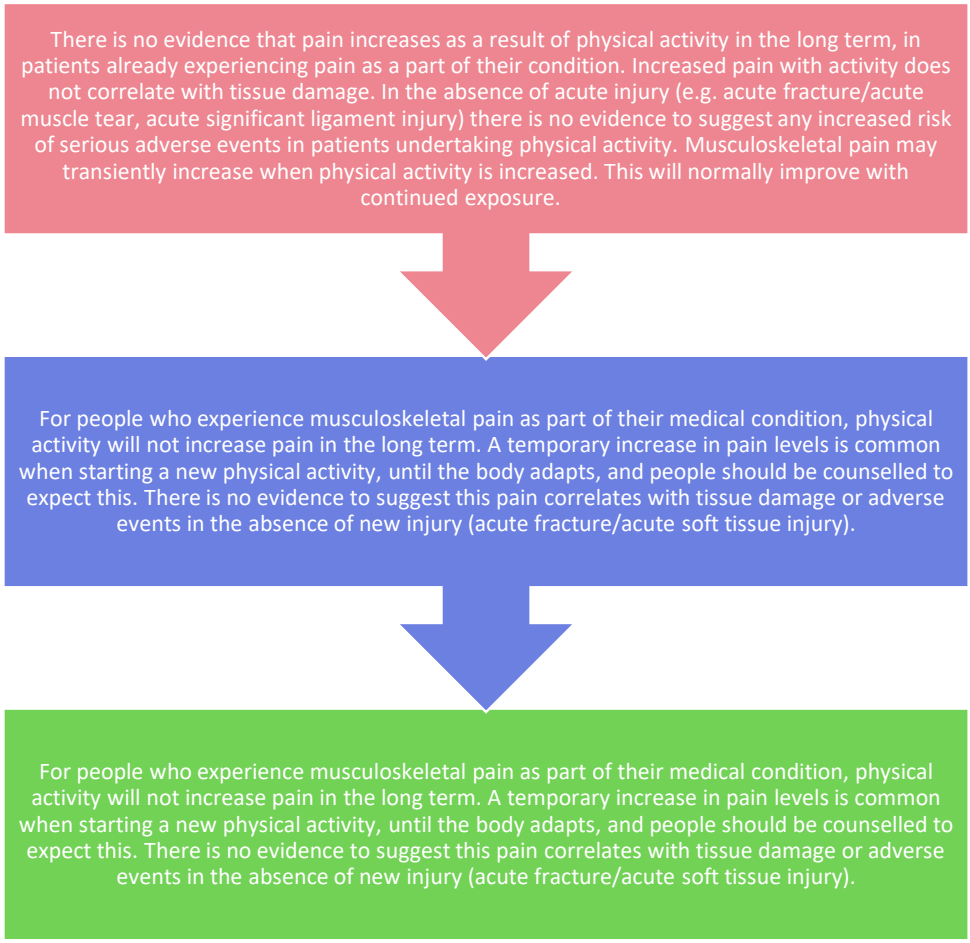
Evolution of statement



MUSCULOSKELETAL PAIN

	Feedback themes	Actions taken
Musculoskeletal Pain	consider bullet points/reduce length of statement	the statement has been adapted to reflect feedback, and simplified to negate the need for bullet points
	emphasise the potential short-term side effects such as increased pain	specific conditions are included in evidence summary
	reconsider use of 'no evidence'	
	Add in specific conditions such as arthritis, back pain, osteoarthritis	

Evolution of statement



FATIGUE

	Feedback themes	Actions taken
Fatigue	emphasise that physical activity can improve sleep, and evidence for reduced fatigue and improved wellbeing/psychological benefits specifically mention cancer-related fatigue & associated factors	cancer related fatigue is listed separately in the supporting evidence section but not separated in headline statement
	ME/CFS patients will feel strongly against this statement	specific reference is included in the supporting evidence about ME/CFS, suggesting that people are directed to specialist services for this group, as published literature is inconclusive

Evolution of statement

There is no evidence to suggest that increasing physical activity causes increasing fatigue in the medium or long term in patients already suffering from fatigue. Some short-lived fatigue is common after increasing physical activity in all populations. Chances of significantly increased fatigue can be reduced by gradually increasing levels of activity.

Appropriate regular physical activity helps reduce fatigue and improves wellbeing and sleep. A temporary increase in fatigue is commonly experienced when starting a new physical activity, until the body adapts. People should be counselled to expect this and advised to build up activity gradually. People experiencing fatigue related to chronic fatigue syndromes may benefit from specialist advice.

Regular physical activity helps reduce fatigue and improves wellbeing and sleep. A temporary increase in fatigue is commonly experienced when starting a new physical activity, until the body adapts. People should be counselled to expect this and advised to build up activity gradually. People experiencing fatigue related to chronic fatigue syndromes may benefit from specialist advice.

SHORTNESS OF BREATH

	Feedback themes	Actions taken
Shortness of Breath	patients should be advised to do what they can, rather than stop being physically active during an exacerbation or hospitalisation	specific disease recommendations have been included in supporting evidence – physical activity risk is sufficiently generic to maintain a symptom-based approach.
	reference the fear that people experience and the psychological impact	safety considerations are now addressed in Headline Statement 4
	distinguish between being physically active and doing physical activities	reference to recognising fear has been included in updated statement
	change 'no evidence' to 'balance of evidence' to improve credibility	the role of pulmonary rehabilitation has been referenced in the evidence statement, but is not within the scope of the symptom statement
	improve safety netting advice for this high-risk group	
	reference pulmonary rehabilitation	

Evolution of statement

There is no evidence to suggest increased risk of adverse events in breathless patients undertaking physical activity programmes. Feeling more breathless than usual is normal with increased physical activity in both patients who are breathless at rest and those who are not. Physical activity should be recommended dependent on severity of symptoms and gradually increased according to tolerance. Patients should be counselled regarding concerning features such as chest pain or dizziness.

It is normal for all people to feel more breathless than usual when increasing their activity level. The balance of evidence suggests that the increased risk of adverse events in breathless people when doing physical activity is very low. People should be counselled individually to gradually increase physical activity, taking into account their severity of symptoms and fear of breathlessness.

It is normal for all people to feel more breathless when increasing their activity level. The balance of evidence suggests that the increased risk of adverse events in breathless people when doing physical activity is very low. People should be counselled individually to gradually increase physical activity, taking into account their severity of symptoms, and fear of breathlessness

CARDIAC CHEST PAIN

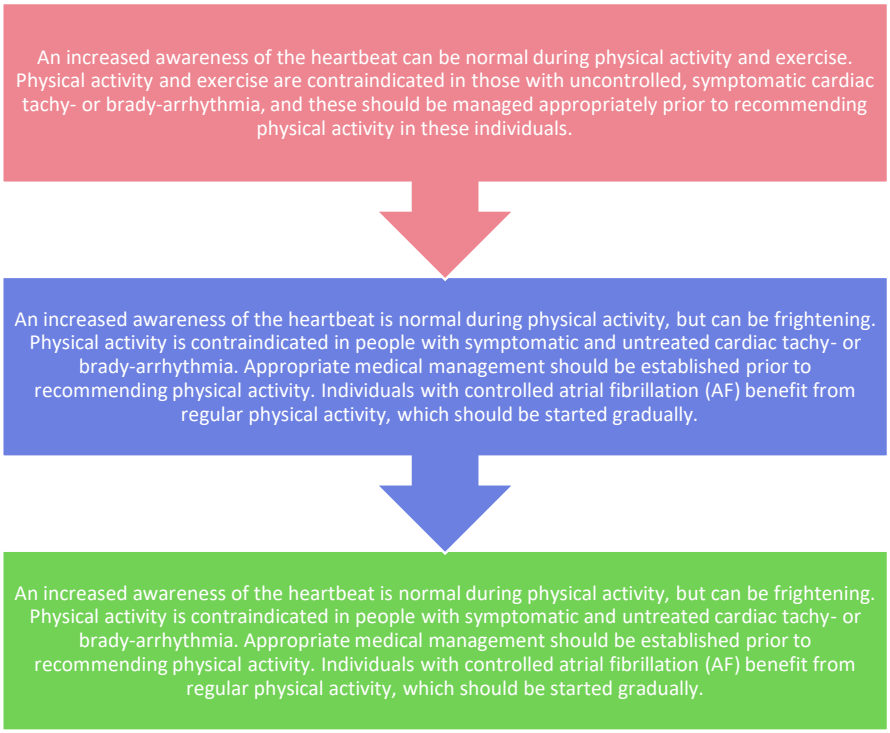
	Feedback themes	Actions taken
Cardiac Chest Pain	quantify the risks of adverse events, including the temporary short-term increased risk during exercise	It is not possible to accurately quantify risk from available evidence regarding individuals with long term medical conditions – this will be highlighted as an area for future work
	make language more accessible	published incidence data on complications from exercise in individuals with known ischaemic heart disease is derived from supervised cardiac rehabilitation programmes, therefore not generalisable to the target population for this consensus statement, and has not been included
	clarify differences between physical activity and exercise	safety statement has been removed as it is now in headline statement 4

Evolution of statement

PALPITATIONS

	Feedback themes	Actions taken
Palpitations	mention new palpitations that occur during activity	comment about new palpitations has been added to Headline Statement 4
	refer to atrial fibrillation specifically	atrial fibrillation is directly addressed in statement and supporting documentation
	consider including other triggers for palpitations, such as anxiety and thyroid disease	

Evolution of statement



DYSGLYCAEMIA

	Feedback themes	Actions taken
Hypoglycaemia	emphasise the long-term benefits of physical activity, including for decreased medication use and improved glycaemic control	significant changes have been made to the content and structure of this statement, so it has been included in Phase 2 (despite meeting consensus agreement in Phase 1)
	consider renaming to 'dysglycaemia'	title of statement has been changed to dysglycaemia
	reconsider reference to ketones in the main symptom statement	references to ketones have been removed from the Symptom Statement (included in supporting evidence)
	intensity of exercise is important, particularly in young people	comment on intensity of exercise is outside of the scope of this consensus statement
	increased risk of hypoglycaemia in those over 45y - more care is needed in this group	specific risks have been addressed in the evidence statement
	include complications of diabetes such as foot ulcers	diabetic complications have not been included in the symptom statement but have been included in the supporting evidence statement

Evolution of statement

COGNITIVE IMPAIRMENT

	Feedback themes	Actions taken
Cognitive Impairment	emphasise available support	title of statement has been kept as 'cognitive impairment' as the statement is following a symptom-based approach and is not limited to dementia
	consider the range of possible impairments and comorbidities in this broad group	statement has been updated to reflect other feedback
	consider changing the name of the statement to 'dementia'	
	address environmental considerations	

Evolution of statement

There is no evidence that physical activity may worsen cognitive impairment, and there are no general contraindications to recommendation of physical activity in this population. Strategies to maintain motivation, engagement and safety are important. Appropriate support is generally beneficial and physical activity should be individualised depending on level of function, communication ability, stage of disease and comorbidities. Individuals with cognitive impairment are at increased risk of falls and associated injury, and approaches to mitigate this should be considered.

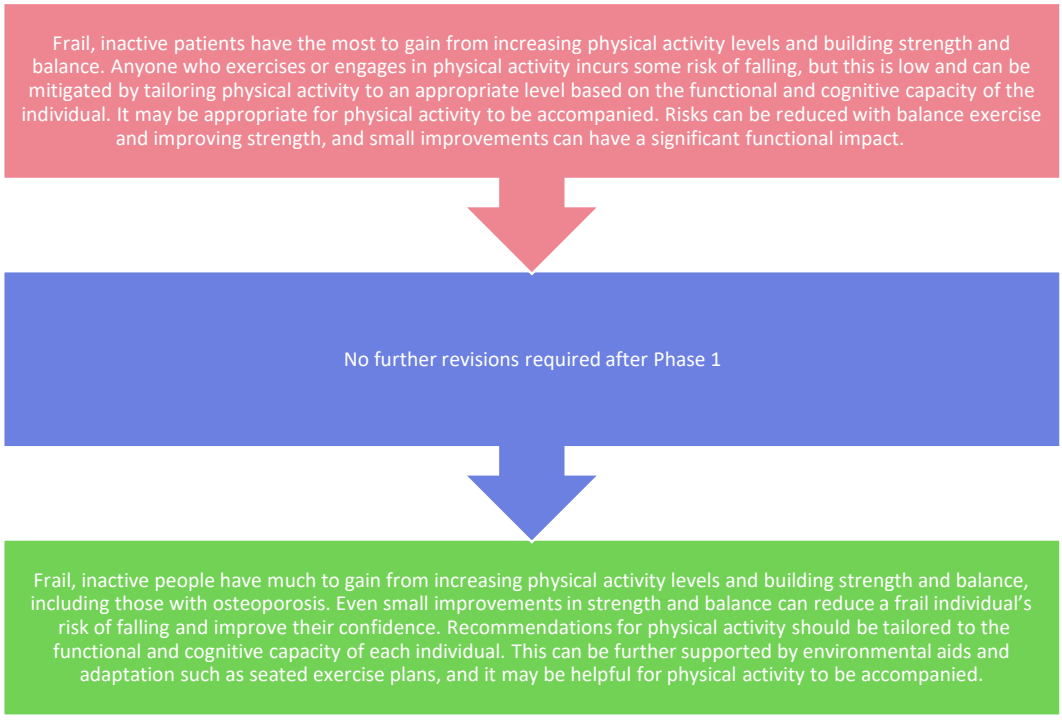
The balance of evidence suggests that the benefits of physical activity in people with cognitive impairment far outweigh the associated risks. Strategies to maintain motivation, engagement and safety are important. These should be individualised, depending on level of function, stage of disease, communication ability (including visual and hearing impairment), preferred environment and other medical conditions. People with cognitive impairment have an increased risk of falling so support from others is often beneficial.

The benefits of physical activity in people with cognitive impairment far outweigh the associated risks. Strategies to maintain motivation, engagement and safety are important and people will often benefit from support from others. Strategies should take into account level of function, stage of disease, communication ability (including visual and hearing impairment), preferred environment, risk of falling and other medical conditions.

FALLS AND FRAILTY

	Feedback themes	Actions taken
Falls & Frailty	a strong and positive statement	osteoporosis is now mentioned in the statement, and included in the supporting evidence
	include osteoporosis	wording updates have been amended as recommended
	change wording from 'the most' ('Frail, inactive patients have the most to gain…') as other groups also have a lot to gain from increasing physical activity levels	
	emphasise the importance of strength and balance	

Evolution of statement



Supplementary file 1. Rapid evidence review

SUMMARY OF EVIDENCE REVIEW PROCESS

A rapid review of the literature was done to establish what is known about the risks of physical activity (PA) and exercise in people with long-term conditions (LTCs). This was presented to the steering group during the consultation phase. Once the symptom-based approach and clinical priorities for the consensus statement were established by the steering group, this review was used in the creation of the symptom-specific evidence statements.

AIMS OF EVIDENCE REVIEW

Provide an overview of existing guidelines and/or recommendations that address the risks of PA for people with long-term conditions, including:

1. What has previously been done to understand the associated risks?
2. What conclusions or consensus were reached?
3. How were conclusions or consensus reached?

Where possible, and using the findings from Aim 1, summarise the nature and incidence of recognised risks (morbidity and mortality) from physical activity by long-term conditions.

METHODS

The approach adopted for this review was a Rapid Evidence Review. This reflected both the nature of the question, and the time and resources available.

In terms of selecting relevant literature the following AGREE II criteria were used:

- Target population: adults (18-64 years) and older adults (65 years+), patients with one or more chronic condition undertaking physical activity;
- Study designs: position statements', 'consensus statements', 'guidelines' and 'recommendations';
- Comparisons: not applicable;
- Outcomes: quantified or qualified risks of physical activity;
- Language: Available in English;
- Context: not applicable.

The online search was conducted in September-October 2019 using four major databases including PubMed, Google Scholar, Scopus and Web of Science. The chronic conditions listed on the Moving Medicine website were used as search terms, and included: 'cancer', 'COPD' ('chronic obstructive pulmonary disease'), 'dementia', 'depression', 'falls' and 'frailty', 'inflammatory rheumatic disease', 'ischaemic heart disease', 'musculoskeletal pain', 'type 2 diabetes mellitus'. Additional search terms including 'mental health', 'rheumatoid arthritis', 'heart disease' and 'cardiovascular disease' were used to ensure that publications were not excluded due to different nomenclature used in different countries.

Reid H, *et al. Br J Sports Med* 2021;0:1–12. doi: 10.1136/bjsports-2021-104281

Furthermore, the search also included conditions/symptoms that are typically associated with the chronic conditions listed on the Moving Medicine website; including 'Parkinson's disease', 'Alzheimer's disease', 'osteoarthritis', 'high blood pressure', 'hypertension', 'obesity', 'lower back pain'. The search terms 'adults' and 'older adults' were used to assess risk of physical activity under the heading of 'primary prevention'. Papers that reported on children and adolescents exclusively were excluded, as well as publications that exclusively covered conditions including fibromyalgia, HIV/AIDs and palliative care.

The search was targeted to 'position statements', 'consensus statements', 'guidelines' and 'recommendations' regarding PA and exercise prescription within each condition mentioned above. Search statements used (though not limited to) included: 'position statement on physical activity in (*insert condition*)', 'risks associated with being physically active', 'risks with physical activity prescription', 'risks with exercise prescription', 'practical considerations exercise prescription in (*insert condition*)' and 'consensus on the risks associated with physical activity'.

For publications where an academic body or organisation (such as the American Diabetes Association, ADA; or American College of Sports Medicine, ACSM) had more than one guideline or position statement, the most recent version was used.

In addition to the search for peer-reviewed publications and towards the end of the review process, an additional search for foundations, charities, and organisations that provide PA guidance for people with chronic conditions in the United Kingdom (UK) was conducted. Search statements for this component of the review process included, but were not limited to, statements such as '(*insert condition*) and physical activity UK', exercise and (*insert condition*) UK' and 'exercise prescription in (*insert condition*) UK'. It is important to note that the organisations and foundations identified in this component of the search process do not always give recommendations or discuss risk based on sound scientific evidence. For this reason, the results of this search are kept separate from the results generated from the primary search described above.

SUMMARY OF RESULTS

The findings of this rapid review suggest that there are condition-specific risks associated with the prescription of PA and/or exercise. However, these risks are outweighed by the benefits of PA for all conditions covered by this review. There is variability between conditions in terms of what has been done, and the specificity of recommendations or guidance.

The evidence is supportive of good prescription practice that involves a patient-centred approach, whereby PA and exercise prescription is tailored to the needs of the patient. A patient-centred approach can be demonstrated in several ways, such as:

- Knowing if and when supervised PA/exercise is required;
- Understanding the condition of the patient according to their symptoms, and not according to their diagnosis or disease exclusively;
- Considering the level of function of a patient according to their physical capabilities within their disease, and not according to their disease exclusively.

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RESULTS IN RESPONSE TO AIMS

a) What has previously been done to understand the associated risks of physical activity in people with long-term conditions?

Seventy-nine relevant reports (reviews, consensus statements, position statements or guidelines) from around the globe were identified as relevant to this question. An overview of the work reviewed is shown in Table 1. It is worth noting that several references consider more than one condition. An overview of the search for foundations and/or organisations that provide PA guidance for people with chronic conditions is also shown in Table 1.

The majority of reports screened for this review primarily emphasise and report on the benefits of PA and/or exercise, and only some addressed the associated risks. When risks are addressed, (i) they are treated as secondary to the benefits; and (ii) they are not always specific to the condition in question.[1]

b) What conclusions or consensus were reached?

When risk is reported, it is discussed in one of three main ways:

1. The risks of PA are weighed against benefits, and the benefits of PA are usually stated to be greater than any potential risks;
2. Generic risks of PA or exercise-induced injury, that would also apply to a healthy population, are reported more often than condition specific risks;[2]
3. The risks of PA are addressed in a way that is not necessarily backed by empirical scientific evidence, but rather using a 'common sense' approach.

Specific risks and considerations as outlined in the various documents are summarised by condition in Table 1.

c) How were conclusions or consensus reached?

For the publications and documents included in this review, conclusions and consensus has been reached in the following ways:

1. For review papers (where recommendations are made following the either systematic or non-systematic review of evidence) the statements are "evidence based" though not always condition specific;
2. For consensus statements, position statements or guidelines, the consensus has been reached following panel discussions. The panels are either made up of medical professionals/clinicians, researchers/academics or a combination. No statements based on Delphi methods have been identified in this review;
3. For some publications including guidelines and position statements, the conclusion has been drawn based on expert opinions. These experts are professionals/clinicians, researchers/academics or a combination

Table 1: Overview of literature reviewed and findings, shown by disease.

Condition and references	Summary of findings	Additional PA considerations	Relevant UK Organisations
Cancer [3–13]	There is no evidence to suggest that PA may worsen the condition of an individual with cancer or undergoing cancer treatment. The risks associated with cancer largely depend on the type and site of cancer (e.g., physical activity following a surgery close to the arms may need to be adjusted). Overall, individuals with cancer are encouraged to exercise as tolerated, and to pay attention to signs/symptoms and the state of their immune system. Specific signs/symptoms or considerations to be aware of include lymphoedema, pain, and chemotherapy-induced peripheral neuropathy. Exercising while supervised may be required.	-Presence of lymphoedema -History of surgery -Presence of pain -Presence of chemotherapy-induced peripheral neuropathy -Be aware of the area affected by the cancer – particularly for bone cancer (for risk of fracture) -Exercise as tolerated (presence of signs/symptoms and state of immune system is particularly important) -Supervision may be required	-Cancer Research UK Exercise Guidelines -The BASES Expert Statement on Exercise and Cancer Survivorship -MacMillan Cancer Support Guidance -NHS – Guys and Thomas -Pancreatic Cancer UK Information and Support -Prostate Cancer UK Guidance -Lymphoma Action UK Guidance -Breast Cancer Now Information
COPD [3,4,6,7,14–21]	An important consideration for patients with COPD is the severity of the condition. As the severity of the condition increases, the level of risk increases. For high-risk, symptomatic COPD patients, PA should be replaced with pulmonary rehabilitation, in which case supervision may be required. There is evidence that PA should be avoided due to increased risk in COPD patients during an infective episode or if the patient is in the immediate recovery phase of an exacerbation. If a COPD patient exercises as tolerated and in a manner that is tailored to their condition, and in an environment that is not polluted, there is no evidence to suggest that PA may worsen the condition of an individual with COPD.	-Timing of exacerbations -Risk of infections -Co-morbidities -Exercise as tolerated (presence of symptoms is particularly important) -Supervision may be required -Prescription of exercise should be tailored	-British Lung Foundation Support -NHS Inform Living with COPD
Dementia [3,4,6,7,22–24]	There is no evidence to suggest that PA may worsen the condition of an individual with dementia. However, exercise and/or PA should be made safer for individuals with dementia, as these individuals tend to have issues related to forgetfulness, balance, gait, and proprioception. Furthermore, these issues can worsen as the disease progresses and therefore the stage of the disease is an important consideration. Prescription of PA should be tailored to the needs of the individual and should be supervised when needed.	-Forgetfulness during activities -Safety related to balance, gait and proprioception -Stage of the disease is important -Tailored prescription as per the needs of an older adults (where applicable -Supervision may be required	-Alzeimer's Society United Against Dementia Guidance -Department of Health: 'Nothing Ventured, Nothing Gained': Risk guidance for people with dementia

Depression [6,7,25–29]	There is evidence that a low risk of 'physical activity dependence' exists in the general population, and this risk may be somewhat higher for people with depression. However, this is extremely rare overall. There is also evidence that PA should not be prescribed to an underweight depressed individual as there is a potential link with disordered eating. Provided that an individual with depression exercises or is physically active in an environment or setting that is not related to the source or trigger of the depression (e.g., avoiding group activities for someone with social phobia) and is not underweight due to an eating disorder, there is no evidence to suggest that PA may worsen the depressive condition of an individual with depression.	-Source of depression (linked to self-esteem and also eating disorders) -Link timing of PA and exercise to depressive symptoms -Exercise dependence (and therefore a negative motivation)	-Mind Tips -Mental Health Foundation Guidance
Falls and Frailty [3,4,16,30–37]	There is evidence that anyone who exercises or engages in PA incurs some risk for an adverse event (including a fall with fracture), but this is at any age. Exercise and PA prescription should be tailored according to the individual's physical condition, level of function and presence of other disease(s) or disability. Supervision may be required for some individuals, and risk may be attenuated by making exercise and/or PA safe through changes to the home environment, selecting appropriate exercise equipment and footwear.	-Exercise (in general) increases acute risk of falls (and potentially fractures) -Presence of other diseases (Multi-morbidity) -Older adulthood is a special consideration and level of function is important -Supervision may be required -Safety (in terms of the home, exercise equipment and footwear) should be considered.	-Age UK guidance for older adults and guidance for falls prevention -National Osteoporosis Society / Royal Osteoporosis Society and British Geriatrics Society Consensus statement
Inflammatory Rheumatic Disease [3,4,6,16,38–42]	There is risk of harming a joint if improper technique is used when stretching, exercising and being physically active, especially if there is existing inflammation. In this regard, supervision may be required. Exercise and/or PA should be tailored according to the individual's physical condition (including the weight status of the patient), level of disability, the degree of pain and inflammation present in the joints needing exercise, as well as the personal preference of the patient. Another potential consideration is that of drug therapy (and the interactions with PA). It is necessary for post-exercise discomfort and pain to inform following exercise sessions. While some muscle soreness (or stiffness) is expected for an individual who is untrained, prescription should change if symptoms of the disease worsen.	-Supervision may be required -Presence of joint pain -Footwear is potentially important -Tailor exercise as per the needs and preference of patient, as well as disease activity (inflammation) -Be aware of medications and interactions with PA -Discomfort and pain post-exercise is important to inform following exercise sessions -Overweight or obesity may limit choice of PA/exercise	-National Rheumatoid Arthritis Society Guidance -ARMA: Arthritis and Musculoskeletal Alliance Guidance -Versus Arthritis, Arthritis Research UK Policy Position

Ischaemic Heart Disease [3,4,6,7,16,43–49]	Supervision during exercise and/or PA is recommended for patients with heart disease, especially higher-risk patients, who may also require monitoring throughout their PA and/or exercise. It is important to be aware of medications and the interactions with PA (e.g., beta-blockers attenuate heart rate response). Hypertensive patients should avoid the Valsalva manoeuvre during resistance training, and exercise should be avoided in the case of systolic BP >180 mmHg and/or diastolic BP >105 mmHg. There is evidence that anyone who exercises or engages in PA incurs some risk for an adverse event. However, the evidence suggests that it is unlikely that a cardiac event that occurs during or soon after exercise is because of the exercise. Rather, it is likely that the individual had an underlying condition that was exacerbated by exercise. Exceeding the recommended dose of exercise or PA may increase the risk for recurrent cardiovascular events. Provided that a heart disease patient exercises within their limitations and are risk-stratified correctly, there is no evidence to suggest that PA may worsen the condition of an individual with heart disease.	-Supervision is recommended -Acute risk of adverse event -Higher-risk patients need supervision and monitoring -Be aware of medications and interactions with PA -Presence of other diseases and conditions (particularly hypertension and obesity) -Hypertensive patients should avoid the Valsalva manoeuvre during resistance training. Exercise to be avoided in the case of systolic BP >180 mmHg or diastolic BP >105 mmHg	-Heart UK (Cholesterol Society) Guidance -Cardiomyopathy UK Guidance -British Heart Foundation Information
Musculo-skeletal pain [3,4,6,7,16,50–53]	For lower back pain specifically, it is important to determine whether the pain is acute or chronic. Thus, obtaining an accurate diagnosis is important before prescribing exercise or PA. Exercise should not be prescribed for individuals with acute lower back pain. Abdominal bracing may cause further harm in some back conditions and is therefore not recommended. Walking downhill may aggravate symptoms in individuals with spinal stenosis. For individuals with other forms of musculoskeletal pain, the evidence suggests that appropriate PA (that is tailored to the individual) is unlikely to cause harm.	-Differences between pain that is acute vs. chronic. Exercise not always indicated for acute back pain. Diagnosis is important before prescribing exercise or PA -Tailored prescription of exercise -Abdominal bracing may cause further harm in some back conditions -Walking downhill may aggravate symptoms in individuals with spinal stenosis. -Risk of increasing damage -Risk of increasing pain	-ARMA: Arthritis and Musculoskeletal Alliance Guidance -Versus Arthritis, Arthritis Research UK Policy Position
Type 2 Diabetes [3,4,6,16,44,54–63]	For type 2 diabetic patients, supervision is recommended depending on symptom severity. Tailored PA and/or exercise prescription is necessary. The evidence suggests that diabetic individuals with neuropathy (autonomic and peripheral) and retinopathy may be at an increased risk of injury during PA and/or	-Supervision is recommended -Tailored prescription necessary -Presence of peripheral neuropathy (footwear is important in this regard) -Presence of autonomic neuropathy	-Diabetes UK Guidance -My Diabetes, My Way Scotland NHS Guidance

	exercise. For patients presenting with retinopathy, the Valsalva manoeuvre during resistance training, and high-impact vigorous exercise, should be avoided. Footwear is important for diabetic patients. Additionally, diabetic individuals with poorly controlled glycaemia may need to modify their PA and exercise, as well as note their carbohydrate intake. Patients with diabetes are often overweight or obese and so it is important to note the presence of other diseases, and to also be aware of prescribed medications. Provided that a patient with diabetes is examined effectively (to determine the optimal dose when weighing risks versus benefits, e.g., running may be better for biological outcomes but may increase risk of injury), there is no evidence to suggest that PA may worsen the diabetic condition of an individual.	-Presence of retinopathy (patients should avoid the Valsalva manoeuvre during resistance training, and high-impact vigorous exercise) -Risk of hypo- and hyper-glycaemia -Be aware of medications and interactions with PA (also note carbohydrate intake) -Presence of other diseases and conditions (particularly obesity)	
Primary Prevention [1–3,64–77]	For adults and older adults that are 'apparently healthy', there is an acute risk of adverse event during vigorous exercise. There is also a general risk of (musculoskeletal) injury during vigorous activity for all healthy people, and this is reduced by proper warming-up, stretching, strength training, and balance training. It is important to note that the risk of injury is relative to the size of the increase in PA and that older age, as well as previous injury, increases risk of further injury. There is evidence that there is an attenuation (and perhaps a reversal) of benefits in the case of too much PA is a risk. However, "too much" is defined as being at the extreme of the PA continuum (e.g., people who participate in ultra-endurance events and who reserve little time for adequate rest).	-Acute risk of adverse event during vigorous exercise -General risk of injury (musculoskeletal injury) for all healthy people exists. Reduced by warming-up, stretching, strength training, and balance training. The risk of injury is related to the size of the increase in activity. -Previous injury increases risk of further injury -In older adults, risk of injury is increased (by comparison to adults due to limited functional ability, previous inactivity, previous illness) -Too much PA is a risk: there is an attenuation (and perhaps a reversal) of benefits at the extreme of the PA continuum (people who participate in ultra-endurance events and/or reserve little time for adequate rest)	-
Multi morbidity [6,78]		-Tailored prescription necessary -Be aware of any competing diseases.	-

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Supplementary file 2. List of contributors by group

Authorship group (n=5)

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Dr Andrew Boyd	Royal College of General Practitioners, Clapham Park Group practice	GP Partner and RCGP Clinical Priority Champion, physical activity & lifestyle

PHYSICAL ACTIVITY RISK CONSENSUS GROUP MEMBERS

Steering Group (n=13)

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Catherine Lester	Consultant in Sport and Exercise Medicine	Moving Medicine Lead, Queen Mary University London
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Delphi Group (n=29)

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Jordan Bowen	Consultant Physician in Acute and Geriatric Medicine	Oxford University Hospitals NHS Foundation Trust	Consultant Physician in Acute and Geriatric Medicine. Special interest in Acute Ambulatory Care and Complex Interface Care
Muir Gray	Consultant in Public Health	The Optimal Ageing Programme	Consultant in Public Health providing knowledge to support our aging population to live better via www.livelongerbetter.net. Additional special interest in teenagers with long term conditions.
Rob Andrews	Associate Professor of Diabetes/Honorary Consultant in Diabetes	University of Exeter	Expert in exercise and both Type 1 and Type 2 Diabetes.
Kim Gregory	Consultant in Sport and Exercise Medicine	University Hospitals of Birmingham	Consultant Physician in Sport and Exercise Medicine
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Paula Manning	Physiotherapist	Derbyshire Healthcare NHS Trust	Physiotherapist, working in mental health inpatients hospital and as a Physical Activity Clinical Champion for PHE, delivering free training to HCPs to encourage themselves and their patients to be more physically active.

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Anushka Soni	Rheumatologist	Nuffield Department of Orthopaedics	Rheumatologist with a research interest in Musculoskeletal Pain Mechanisms. During my DPhil, I studied the impact of abnormal central pain processing in patients with osteoarthritis of the knee. I showed a relationship between the presence of neuropathic pain and central sensitization pre-operatively, and that this modified the patient's response to knee replacement surgery. Moving forwards, my work will use a combination of techniques, including neuroimaging and clinical pain quantification, to investigate pain related predictors of response to treatment in inflammatory arthritis as well as fibromyalgia.
Scarlett McNally	Consultant Orthopaedic Surgeon, Deputy Director of the Centre for Perioperative Care	Eastbourne District General Hospital	Consultant Orthopaedic Surgeon, Eastbourne D.G.H. since 2002. Elected council member of the Royal College of Surgeons of England, 2011-21. Lead author of 'Exercise the miracle cure and the role of the doctor in promoting it'. Other published work on the link with the economy and social care – we need environments and expectations to change to support everybody to be more active which would reduce need for social care (and improve mental and physical health). Deputy Director of the Centre for Perioperative Care (www.cpoc.org.uk aimed at getting people fitterbettersooner around an operation). Papers on www.scarlettmcnally.co.uk. Twitter @scarlettmcnally
Cliff Kilgore	Consultant Nurse for Intermediate Care and Older People	Dorset Healthcare NHS Trust	Consultant Geriatrician Nurse specialising in care of older people and visiting Fellow to Bournemouth University
Chris Pugh	Professor of Renal Medicine, Honorary Consultant Physician	Oxford University and Oxford University Hospitals NHS Foundation Trust	Professor of Renal Medicine, University of Oxford.

Sarah Wheatley	Exercise teacher	Age UK Oxfordshire	Exercise teacher. Responsible for shaping community exercise services for older adults, previously for NHS and currently for Age UK Oxfordshire.
Lucy Gossage	Consultant Medical Oncologist.	Nottingham University Hospitals NHS	Medical Oncology Consultant in Nottingham with an interest in Exercise Oncology. Co-founder of 5K Your Way, Move Against Cancer (www.5kyourway.org) and have spoken about physical activity in those living with and after cancer at national and international conferences.
Anna Lowe	Programme Manager, Physiotherapist	National Centre for Sport & Exercise Medicine, Sheffield.	Programme Manager at the National Centre for Sport & Exercise Medicine, Sheffield.
Rebecca Robinson	Consultant in Sport and Exercise Medicine	Sheffield Teaching Hospitals NHS Foundation Trust	Consultant in Sport and Exercise Medicine.
Rebecca Appelboam	Consultant in Intensive Care Medicine	Royal Devon and Exeter NHS Foundation Trust	Consultant in Intensive Care Medicine, involved in the follow up of survivors of intensive care in multidisciplinary clinics which patients are invited to 3 months after discharge from hospital. We tackle the psychological cognitive, and physical deficits that survivors experience, and provide support and advice to aid rehabilitation
Diana Greenfield	Consultant Nurse in Late Effects (of cancer treatments) and Honorary Professor in Cancer Survivorship	Consultant Nurse at Sheffield Teaching Hospital, Honorary Professor of The University of Sheffield	Consultant Nurse in Late Effects (of cancer treatments) and Honorary Prof in Cancer Survivorship. Diana Greenfield is a National Institute for Health Research (NIHR) Senior Nurse Research Leader. The views expressed in this article are those of the author and not necessarily those of the NIHR, or the Department of Health and Social Care.
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Sheera Sutherland	Renal Dialysis Research Nurse	Oxford University Hospitals NHS Foundation Trust	Renal Dialysis Research Nurse in Renal Rehabilitation

Julia Newton	Clinical Academic and Consultant in Rheumatology/Sport and Exercise Medicine	Oxford University Hospitals NHS Foundation Trust	Clinical Academic and Consultant in Rheumatology/Sport and Exercise Medicine
Sally Retallick	Lead nurse in Weald PCN	West Kent Health NHS	Practice Nurse in West Kent caring for a range of patients including those with long term conditions. Lead nurse in Weald PCN and Physical Activity Clinical Champion for PHE, delivering free training to HCPs to encourage themselves and their patients to be more physically active.
Andrew Murray	GP and Consultant in Sport and Exercise Medicine	The University of Edinburgh	GP and Consultant in SEM. Previous employment working full time in Public Health policy (Scottish Government). Current Vice-President Ramblers Scotland.
James Hull	Consultant respiratory physician	Royal Brompton & Harefield Hospitals Specialist Care	Consultant Respiratory physician with expertise in asthma, chronic lung disease and impact of exercise in this context
Marie Murphy	Professor of Exercise and Health, Dean of Postgraduate Research and Director of the Ulster Doctoral College.	Ulster University	Professor of Exercise and Health, Dean of Postgraduate Research and Director of the Ulster Doctoral College. Marie's research focuses on the effect of physical activity and exercise, in particular walking, on health and uses multidisciplinary approach that has included outcome measures ranging from the behavioural to the biochemical.
Tracy Barnett	Lead Physiotherapist, Physical Activity Pilot	Oxford University Hospitals NHS Foundation Trust	Senior Physiotherapist with a particular interest in neuro-rehabilitation. Physical Activity Champion for the Active Hospital Project at Oxford University Hospitals Foundation Trust. The project was commissioned by Public Health England to explore ways in which physical activity could be embedded into pathways in secondary care. Extensive work within Frailty pathways as part of this project.
Neil Heron	Consultant in Sport and Exercise Medicine; GP; Clinical Lecturer	Queen's University Belfast	Consultant in Sport and Exercise Medicine; GP; Clinical Lecturer with expertise in physical activity promotion.

Amit Mistry	Consultant in General Adult & Old Age Psychiatry; Honorary Lecturer	Oxford Health NHS Foundation Trust, Queen Mary University of London	General Adult and Old Age Psychiatry and Sports Psychiatry. Chair of the Royal College of Psychiatrists (RCPsych) Sport & Exercise Psychiatry Special Interest Group.

Supplementary file 3: Preparatory stage

This supplementary file details the three parts of the preparatory stage (1) practitioner consultation (2) Patient and Public Involvement project and (3) national service user survey.

1. PRACTITIONER CONSULTATION

Aim

To gain insight into the concerns and requirements of Healthcare Professionals (HCPs) around advice on risk when talking about Physical Activity (PA) to people living with long term conditions (LTC).

Methods

We distributed an online survey using the commercial Survey Monkey software[1] to two national primary care networks in the UK and the Moving Medicine ambassador network between October-November 2019. The Moving Medicine ambassador network is a network of multidisciplinary HCPs who have expressed an interest in the role of physical activity in the management of long-term conditions. The survey contained six open questions with free-text responses. Two questions collected data about respondent job role and place of work, and four around the perception and experience of risk when discussing physical activity with patients. The survey was tested with two HCPs not involved in the project prior to distribution. Responses were analysed through thematic analysis.

Results

57 responses were received (Doctor 42%, Physiotherapist 33%, Nurse 9%, other 16%). 53% worked in primary care, 28% in secondary care and 19% in other care settings. Responders were asked to select more than one answer for questions 3-6. Leading themes that emerged from the consultation are presented in table 1. Full results are presented in table 2 with subgroup analyses in tables 3 and 4.

Table 1. Summary of leading themes

Question		Theme 1	Theme 2	Theme 3
1	What risks are you concerned about when recommending physical activity to patients	Exacerbation of symptoms, causing complications	Demotivating or 'putting off' the patient	Appropriate recommendation of physical activity, tailored to the individual
2	Have you encountered any specific clinical issues or symptoms, related to physical activity, in your patients with long term conditions?	Psychological motivation, patient willingness to change	Worsening of symptoms	Patient concerns regarding worsening of another pre-existing condition
3	What have your patients with long term conditions asked you about their risks of physical activity?	Concerns about risk of worsening of current symptoms	Concerns regarding perceived barriers due to	General safety and development of new symptoms/ events eg pain/myocardial infarction

			other symptoms	
4	What information/ resources/ other would help you to manage risk in clinical practice, when recommending physical activity to people with long term conditions?	Advice regarding specific long-term conditions and safe prescription of physical activity	General advice to give patients about the benefits of physical activity	Leaflets/Posters/Online Resource/Mobile App for patients

Table 2. All results from practitioner survey

Question	Theme	Rank	Number of comments
1. What risks are you concerned about when recommending physical activity to patients?	Exacerbation of symptoms, causing complications	1	29
	Demotivating or 'putting off' the patient	2	9
	No concerns about risk	3	7
	Appropriate recommendation of physical activity, tailored to the individual	4	6
	Adequate support for the clinician recommending physical activity	5	4
	Patients own ability to be physically active	6	2
	Other[a]	7	1
2. Have you encountered any specific clinical issues or symptoms, related to physical activity, in your patients with long-term conditions?	No issues	1	17
	Psychological motivation, patient willingness to change	2	15
	Worsening of symptoms	3	12
	Patient concerns regarding worsening of another pre-existing condition	4	7
	Other[b]	5	7
	Fatigue	6	3
	Physical activity advice from non-clinical practitioners	7	2
3. Have you encountered any specific clinical issues or symptoms, related to physical activity, in your	No issues	1	17
	Psychological motivation, patient willingness to change	2	15
	Worsening of symptoms	3	12

patients with long-term conditions?	Patient concerns regarding worsening of another pre-existing condition	4	7
	Other[c]	5	7
	Fatigue	6	3
	Physical activity advice from non-clinical practitioners	7	2
4. What have your patients with long-term conditions asked you about their risks of physical activity?	Concerns about risk of worsening of current symptoms	1	21
	No questions from patients	2	17
	Concerns regarding perceived barriers due to other symptoms	3	10
	General safety of physical activity	4	8
	Development of new symptoms or risks[3]	5	4
	Other[d]	6	2
5. What information/resources/other would help you to manage risk in clinical practice, when recommending physical activity to people with long-term conditions?	Advice regarding specific long-term conditions and safe prescription of physical activity	1	15
	General advice to give patients about the benefits of physical activity	2	10
	Leaflets/Posters/Online Resource/Mobile App for patients	3	10
	When to refer to a physical activity specialist	4	5
	Specific guidelines or algorithms for recommendation of physical activity	5	4
	Not required	6	6
	Other[e]	7	6

[a] "fully understanding their individual barriers to exercise"
[b] "minor injury"; "screening tools used to access physical activity"; "people requiring support to get changed, eg for swimming – volunteers don't tend to want to support in this area and cost of carers makes a swimming session prohibitively expensive"; "exercise progression and the ability to access further information"; "improvement in physical fitness that translates into better function, or prolonged function in the face of decline; build friendships, confidence, sleep better etc"; "falls off bikes on roads – fractures clavicle, concussion"; "access to facilities, cost or transport problems"
[c] When stated – "will I have a heart attack"; "death, MI"; "heart attack"; "falls, joint pain"
[d] "can't motivate themselves to do any PA"; "do the risks of being physically active outweigh the risk of staying as I am?"
[e] "I think it would be really useful to understand how to manage symptoms rather than being disease specific. We tend to work in chronic diseases whereas what the patient worries about is the symptoms of the disease, this can be tricky with multi morbidity"; "supervised structured classes with time to make friendships"; "some of my SU's can't read, struggle to understand written messages"; "support from local ambassadors and motivators"; "history taking"; "some generic disclaimer type documents"

Subgroup Analyses

Table 3. Subgroup analysis of concerns around worsening of symptoms

Specific symptom of concern	Number of concerns
Respiratory	6
Musculoskeletal/ joint pain	5
Cardiac[a]	2
Medication related[b]	2
Dizziness	2
Blood glucose control	1
Falls	1
Psychological issues	1
Not specified	1

[a] When specified – hypertension; hypotension; angina
[b] Considerations with antipsychotic medication prescription; fluctuations of heart rate on chemotherapy

Table 4. Subgroup analysis of patient concerns regarding worsening of another pre-existing condition

Condition of concern	Number of concerns
Musculoskeletal/ joint pain	5
Blood glucose control	1
Not specified	1

Conclusion

This survey corroborates published data showing the HCPs feel they lack knowledge and skills to discuss PA with patients with LTCs. HCPs expressed a significant level of concern about discussing PA with people with LTC. Fear of aggravating symptoms was a common concern. Primum, non nocere (first, do no harm) is an important driver of medical practice and fear of conflicting with this was commonly expressed. Further to this HCPs felt that they lacked skills to discuss PA in a constructive way with patients and were concerned that they might demotivate patients further. HCPs highlighted the need for specific resources to help them discuss risk with patients.

2. PATIENT AND PUBLIC INVOLVEMENT

This Patient and Public involvement (PPI) project was undertaken in 2016.[2] Results and insight closely aligned with the objectives of this project and were therefore used to inform the development of this consensus statement.

Aim

To explore service users' views on how the National Health Service (NHS) could better support their needs.

Methods

The PPI team recruited forty participants living with multiple LTC's through hospital-based patient support networks across a range of conditions in the UK. Patients were interviewed either individually or in groups (patient preference) by semi-structured interviews. Interviews were recorded and transcribed and thematic analysis of interview transcripts was carried out.

Results

The participants' age range was 60-92, and the mean age was 74 (SD 7.4). There were four ethnic groups represented. 55% of the participants were female, and 45% were male. The mean number of co-morbidities was 2.85(SD 2.9). The analysis identified that although participants overwhelmingly stated they wanted to become more active, fear of exacerbating the symptoms of health conditions was a major barrier in keeping with published studies examining barriers to PA in multimorbid groups.[3–5] Symptoms of concern included breathlessness, fatigue, muscle weakness and anxiety about falling or 'getting stuck'.

'it is a bit like trusting a parachute; you get up there and trust the silk, you will find the most wonderful thing in the world, but actually doing it is hard'

Participants reported conflicting advice from HCPs about the risk of adverse events from PA.

'they told me I should never bend forward, never'

The following primary themes emerged from qualitative analysis: [2]

- Patients generally present concerns based on their symptoms or syndromes, not their underlying LTC's.
- Continuity of advice and simple messages reduce confusion and are therefore empowering for people living with LTC's.
- Addressing risk is an essential facilitator for people considering increasing their PA levels
- Cross-sector system support is required to improve the experience of inactive people with LTC's starting to become more physically active.

3. NATIONAL CONSULTATION

Stakeholder consultation with Sport England further informed our understanding of patient preferences through a related piece of work in the UK. In 2019, The National Centre for Sport and Exercise Medicine (NCSEM) at Sheffield Hallam University in collaboration with Sport England and RCGP clinical priority group engaged 361 participants in a national online consultation to inform approaches to improving physical activity support for people with LTCs.[6]

A frequently reported barrier to participation in PA initiatives was getting medical 'sign-off' to participate.

> *"People who are fit and healthy are told they need to see their GP prior to being able to exercise and this sends the* wrong *message … Patients who have a health condition but are safe and well managed should not be asked to see their GP."*

Triage processes are often unclear, with a lack of system support for the 'sign-off' process.

> *"…most aren't qualified to assess the risk for an individual of exercising and the current system doesn't give them the confidence to signpost or refer without fear of them being liable"*

People over 50 were more likely to have individual concerns with getting sign-off before participation in PA. Those under 50 emphasised the importance of HCPs having the knowledge, confidence and the right attitudes to have conversations about sport and PA with people with LTC's.

> *"If you have a health condition, it can be difficult to get medical clearance to participate in certain physical activities. Often this requires sign-off from a health professional, for a fee, who may not even feel qualified or confident to do this."*

Finally, our conclusions from our patient and public insight were presented to the Richmond Group of Charities who have done extensive patient facing work in this areas including the 'We are undefeatable' campaign in collaboration with Sport England. The Richmond group confirmed that key themes identified through our consultation process matched commonly held concerns heard reported by their membership groups.

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3 Hunt ER, Papathomas A. Being physically active through chronic illness: life experiences of people with arthritis. *Qual Res Sport Exerc Heal* 2020;**12**:242–55. doi:10.1080/2159676X.2019.1601637
4 Franco MR, Tong A, Howard K, *et al.* Older people's perspectives on participation in physical activity: A systematic review and thematic synthesis of qualitative literature. Br. J. Sports Med. 2015;**49**:1268–76. doi:10.1136/bjsports-2014-094015
5 Yarmohammadi S, Mozafar Saadati H, Ghaffari M, *et al.* A systematic review of barriers and motivators to physical activity in elderly adults in Iran and worldwide. Epidemiol. Health.

2019;**41**:e2019049. doi:10.4178/epih.e2019049

6 CleverTogether. #EasierToBeActive: Making it easier to be active with a health condition: a national conversation. Report of findings from Phase one. Sheffield: 2019. https://easiertobeactive.clevertogether.com/

Supplementary file 4. Delphi survey qualitative feedback

Feedback themes are presented alongside actions taken alongside statement progression

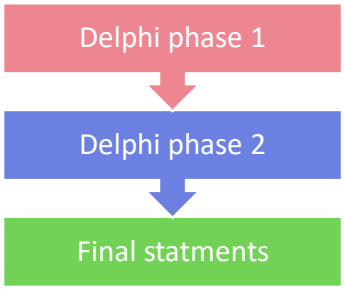
General feedback

Theme	Actions taken
Simplify wording & frame messages more positively	Messages reduced in length, statement wording simplified and standardised. Single sentence 'impact statements' added to headline statements to simplify messages and improve readability.
Reduce medical language	The use of 'patients' has been changed to 'people' or 'individuals'. Medical language simplified, but since this is a medical statement and not aimed at the general public or fitness professionals some medical language remains where it has been felt to provide extra clarity.
Remove the comment that there is 'no evidence' from several of the symptom statements	Wording of symptom statements amended to better reflect the balance of evidence.
Include more about benefits of physical activity in the symptom statements	The benefits of physical activity are not the main focus of this paper, so are not emphasised in this consensus statement.

Feedback on headline messages

Theme	Actions taken
consider order of the messages: start with patient barriers, address these and then describe benefits/what can be offered by healthcare professionals	this was not been changed, as consensus reached – however, bullet point headlines have added as suggested
shorten headlines and then give further information in a paragraph underneath	in response to overarching themes about safety considerations, we are now testing an additional 4th statement (see below) to directly address these concerns in the headline messages

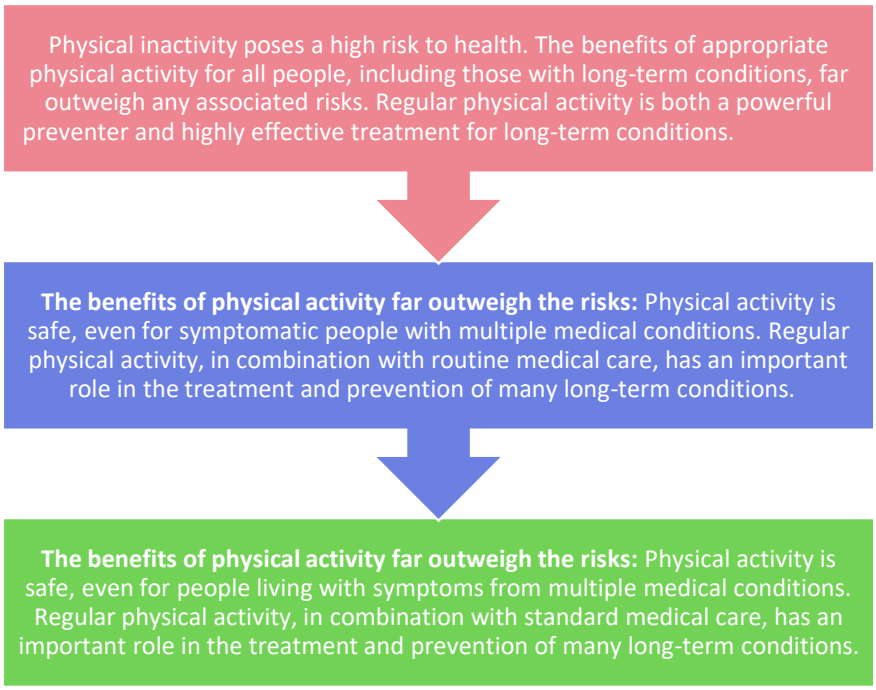
Evolution of each statement is subsequently presented in the following format:



HEADLINE 1

	Feedback themes	Actions taken
Headline Message 1	this message reassures that physical activity is appropriate/beneficial to all	statement simplified to reflect feedback
	simplify language and use physical activity, rather than inactivity	mental health is not specifically included, as this is not commonly reported as a specific risk in physical activity interventions
	some long-term conditions may not be preventable, although physical activity can help in their management	
	include mental health	
	it is important to reassure healthcare professionals that physical activity in those with long-term conditions is not dangerous	
	message reinforces the importance of discussion about physical activity between healthcare providers & those with long-term conditions	

Evolution of statement



HEADLINE 2

	Feedback themes	Actions taken
Headline Message 2	clarify 'tolerance'	statement simplified
	it is important to emphasise that increase in physical activity should be gradual	'tolerance' removed
	simplify language	
	this is a very important message emphasise low risk of physical activity	

Evolution of statement

There is a very low risk of serious adverse events when physical activity is gradually increased, according to tolerance, in symptomatic individuals with long-term conditions. This risk is mitigated by appropriate, well informed conversations between patients and their healthcare provider, and subsequently, where applicable, by patients and physical activity providers.

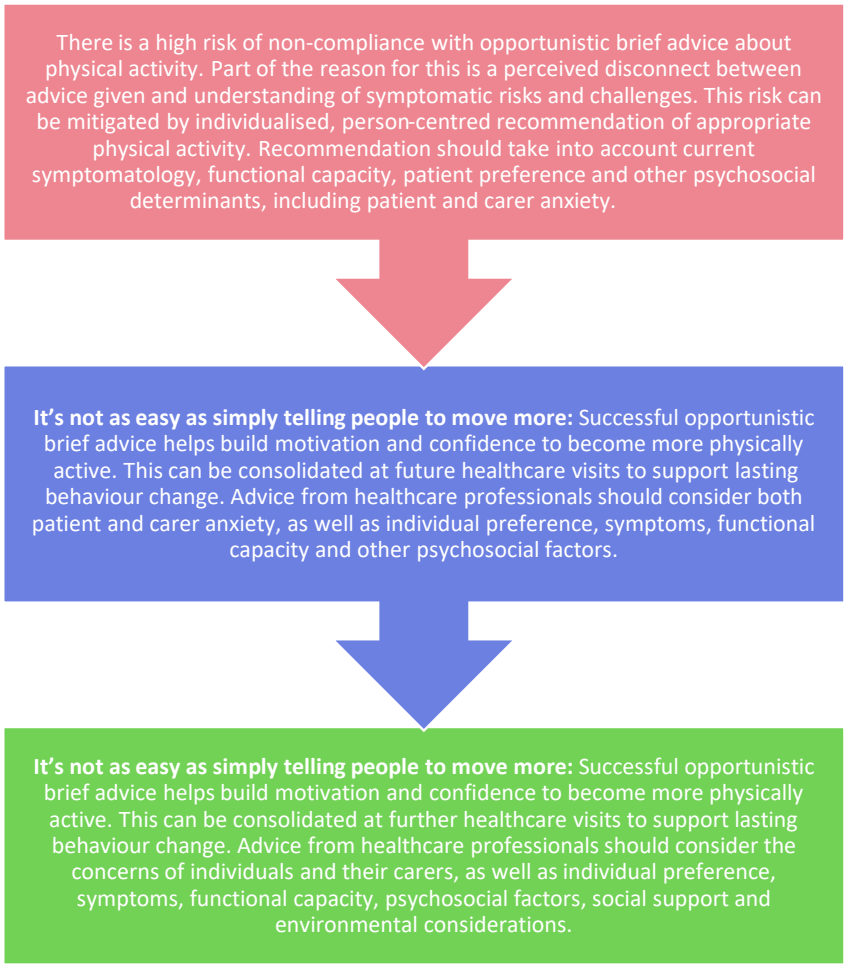
The risk of serious adverse events is very low, but that's not how people feel: People with long-term conditions are often fearful of potential undesired consequences from physical activity. However, when physical activity levels are gradually increased, the risk of serious adverse events is very low indeed. Well informed, person-centred conversations with healthcare professionals can reassure people and further reduce this risk.

The risk of serious adverse events is very low, but that's not how people feel: People with long-term conditions are often fearful of worsening their condition or experiencing potentially undesired consequences from physical activity. In fact, when physical activity levels are increased gradually, the risk of serious adverse events is very low. Well informed, person-centred conversations with healthcare professionals can reassure people and further reduce this risk.

HEADLINE 3

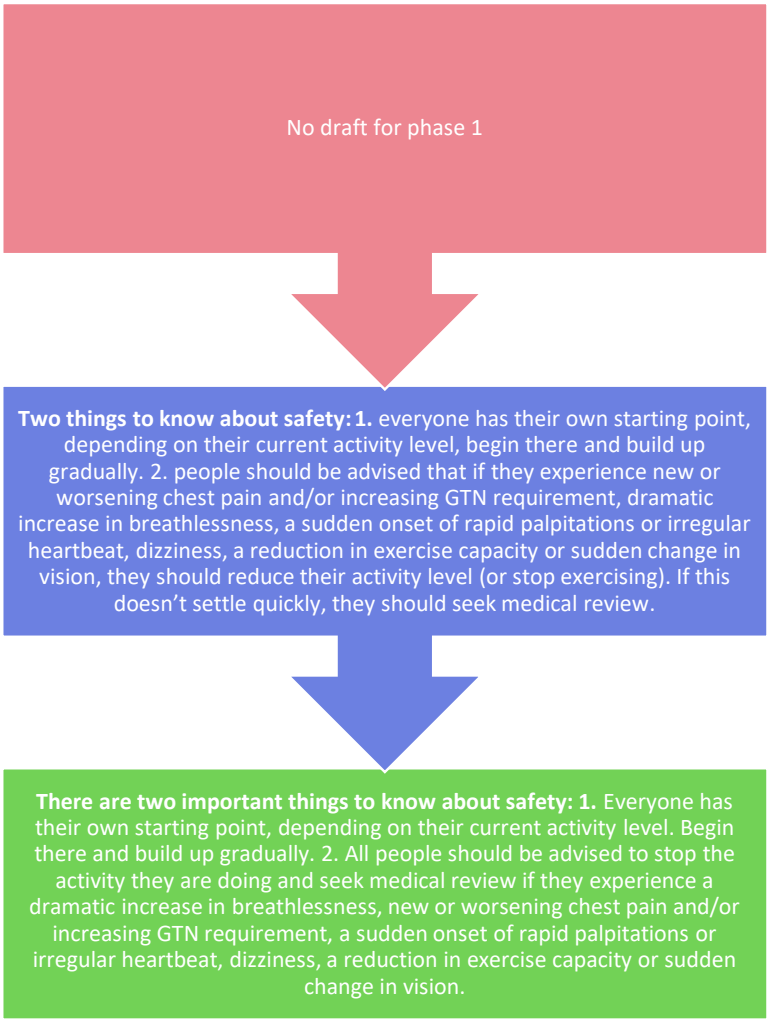
	Feedback themes	Actions taken
Headline 3	avoid use of 'non-compliance'	'non-compliance' removed
	simplify statement	message simplified
	a very important part of the overall message	
	important to emphasise the personalised/individualised aspects of conversations between healthcare professionals & individuals with long-term conditions	

Evolution of statement



HEADLINE 4

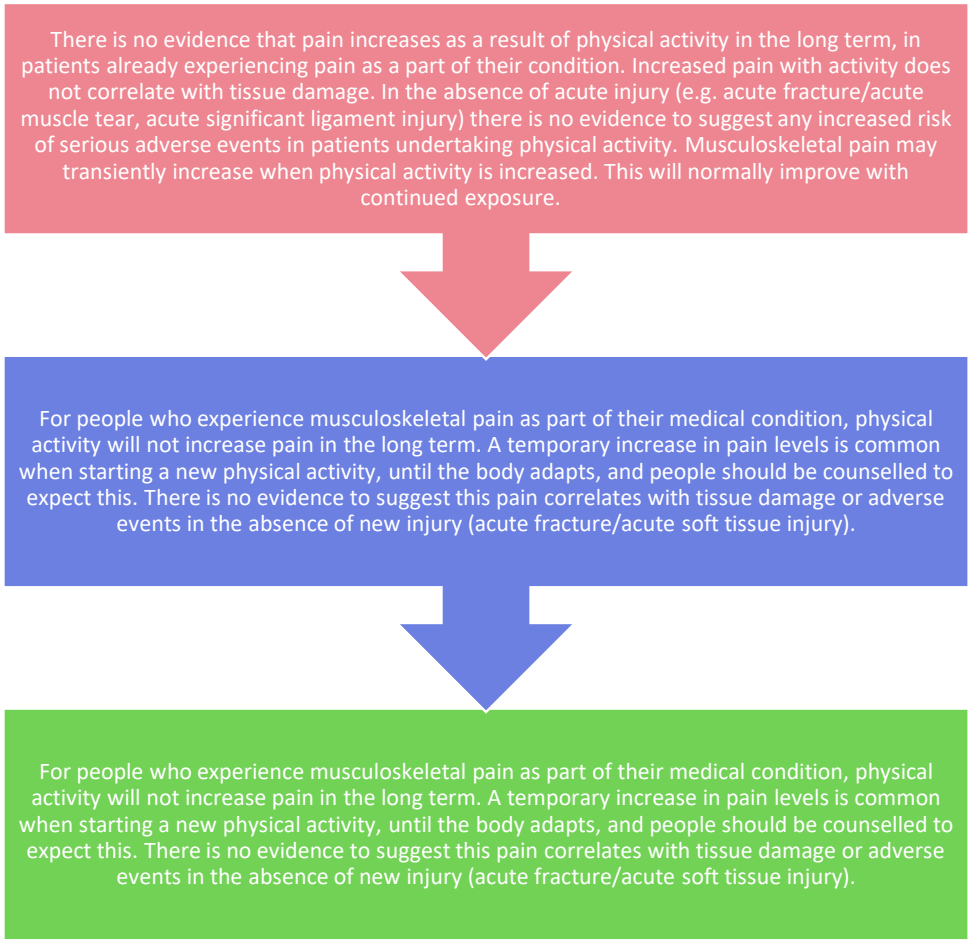
Evolution of statement



MUSCULOSKELETAL PAIN

	Feedback themes	Actions taken
Musculoskeletal Pain	consider bullet points/reduce length of statement	the statement has been adapted to reflect feedback, and simplified to negate the need for bullet points
	emphasise the potential short-term side effects such as increased pain	specific conditions are included in evidence summary
	reconsider use of 'no evidence'	
	Add in specific conditions such as arthritis, back pain, osteoarthritis	

Evolution of statement



FATIGUE

	Feedback themes	Actions taken
Fatigue	emphasise that physical activity can improve sleep, and evidence for reduced fatigue and improved wellbeing/psychological benefits specifically mention cancer-related fatigue & associated factors	cancer related fatigue is listed separately in the supporting evidence section but not separated in headline statement
	ME/CFS patients will feel strongly against this statement	specific reference is included in the supporting evidence about ME/CFS, suggesting that people are directed to specialist services for this group, as published literature is inconclusive

Evolution of statement

There is no evidence to suggest that increasing physical activity causes increasing fatigue in the medium or long term in patients already suffering from fatigue. Some short-lived fatigue is common after increasing physical activity in all populations. Chances of significantly increased fatigue can be reduced by gradually increasing levels of activity.

Appropriate regular physical activity helps reduce fatigue and improves wellbeing and sleep. A temporary increase in fatigue is commonly experienced when starting a new physical activity, until the body adapts. People should be counselled to expect this and advised to build up activity gradually. People experiencing fatigue related to chronic fatigue syndromes may benefit from specialist advice.

Regular physical activity helps reduce fatigue and improves wellbeing and sleep. A temporary increase in fatigue is commonly experienced when starting a new physical activity, until the body adapts. People should be counselled to expect this and advised to build up activity gradually. People experiencing fatigue related to chronic fatigue syndromes may benefit from specialist advice.

SHORTNESS OF BREATH

	Feedback themes	Actions taken
Shortness of Breath	patients should be advised to do what they can, rather than stop being physically active during an exacerbation or hospitalisation	specific disease recommendations have been included in supporting evidence – physical activity risk is sufficiently generic to maintain a symptom-based approach.
	reference the fear that people experience and the psychological impact	safety considerations are now addressed in Headline Statement 4
	distinguish between being physically active and doing physical activities	reference to recognising fear has been included in updated statement
	change 'no evidence' to 'balance of evidence' to improve credibility	the role of pulmonary rehabilitation has been referenced in the evidence statement, but is not within the scope of the symptom statement
	improve safety netting advice for this high-risk group	
	reference pulmonary rehabilitation	

Evolution of statement

There is no evidence to suggest increased risk of adverse events in breathless patients undertaking physical activity programmes. Feeling more breathless than usual is normal with increased physical activity in both patients who are breathless at rest and those who are not. Physical activity should be recommended dependent on severity of symptoms and gradually increased according to tolerance. Patients should be counselled regarding concerning features such as chest pain or dizziness.

It is normal for all people to feel more breathless than usual when increasing their activity level. The balance of evidence suggests that the increased risk of adverse events in breathless people when doing physical activity is very low. People should be counselled individually to gradually increase physical activity, taking into account their severity of symptoms and fear of breathlessness.

It is normal for all people to feel more breathless when increasing their activity level. The balance of evidence suggests that the increased risk of adverse events in breathless people when doing physical activity is very low. People should be counselled individually to gradually increase physical activity, taking into account their severity of symptoms, and fear of breathlessness

CARDIAC CHEST PAIN

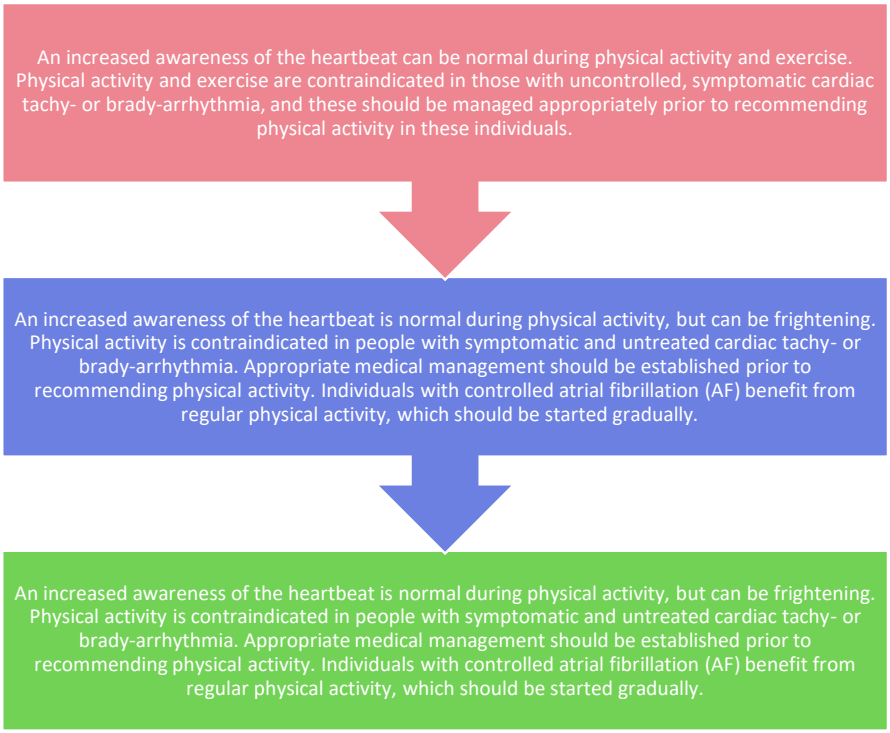
	Feedback themes	Actions taken
Cardiac Chest Pain	quantify the risks of adverse events, including the temporary short-term increased risk during exercise	It is not possible to accurately quantify risk from available evidence regarding individuals with long term medical conditions – this will be highlighted as an area for future work
	make language more accessible	published incidence data on complications from exercise in individuals with known ischaemic heart disease is derived from supervised cardiac rehabilitation programmes, therefore not generalisable to the target population for this consensus statement, and has not been included
	clarify differences between physical activity and exercise	safety statement has been removed as it is now in headline statement 4

Evolution of statement

PALPITATIONS

	Feedback themes	Actions taken
Palpitations	mention new palpitations that occur during activity	comment about new palpitations has been added to Headline Statement 4
	refer to atrial fibrillation specifically	atrial fibrillation is directly addressed in statement and supporting documentation
	consider including other triggers for palpitations, such as anxiety and thyroid disease	

Evolution of statement



DYSGLYCAEMIA

	Feedback themes	Actions taken
Hypoglycaemia	emphasise the long-term benefits of physical activity, including for decreased medication use and improved glycaemic control	significant changes have been made to the content and structure of this statement, so it has been included in Phase 2 (despite meeting consensus agreement in Phase 1)
	consider renaming to 'dysglycaemia'	title of statement has been changed to dysglycaemia
	reconsider reference to ketones in the main symptom statement	references to ketones have been removed from the Symptom Statement (included in supporting evidence)
	intensity of exercise is important, particularly in young people	comment on intensity of exercise is outside of the scope of this consensus statement
	increased risk of hypoglycaemia in those over 45y - more care is needed in this group	specific risks have been addressed in the evidence statement
	include complications of diabetes such as foot ulcers	diabetic complications have not been included in the symptom statement but have been included in the supporting evidence statement

Evolution of statement

COGNITIVE IMPAIRMENT

	Feedback themes	Actions taken
Cognitive Impairment	emphasise available support	title of statement has been kept as 'cognitive impairment' as the statement is following a symptom-based approach and is not limited to dementia
	consider the range of possible impairments and comorbidities in this broad group	statement has been updated to reflect other feedback
	consider changing the name of the statement to 'dementia'	
	address environmental considerations	

Evolution of statement

There is no evidence that physical activity may worsen cognitive impairment, and there are no general contraindications to recommendation of physical activity in this population. Strategies to maintain motivation, engagement and safety are important. Appropriate support is generally beneficial and physical activity should be individualised depending on level of function, communication ability, stage of disease and comorbidities. Individuals with cognitive impairment are at increased risk of falls and associated injury, and approaches to mitigate this should be considered.

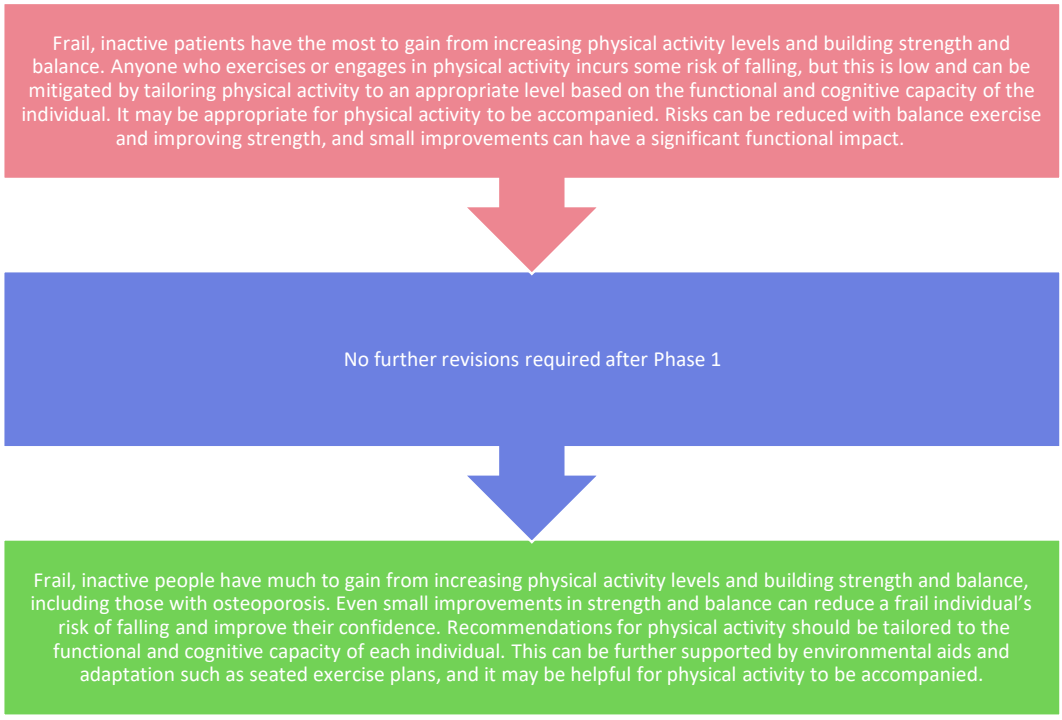
The balance of evidence suggests that the benefits of physical activity in people with cognitive impairment far outweigh the associated risks. Strategies to maintain motivation, engagement and safety are important. These should be individualised, depending on level of function, stage of disease, communication ability (including visual and hearing impairment), preferred environment and other medical conditions. People with cognitive impairment have an increased risk of falling so support from others is often beneficial.

The benefits of physical activity in people with cognitive impairment far outweigh the associated risks. Strategies to maintain motivation, engagement and safety are important and people will often benefit from support from others. Strategies should take into account level of function, stage of disease, communication ability (including visual and hearing impairment), preferred environment, risk of falling and other medical conditions.

FALLS AND FRAILTY

	Feedback themes	Actions taken
Falls & Frailty	a strong and positive statement	osteoporosis is now mentioned in the statement, and included in the supporting evidence
	include osteoporosis	wording updates have been amended as recommended
	change wording from 'the most' ('Frail, inactive patients have the most to gain…') as other groups also have a lot to gain from increasing physical activity levels	
	emphasise the importance of strength and balance	

Evolution of statement



Supplementary file 1. Rapid evidence review

SUMMARY OF EVIDENCE REVIEW PROCESS

A rapid review of the literature was done to establish what is known about the risks of physical activity (PA) and exercise in people with long-term conditions (LTCs). This was presented to the steering group during the consultation phase. Once the symptom-based approach and clinical priorities for the consensus statement were established by the steering group, this review was used in the creation of the symptom-specific evidence statements.

AIMS OF EVIDENCE REVIEW

Provide an overview of existing guidelines and/or recommendations that address the risks of PA for people with long-term conditions, including:

1. What has previously been done to understand the associated risks?
2. What conclusions or consensus were reached?
3. How were conclusions or consensus reached?

Where possible, and using the findings from Aim 1, summarise the nature and incidence of recognised risks (morbidity and mortality) from physical activity by long-term conditions.

METHODS

The approach adopted for this review was a Rapid Evidence Review. This reflected both the nature of the question, and the time and resources available.

In terms of selecting relevant literature the following AGREE II criteria were used:

- Target population: adults (18-64 years) and older adults (65 years+), patients with one or more chronic condition undertaking physical activity;
- Study designs: position statements', 'consensus statements', 'guidelines' and 'recommendations';
- Comparisons: not applicable;
- Outcomes: quantified or qualified risks of physical activity;
- Language: Available in English;
- Context: not applicable.

The online search was conducted in September-October 2019 using four major databases including PubMed, Google Scholar, Scopus and Web of Science. The chronic conditions listed on the Moving Medicine website were used as search terms, and included: 'cancer', 'COPD' ('chronic obstructive pulmonary disease'), 'dementia', 'depression', 'falls' and 'frailty', 'inflammatory rheumatic disease', 'ischaemic heart disease', 'musculoskeletal pain', 'type 2 diabetes mellitus'. Additional search terms including 'mental health', 'rheumatoid arthritis', 'heart disease' and 'cardiovascular disease' were used to ensure that publications were not excluded due to different nomenclature used in different countries.

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Furthermore, the search also included conditions/symptoms that are typically associated with the chronic conditions listed on the Moving Medicine website; including 'Parkinson's disease', 'Alzheimer's disease', 'osteoarthritis', 'high blood pressure', 'hypertension', 'obesity', 'lower back pain'. The search terms 'adults' and 'older adults' were used to assess risk of physical activity under the heading of 'primary prevention'. Papers that reported on children and adolescents exclusively were excluded, as well as publications that exclusively covered conditions including fibromyalgia, HIV/AIDs and palliative care.

The search was targeted to 'position statements', 'consensus statements', 'guidelines' and 'recommendations' regarding PA and exercise prescription within each condition mentioned above. Search statements used (though not limited to) included: 'position statement on physical activity in (*insert condition*)', 'risks associated with being physically active', 'risks with physical activity prescription', 'risks with exercise prescription', 'practical considerations exercise prescription in (*insert condition*)' and 'consensus on the risks associated with physical activity'.

For publications where an academic body or organisation (such as the American Diabetes Association, ADA; or American College of Sports Medicine, ACSM) had more than one guideline or position statement, the most recent version was used.

In addition to the search for peer-reviewed publications and towards the end of the review process, an additional search for foundations, charities, and organisations that provide PA guidance for people with chronic conditions in the United Kingdom (UK) was conducted. Search statements for this component of the review process included, but were not limited to, statements such as '(*insert condition*) and physical activity UK', exercise and (*insert condition*) UK' and 'exercise prescription in (*insert condition*) UK'. It is important to note that the organisations and foundations identified in this component of the search process do not always give recommendations or discuss risk based on sound scientific evidence. For this reason, the results of this search are kept separate from the results generated from the primary search described above.

SUMMARY OF RESULTS

The findings of this rapid review suggest that there are condition-specific risks associated with the prescription of PA and/or exercise. However, these risks are outweighed by the benefits of PA for all conditions covered by this review. There is variability between conditions in terms of what has been done, and the specificity of recommendations or guidance.

The evidence is supportive of good prescription practice that involves a patient-centred approach, whereby PA and exercise prescription is tailored to the needs of the patient. A patient-centred approach can be demonstrated in several ways, such as:

- Knowing if and when supervised PA/exercise is required;
- Understanding the condition of the patient according to their symptoms, and not according to their diagnosis or disease exclusively;
- Considering the level of function of a patient according to their physical capabilities within their disease, and not according to their disease exclusively.

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RESULTS IN RESPONSE TO AIMS

a) What has previously been done to understand the associated risks of physical activity in people with long-term conditions?

Seventy-nine relevant reports (reviews, consensus statements, position statements or guidelines) from around the globe were identified as relevant to this question. An overview of the work reviewed is shown in Table 1. It is worth noting that several references consider more than one condition. An overview of the search for foundations and/or organisations that provide PA guidance for people with chronic conditions is also shown in Table 1.

The majority of reports screened for this review primarily emphasise and report on the benefits of PA and/or exercise, and only some addressed the associated risks. When risks are addressed, (i) they are treated as secondary to the benefits; and (ii) they are not always specific to the condition in question.[1]

b) What conclusions or consensus were reached?

When risk is reported, it is discussed in one of three main ways:

1. The risks of PA are weighed against benefits, and the benefits of PA are usually stated to be greater than any potential risks;
2. Generic risks of PA or exercise-induced injury, that would also apply to a healthy population, are reported more often than condition specific risks;[2]
3. The risks of PA are addressed in a way that is not necessarily backed by empirical scientific evidence, but rather using a 'common sense' approach.

Specific risks and considerations as outlined in the various documents are summarised by condition in Table 1.

c) How were conclusions or consensus reached?

For the publications and documents included in this review, conclusions and consensus has been reached in the following ways:

1. For review papers (where recommendations are made following the either systematic or non-systematic review of evidence) the statements are "evidence based" though not always condition specific;
2. For consensus statements, position statements or guidelines, the consensus has been reached following panel discussions. The panels are either made up of medical professionals/clinicians, researchers/academics or a combination. No statements based on Delphi methods have been identified in this review;
3. For some publications including guidelines and position statements, the conclusion has been drawn based on expert opinions. These experts are professionals/clinicians, researchers/academics or a combination

Table 1: Overview of literature reviewed and findings, shown by disease.

Condition and references	Summary of findings	Additional PA considerations	Relevant UK Organisations
Cancer [3–13]	There is no evidence to suggest that PA may worsen the condition of an individual with cancer or undergoing cancer treatment. The risks associated with cancer largely depend on the type and site of cancer (e.g., physical activity following a surgery close to the arms may need to be adjusted). Overall, individuals with cancer are encouraged to exercise as tolerated, and to pay attention to signs/symptoms and the state of their immune system. Specific signs/symptoms or considerations to be aware of include lymphoedema, pain, and chemotherapy-induced peripheral neuropathy. Exercising while supervised may be required.	-Presence of lymphoedema -History of surgery -Presence of pain -Presence of chemotherapy-induced peripheral neuropathy -Be aware of the area affected by the cancer – particularly for bone cancer (for risk of fracture) -Exercise as tolerated (presence of signs/symptoms and state of immune system is particularly important) -Supervision may be required	-Cancer Research UK Exercise Guidelines -The BASES Expert Statement on Exercise and Cancer Survivorship -MacMillan Cancer Support Guidance -NHS – Guys and Thomas -Pancreatic Cancer UK Information and Support -Prostate Cancer UK Guidance -Lymphoma Action UK Guidance -Breast Cancer Now Information
COPD [3,4,6,7,14–21]	An important consideration for patients with COPD is the severity of the condition. As the severity of the condition increases, the level of risk increases. For high-risk, symptomatic COPD patients, PA should be replaced with pulmonary rehabilitation, in which case supervision may be required. There is evidence that PA should be avoided due to increased risk in COPD patients during an infective episode or if the patient is in the immediate recovery phase of an exacerbation. If a COPD patient exercises as tolerated and in a manner that is tailored to their condition, and in an environment that is not polluted, there is no evidence to suggest that PA may worsen the condition of an individual with COPD.	-Timing of exacerbations -Risk of infections -Co-morbidities -Exercise as tolerated (presence of symptoms is particularly important) -Supervision may be required -Prescription of exercise should be tailored	-British Lung Foundation Support -NHS Inform Living with COPD
Dementia [3,4,6,7,22–24]	There is no evidence to suggest that PA may worsen the condition of an individual with dementia. However, exercise and/or PA should be made safer for individuals with dementia, as these individuals tend to have issues related to forgetfulness, balance, gait, and proprioception. Furthermore, these issues can worsen as the disease progresses and therefore the stage of the disease is an important consideration. Prescription of PA should be tailored to the needs of the individual and should be supervised when needed.	-Forgetfulness during activities -Safety related to balance, gait and proprioception -Stage of the disease is important -Tailored prescription as per the needs of an older adults (where applicable -Supervision may be required	-Alzeimer's Society United Against Dementia Guidance -Department of Health: 'Nothing Ventured, Nothing Gained': Risk guidance for people with dementia

Depression [6,7,25–29]	There is evidence that a low risk of 'physical activity dependence' exists in the general population, and this risk may be somewhat higher for people with depression. However, this is extremely rare overall. There is also evidence that PA should not be prescribed to an underweight depressed individual as there is a potential link with disordered eating. Provided that an individual with depression exercises or is physically active in an environment or setting that is not related to the source or trigger of the depression (e.g., avoiding group activities for someone with social phobia) and is not underweight due to an eating disorder, there is no evidence to suggest that PA may worsen the depressive condition of an individual with depression.	-Source of depression (linked to self-esteem and also eating disorders) -Link timing of PA and exercise to depressive symptoms -Exercise dependence (and therefore a negative motivation)	-Mind Tips -Mental Health Foundation Guidance
Falls and Frailty [3,4,16,30–37]	There is evidence that anyone who exercises or engages in PA incurs some risk for an adverse event (including a fall with fracture), but this is at any age. Exercise and PA prescription should be tailored according to the individual's physical condition, level of function and presence of other disease(s) or disability. Supervision may be required for some individuals, and risk may be attenuated by making exercise and/or PA safe through changes to the home environment, selecting appropriate exercise equipment and footwear.	-Exercise (in general) increases acute risk of falls (and potentially fractures) -Presence of other diseases (Multi-morbidity) -Older adulthood is a special consideration and level of function is important -Supervision may be required -Safety (in terms of the home, exercise equipment and footwear) should be considered.	-Age UK guidance for older adults and guidance for falls prevention -National Osteoporosis Society / Royal Osteoporosis Society and British Geriatrics Society Consensus statement
Inflammatory Rheumatic Disease [3,4,6,16,38–42]	There is risk of harming a joint if improper technique is used when stretching, exercising and being physically active, especially if there is existing inflammation. In this regard, supervision may be required. Exercise and/or PA should be tailored according to the individual's physical condition (including the weight status of the patient), level of disability, the degree of pain and inflammation present in the joints needing exercise, as well as the personal preference of the patient. Another potential consideration is that of drug therapy (and the interactions with PA). It is necessary for post-exercise discomfort and pain to inform following exercise sessions. While some muscle soreness (or stiffness) is expected for an individual who is untrained, prescription should change if symptoms of the disease worsen.	-Supervision may be required -Presence of joint pain -Footwear is potentially important -Tailor exercise as per the needs and preference of patient, as well as disease activity (inflammation) -Be aware of medications and interactions with PA -Discomfort and pain post-exercise is important to inform following exercise sessions -Overweight or obesity may limit choice of PA/exercise	-National Rheumatoid Arthritis Society Guidance -ARMA: Arthritis and Musculoskeletal Alliance Guidance -Versus Arthritis, Arthritis Research UK Policy Position

Ischaemic Heart Disease [3,4,6,7,16,43–49]	Supervision during exercise and/or PA is recommended for patients with heart disease, especially higher-risk patients, who may also require monitoring throughout their PA and/or exercise. It is important to be aware of medications and the interactions with PA (e.g., beta-blockers attenuate heart rate response). Hypertensive patients should avoid the Valsalva manoeuvre during resistance training, and exercise should be avoided in the case of systolic BP >180 mmHg and/or diastolic BP >105 mmHg. There is evidence that anyone who exercises or engages in PA incurs some risk for an adverse event. However, the evidence suggests that it is unlikely that a cardiac event that occurs during or soon after exercise is because of the exercise. Rather, it is likely that the individual had an underlying condition that was exacerbated by exercise. Exceeding the recommended dose of exercise or PA may increase the risk for recurrent cardiovascular events. Provided that a heart disease patient exercises within their limitations and are risk-stratified correctly, there is no evidence to suggest that PA may worsen the condition of an individual with heart disease.	-Supervision is recommended -Acute risk of adverse event -Higher-risk patients need supervision and monitoring -Be aware of medications and interactions with PA -Presence of other diseases and conditions (particularly hypertension and obesity) -Hypertensive patients should avoid the Valsalva manoeuvre during resistance training. Exercise to be avoided in the case of systolic BP >180 mmHg or diastolic BP >105 mmHg	-Heart UK (Cholesterol Society) Guidance -Cardiomyopathy UK Guidance -British Heart Foundation Information
Musculo-skeletal pain [3,4,6,7,16,50–53]	For lower back pain specifically, it is important to determine whether the pain is acute or chronic. Thus, obtaining an accurate diagnosis is important before prescribing exercise or PA. Exercise should not be prescribed for individuals with acute lower back pain. Abdominal bracing may cause further harm in some back conditions and is therefore not recommended. Walking downhill may aggravate symptoms in individuals with spinal stenosis. For individuals with other forms of musculoskeletal pain, the evidence suggests that appropriate PA (that is tailored to the individual) is unlikely to cause harm.	-Differences between pain that is acute vs. chronic. Exercise not always indicated for acute back pain. Diagnosis is important before prescribing exercise or PA -Tailored prescription of exercise -Abdominal bracing may cause further harm in some back conditions -Walking downhill may aggravate symptoms in individuals with spinal stenosis. -Risk of increasing damage -Risk of increasing pain	-ARMA: Arthritis and Musculoskeletal Alliance Guidance -Versus Arthritis, Arthritis Research UK Policy Position
Type 2 Diabetes [3,4,6,16,44,54–63]	For type 2 diabetic patients, supervision is recommended depending on symptom severity. Tailored PA and/or exercise prescription is necessary. The evidence suggests that diabetic individuals with neuropathy (autonomic and peripheral) and retinopathy may be at an increased risk of injury during PA and/or	-Supervision is recommended -Tailored prescription necessary -Presence of peripheral neuropathy (footwear is important in this regard) -Presence of autonomic neuropathy	-Diabetes UK Guidance -My Diabetes, My Way Scotland NHS Guidance

	exercise. For patients presenting with retinopathy, the Valsalva manoeuvre during resistance training, and high-impact vigorous exercise, should be avoided. Footwear is important for diabetic patients. Additionally, diabetic individuals with poorly controlled glycaemia may need to modify their PA and exercise, as well as note their carbohydrate intake. Patients with diabetes are often overweight or obese and so it is important to note the presence of other diseases, and to also be aware of prescribed medications. Provided that a patient with diabetes is examined effectively (to determine the optimal dose when weighing risks versus benefits, e.g., running may be better for biological outcomes but may increase risk of injury), there is no evidence to suggest that PA may worsen the diabetic condition of an individual.	-Presence of retinopathy (patients should avoid the Valsalva manoeuvre during resistance training, and high-impact vigorous exercise) -Risk of hypo- and hyper-glycaemia -Be aware of medications and interactions with PA (also note carbohydrate intake) -Presence of other diseases and conditions (particularly obesity)	
Primary Prevention [1–3,64–77]	For adults and older adults that are 'apparently healthy', there is an acute risk of adverse event during vigorous exercise. There is also a general risk of (musculoskeletal) injury during vigorous activity for all healthy people, and this is reduced by proper warming-up, stretching, strength training, and balance training. It is important to note that the risk of injury is relative to the size of the increase in PA and that older age, as well as previous injury, increases risk of further injury. There is evidence that there is an attenuation (and perhaps a reversal) of benefits in the case of too much PA is a risk. However, "too much" is defined as being at the extreme of the PA continuum (e.g., people who participate in ultra-endurance events and who reserve little time for adequate rest).	-Acute risk of adverse event during vigorous exercise -General risk of injury (musculoskeletal injury) for all healthy people exists. Reduced by warming-up, stretching, strength training, and balance training. The risk of injury is related to the size of the increase in activity. -Previous injury increases risk of further injury -In older adults, risk of injury is increased (by comparison to adults due to limited functional ability, previous inactivity, previous illness) -Too much PA is a risk: there is an attenuation (and perhaps a reversal) of benefits at the extreme of the PA continuum (people who participate in ultra-endurance events and/or reserve little time for adequate rest)	-
Multi morbidity [6,78]		-Tailored prescription necessary -Be aware of any competing diseases.	-

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Supplementary file 2. List of contributors by group

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PHYSICAL ACTIVITY RISK CONSENSUS GROUP MEMBERS

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Nikant Sabharwal	Consultant Cardiologist and Head of the Nuclear Cardiology Department	Oxford University Hospitals NHS Foundation Trust	Consultant Cardiologist with interest in Exercise Medicine
Brian Johnson	GP, Honorary Medical Advisor to Public Health Wales	NHS	GP and Sport and Exercise Medicine practitioner, Honorary Medical Advisor to PHWales, RCGP Clinical Priority of Physical Activity and Lifestyle Steering group member, CEO of Motivate2Move.co.uk and Benefitfromactivity.org
Anushka Soni	Rheumatologist	Nuffield Department of Orthopaedics	Rheumatologist with a research interest in Musculoskeletal Pain Mechanisms. During my DPhil, I studied the impact of abnormal central pain processing in patients with osteoarthritis of the knee. I showed a relationship between the presence of neuropathic pain and central sensitization pre-operatively, and that this modified the patient's response to knee replacement surgery. Moving forwards, my work will use a combination of techniques, including neuroimaging and clinical pain quantification, to investigate pain related predictors of response to treatment in inflammatory arthritis as well as fibromyalgia.
Scarlett McNally	Consultant Orthopaedic Surgeon, Deputy Director of the Centre for Perioperative Care	Eastbourne District General Hospital	Consultant Orthopaedic Surgeon, Eastbourne D.G.H. since 2002. Elected council member of the Royal College of Surgeons of England, 2011-21. Lead author of 'Exercise the miracle cure and the role of the doctor in promoting it'. Other published work on the link with the economy and social care – we need environments and expectations to change to support everybody to be more active which would reduce need for social care (and improve mental and physical health). Deputy Director of the Centre for Perioperative Care (www.cpoc.org.uk aimed at getting people fitterbettersooner around an operation). Papers on www.scarlettmcnally.co.uk. Twitter @scarlettmcnally
Cliff Kilgore	Consultant Nurse for Intermediate Care and Older People	Dorset Healthcare NHS Trust	Consultant Geriatrician Nurse specialising in care of older people and visiting Fellow to Bournemouth University
Chris Pugh	Professor of Renal Medicine, Honorary Consultant Physician	Oxford University and Oxford University Hospitals NHS Foundation Trust	Professor of Renal Medicine, University of Oxford.

Sarah Wheatley	Exercise teacher	Age UK Oxfordshire	Exercise teacher. Responsible for shaping community exercise services for older adults, previously for NHS and currently for Age UK Oxfordshire.
Lucy Gossage	Consultant Medical Oncologist.	Nottingham University Hospitals NHS	Medical Oncology Consultant in Nottingham with an interest in Exercise Oncology. Co-founder of 5K Your Way, Move Against Cancer (www.5kyourway.org) and have spoken about physical activity in those living with and after cancer at national and international conferences.
Anna Lowe	Programme Manager, Physiotherapist	National Centre for Sport & Exercise Medicine, Sheffield.	Programme Manager at the National Centre for Sport & Exercise Medicine, Sheffield.
Rebecca Robinson	Consultant in Sport and Exercise Medicine	Sheffield Teaching Hospitals NHS Foundation Trust	Consultant in Sport and Exercise Medicine.
Rebecca Appelboam	Consultant in Intensive Care Medicine	Royal Devon and Exeter NHS Foundation Trust	Consultant in Intensive Care Medicine, involved in the follow up of survivors of intensive care in multidisciplinary clinics which patients are invited to 3 months after discharge from hospital. We tackle the psychological cognitive, and physical deficits that survivors experience, and provide support and advice to aid rehabilitation
Diana Greenfield	Consultant Nurse in Late Effects (of cancer treatments) and Honorary Professor in Cancer Survivorship	Consultant Nurse at Sheffield Teaching Hospital, Honorary Professor of The University of Sheffield	Consultant Nurse in Late Effects (of cancer treatments) and Honorary Prof in Cancer Survivorship. Diana Greenfield is a National Institute for Health Research (NIHR) Senior Nurse Research Leader. The views expressed in this article are those of the author and not necessarily those of the NIHR, or the Department of Health and Social Care.
Alistair Lumb	Consultant in Diabetes and General Medicine	Oxford University Hospitals NHS Foundation Trust	Consultant in Diabetes and General Medicine at Oxford University Hospitals NHS Foundation Trust. Affiliated to NIHR Oxford BRC Specialist interest in managing Diabetes (particularly type 1 diabetes) for physical activity and exercise
Sheera Sutherland	Renal Dialysis Research Nurse	Oxford University Hospitals NHS Foundation Trust	Renal Dialysis Research Nurse in Renal Rehabilitation

Julia Newton	Clinical Academic and Consultant in Rheumatology/Sport and Exercise Medicine	Oxford University Hospitals NHS Foundation Trust	Clinical Academic and Consultant in Rheumatology/Sport and Exercise Medicine
Sally Retallick	Lead nurse in Weald PCN	West Kent Health NHS	Practice Nurse in West Kent caring for a range of patients including those with long term conditions. Lead nurse in Weald PCN and Physical Activity Clinical Champion for PHE, delivering free training to HCPs to encourage themselves and their patients to be more physically active.
Andrew Murray	GP and Consultant in Sport and Exercise Medicine	The University of Edinburgh	GP and Consultant in SEM. Previous employment working full time in Public Health policy (Scottish Government). Current Vice-President Ramblers Scotland.
James Hull	Consultant respiratory physician	Royal Brompton & Harefield Hospitals Specialist Care	Consultant Respiratory physician with expertise in asthma, chronic lung disease and impact of exercise in this context
Marie Murphy	Professor of Exercise and Health, Dean of Postgraduate Research and Director of the Ulster Doctoral College.	Ulster University	Professor of Exercise and Health, Dean of Postgraduate Research and Director of the Ulster Doctoral College. Marie's research focuses on the effect of physical activity and exercise, in particular walking, on health and uses multidisciplinary approach that has included outcome measures ranging from the behavioural to the biochemical.
Tracy Barnett	Lead Physiotherapist, Physical Activity Pilot	Oxford University Hospitals NHS Foundation Trust	Senior Physiotherapist with a particular interest in neuro-rehabilitation. Physical Activity Champion for the Active Hospital Project at Oxford University Hospitals Foundation Trust. The project was commissioned by Public Health England to explore ways in which physical activity could be embedded into pathways in secondary care. Extensive work within Frailty pathways as part of this project.
Neil Heron	Consultant in Sport and Exercise Medicine; GP; Clinical Lecturer	Queen's University Belfast	Consultant in Sport and Exercise Medicine; GP; Clinical Lecturer with expertise in physical activity promotion.

Amit Mistry	Consultant in General Adult & Old Age Psychiatry; Honorary Lecturer	Oxford Health NHS Foundation Trust, Queen Mary University of London	General Adult and Old Age Psychiatry and Sports Psychiatry. Chair of the Royal College of Psychiatrists (RCPsych) Sport & Exercise Psychiatry Special Interest Group.

Supplementary file 3: Preparatory stage

This supplementary file details the three parts of the preparatory stage (1) practitioner consultation (2) Patient and Public Involvement project and (3) national service user survey.

1. PRACTITIONER CONSULTATION

Aim

To gain insight into the concerns and requirements of Healthcare Professionals (HCPs) around advice on risk when talking about Physical Activity (PA) to people living with long term conditions (LTC).

Methods

We distributed an online survey using the commercial Survey Monkey software[1] to two national primary care networks in the UK and the Moving Medicine ambassador network between October-November 2019. The Moving Medicine ambassador network is a network of multidisciplinary HCPs who have expressed an interest in the role of physical activity in the management of long-term conditions. The survey contained six open questions with free-text responses. Two questions collected data about respondent job role and place of work, and four around the perception and experience of risk when discussing physical activity with patients. The survey was tested with two HCPs not involved in the project prior to distribution. Responses were analysed through thematic analysis.

Results

57 responses were received (Doctor 42%, Physiotherapist 33%, Nurse 9%, other 16%). 53% worked in primary care, 28% in secondary care and 19% in other care settings. Responders were asked to select more than one answer for questions 3-6. Leading themes that emerged from the consultation are presented in table 1. Full results are presented in table 2 with subgroup analyses in tables 3 and 4.

Table 1. Summary of leading themes

Question		Theme 1	Theme 2	Theme 3
1	What risks are you concerned about when recommending physical activity to patients	Exacerbation of symptoms, causing complications	Demotivating or 'putting off' the patient	Appropriate recommendation of physical activity, tailored to the individual
2	Have you encountered any specific clinical issues or symptoms, related to physical activity, in your patients with long term conditions?	Psychological motivation, patient willingness to change	Worsening of symptoms	Patient concerns regarding worsening of another pre-existing condition
3	What have your patients with long term conditions asked you about their risks of physical activity?	Concerns about risk of worsening of current symptoms	Concerns regarding perceived barriers due to	General safety and development of new symptoms/ events eg pain/myocardial infarction

			other symptoms	
4	What information/ resources/ other would help you to manage risk in clinical practice, when recommending physical activity to people with long term conditions?	Advice regarding specific long-term conditions and safe prescription of physical activity	General advice to give patients about the benefits of physical activity	Leaflets/Posters/Online Resource/Mobile App for patients

Table 2. All results from practitioner survey

Question	Theme	Rank	Number of comments
1. What risks are you concerned about when recommending physical activity to patients?	Exacerbation of symptoms, causing complications	1	29
	Demotivating or 'putting off' the patient	2	9
	No concerns about risk	3	7
	Appropriate recommendation of physical activity, tailored to the individual	4	6
	Adequate support for the clinician recommending physical activity	5	4
	Patients own ability to be physically active	6	2
	Other[a]	7	1
2. Have you encountered any specific clinical issues or symptoms, related to physical activity, in your patients with long-term conditions?	No issues	1	17
	Psychological motivation, patient willingness to change	2	15
	Worsening of symptoms	3	12
	Patient concerns regarding worsening of another pre-existing condition	4	7
	Other[b]	5	7
	Fatigue	6	3
	Physical activity advice from non-clinical practitioners	7	2
3. Have you encountered any specific clinical issues or symptoms, related to physical activity, in your	No issues	1	17
	Psychological motivation, patient willingness to change	2	15
	Worsening of symptoms	3	12

patients with long-term conditions?	Patient concerns regarding worsening of another pre-existing condition	4	7
	Other[c]	5	7
	Fatigue	6	3
	Physical activity advice from non-clinical practitioners	7	2
4. What have your patients with long-term conditions asked you about their risks of physical activity?	Concerns about risk of worsening of current symptoms	1	21
	No questions from patients	2	17
	Concerns regarding perceived barriers due to other symptoms	3	10
	General safety of physical activity	4	8
	Development of new symptoms or risks[3]	5	4
	Other[d]	6	2
5. What information/resources/other would help you to manage risk in clinical practice, when recommending physical activity to people with long-term conditions?	Advice regarding specific long-term conditions and safe prescription of physical activity	1	15
	General advice to give patients about the benefits of physical activity	2	10
	Leaflets/Posters/Online Resource/Mobile App for patients	3	10
	When to refer to a physical activity specialist	4	5
	Specific guidelines or algorithms for recommendation of physical activity	5	4
	Not required	6	6
	Other[e]	7	6

[a] "fully understanding their individual barriers to exercise"
[b] "minor injury"; "screening tools used to access physical activity"; "people requiring support to get changed, eg for swimming – volunteers don't tend to want to support in this area and cost of carers makes a swimming session prohibitively expensive"; "exercise progression and the ability to access further information"; "improvement in physical fitness that translates into better function, or prolonged function in the face of decline; build friendships, confidence, sleep better etc"; "falls off bikes on roads – fractures clavicle, concussion"; "access to facilities, cost or transport problems"
[c] When stated – "will I have a heart attack"; "death, MI"; "heart attack"; "falls, joint pain"
[d] "can't motivate themselves to do any PA"; "do the risks of being physically active outweigh the risk of staying as I am?"
[e] "I think it would be really useful to understand how to manage symptoms rather than being disease specific. We tend to work in chronic diseases whereas what the patient worries about is the symptoms of the disease, this can be tricky with multi morbidity"; "supervised structured classes with time to make friendships"; "some of my SU's can't read, struggle to understand written messages"; "support from local ambassadors and motivators"; "history taking"; "some generic disclaimer type documents"

Subgroup Analyses

Table 3. Subgroup analysis of concerns around worsening of symptoms

Specific symptom of concern	Number of concerns
Respiratory	6
Musculoskeletal/ joint pain	5
Cardiac[a]	2
Medication related[b]	2
Dizziness	2
Blood glucose control	1
Falls	1
Psychological issues	1
Not specified	1

[a] When specified – hypertension; hypotension; angina
[b] Considerations with antipsychotic medication prescription; fluctuations of heart rate on chemotherapy

Table 4. Subgroup analysis of patient concerns regarding worsening of another pre-existing condition

Condition of concern	Number of concerns
Musculoskeletal/ joint pain	5
Blood glucose control	1
Not specified	1

Conclusion

This survey corroborates published data showing the HCPs feel they lack knowledge and skills to discuss PA with patients with LTCs. HCPs expressed a significant level of concern about discussing PA with people with LTC. Fear of aggravating symptoms was a common concern. Primum, non nocere (first, do no harm) is an important driver of medical practice and fear of conflicting with this was commonly expressed. Further to this HCPs felt that they lacked skills to discuss PA in a constructive way with patients and were concerned that they might demotivate patients further. HCPs highlighted the need for specific resources to help them discuss risk with patients.

2. PATIENT AND PUBLIC INVOLVEMENT

This Patient and Public involvement (PPI) project was undertaken in 2016.[2] Results and insight closely aligned with the objectives of this project and were therefore used to inform the development of this consensus statement.

Aim

To explore service users' views on how the National Health Service (NHS) could better support their needs.

Methods

The PPI team recruited forty participants living with multiple LTC's through hospital-based patient support networks across a range of conditions in the UK. Patients were interviewed either individually or in groups (patient preference) by semi-structured interviews. Interviews were recorded and transcribed and thematic analysis of interview transcripts was carried out.

Results

The participants' age range was 60-92, and the mean age was 74 (SD 7.4). There were four ethnic groups represented. 55% of the participants were female, and 45% were male. The mean number of co-morbidities was 2.85(SD 2.9). The analysis identified that although participants overwhelmingly stated they wanted to become more active, fear of exacerbating the symptoms of health conditions was a major barrier in keeping with published studies examining barriers to PA in multimorbid groups.[3–5] Symptoms of concern included breathlessness, fatigue, muscle weakness and anxiety about falling or 'getting stuck'.

'it is a bit like trusting a parachute; you get up there and trust the silk, you will find the most wonderful thing in the world, but actually doing it is hard'

Participants reported conflicting advice from HCPs about the risk of adverse events from PA.

'they told me I should never bend forward, never'

The following primary themes emerged from qualitative analysis: [2]

- Patients generally present concerns based on their symptoms or syndromes, not their underlying LTC's.
- Continuity of advice and simple messages reduce confusion and are therefore empowering for people living with LTC's.
- Addressing risk is an essential facilitator for people considering increasing their PA levels
- Cross-sector system support is required to improve the experience of inactive people with LTC's starting to become more physically active.

3. NATIONAL CONSULTATION

Stakeholder consultation with Sport England further informed our understanding of patient preferences through a related piece of work in the UK. In 2019, The National Centre for Sport and Exercise Medicine (NCSEM) at Sheffield Hallam University in collaboration with Sport England and RCGP clinical priority group engaged 361 participants in a national online consultation to inform approaches to improving physical activity support for people with LTCs.[6]

A frequently reported barrier to participation in PA initiatives was getting medical 'sign-off' to participate.

> *"People who are fit and healthy are told they need to see their GP prior to being able to exercise and this sends the* wrong *message … Patients who have a health condition but are safe and well managed should not be asked to see their GP."*

Triage processes are often unclear, with a lack of system support for the 'sign-off' process.

> *"…most aren't qualified to assess the risk for an individual of exercising and the current system doesn't give them the confidence to signpost or refer without fear of them being liable"*

People over 50 were more likely to have individual concerns with getting sign-off before participation in PA. Those under 50 emphasised the importance of HCPs having the knowledge, confidence and the right attitudes to have conversations about sport and PA with people with LTC's.

> *"If you have a health condition, it can be difficult to get medical clearance to participate in certain physical activities. Often this requires sign-off from a health professional, for a fee, who may not even feel qualified or confident to do this."*

Finally, our conclusions from our patient and public insight were presented to the Richmond Group of Charities who have done extensive patient facing work in this areas including the 'We are undefeatable' campaign in collaboration with Sport England. The Richmond group confirmed that key themes identified through our consultation process matched commonly held concerns heard reported by their membership groups.

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1 SurveyMonkey Inc. 1999.www.surveymonkey.com
2 Jones N, Jackson K, Foster C, *et al.* Patient and Public Involvement project to identify and prioritize key components of a new exercise rehabilitation service for people with multi-morbidity. 2016. *OSF Prepr* 2016;:1–30. doi:10.31219/OSF.IO/FT8W6
3 Hunt ER, Papathomas A. Being physically active through chronic illness: life experiences of people with arthritis. *Qual Res Sport Exerc Heal* 2020;**12**:242–55. doi:10.1080/2159676X.2019.1601637
4 Franco MR, Tong A, Howard K, *et al.* Older people's perspectives on participation in physical activity: A systematic review and thematic synthesis of qualitative literature. Br. J. Sports Med. 2015;**49**:1268–76. doi:10.1136/bjsports-2014-094015
5 Yarmohammadi S, Mozafar Saadati H, Ghaffari M, *et al.* A systematic review of barriers and motivators to physical activity in elderly adults in Iran and worldwide. Epidemiol. Health.

2019;**41**:e2019049. doi:10.4178/epih.e2019049

6 CleverTogether. #EasierToBeActive: Making it easier to be active with a health condition: a national conversation. Report of findings from Phase one. Sheffield: 2019. https://easiertobeactive.clevertogether.com/

Supplementary file 4. Delphi survey qualitative feedback

Feedback themes are presented alongside actions taken alongside statement progression

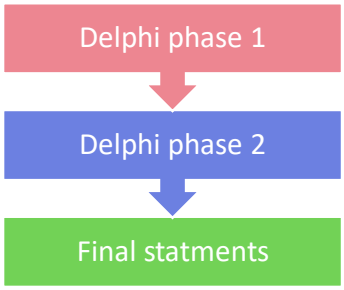
General feedback

Theme	Actions taken
Simplify wording & frame messages more positively	Messages reduced in length, statement wording simplified and standardised. Single sentence 'impact statements' added to headline statements to simplify messages and improve readability.
Reduce medical language	The use of 'patients' has been changed to 'people' or 'individuals'. Medical language simplified, but since this is a medical statement and not aimed at the general public or fitness professionals some medical language remains where it has been felt to provide extra clarity.
Remove the comment that there is 'no evidence' from several of the symptom statements	Wording of symptom statements amended to better reflect the balance of evidence.
Include more about benefits of physical activity in the symptom statements	The benefits of physical activity are not the main focus of this paper, so are not emphasised in this consensus statement.

Feedback on headline messages

Theme	Actions taken
consider order of the messages: start with patient barriers, address these and then describe benefits/what can be offered by healthcare professionals	this was not been changed, as consensus reached – however, bullet point headlines have added as suggested
shorten headlines and then give further information in a paragraph underneath	in response to overarching themes about safety considerations, we are now testing an additional 4th statement (see below) to directly address these concerns in the headline messages

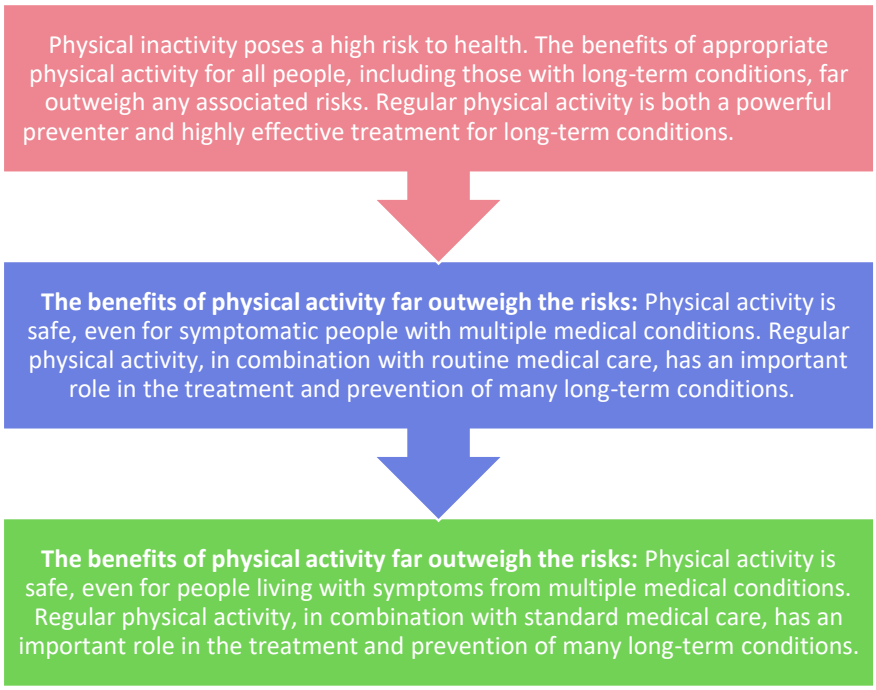
Evolution of each statement is subsequently presented in the following format:



HEADLINE 1

	Feedback themes	Actions taken
Headline Message 1	this message reassures that physical activity is appropriate/beneficial to all	statement simplified to reflect feedback
	simplify language and use physical activity, rather than inactivity	mental health is not specifically included, as this is not commonly reported as a specific risk in physical activity interventions
	some long-term conditions may not be preventable, although physical activity can help in their management	
	include mental health	
	it is important to reassure healthcare professionals that physical activity in those with long-term conditions is not dangerous	
	message reinforces the importance of discussion about physical activity between healthcare providers & those with long-term conditions	

Evolution of statement



HEADLINE 2

	Feedback themes	Actions taken
Headline Message 2	clarify 'tolerance'	statement simplified
	it is important to emphasise that increase in physical activity should be gradual	'tolerance' removed
	simplify language	
	this is a very important message emphasise low risk of physical activity	

Evolution of statement

There is a very low risk of serious adverse events when physical activity is gradually increased, according to tolerance, in symptomatic individuals with long-term conditions. This risk is mitigated by appropriate, well informed conversations between patients and their healthcare provider, and subsequently, where applicable, by patients and physical activity providers.

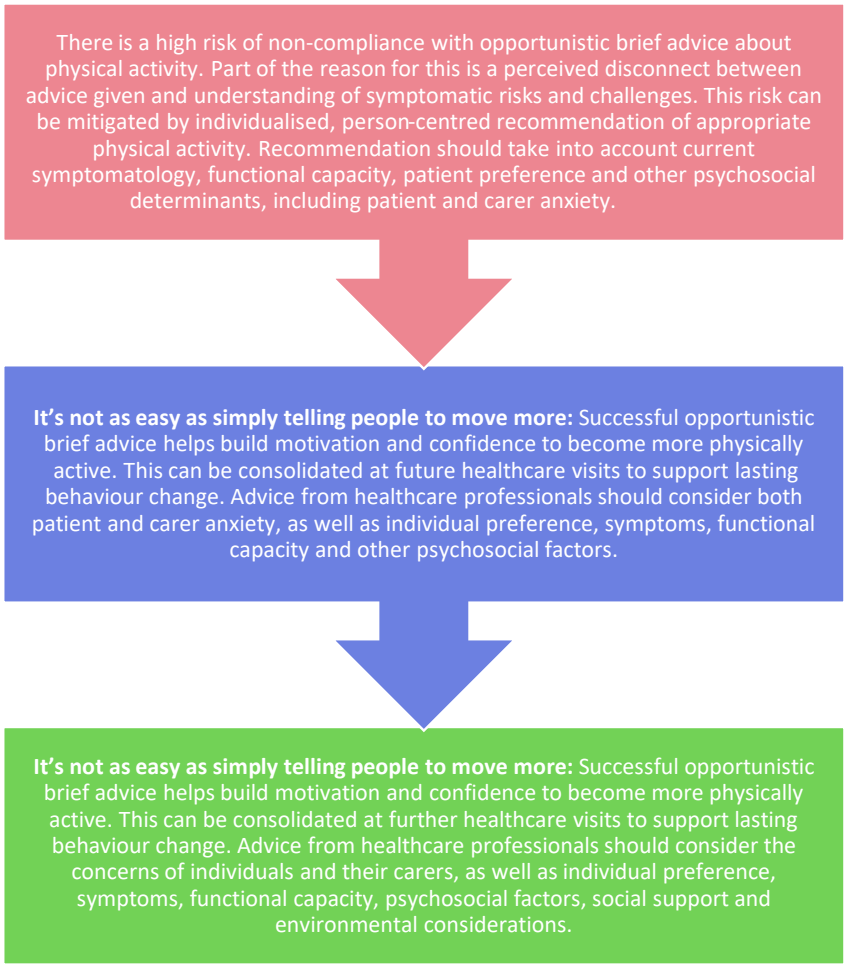
The risk of serious adverse events is very low, but that's not how people feel: People with long-term conditions are often fearful of potential undesired consequences from physical activity. However, when physical activity levels are gradually increased, the risk of serious adverse events is very low indeed. Well informed, person-centred conversations with healthcare professionals can reassure people and further reduce this risk.

The risk of serious adverse events is very low, but that's not how people feel: People with long-term conditions are often fearful of worsening their condition or experiencing potentially undesired consequences from physical activity. In fact, when physical activity levels are increased gradually, the risk of serious adverse events is very low. Well informed, person-centred conversations with healthcare professionals can reassure people and further reduce this risk.

HEADLINE 3

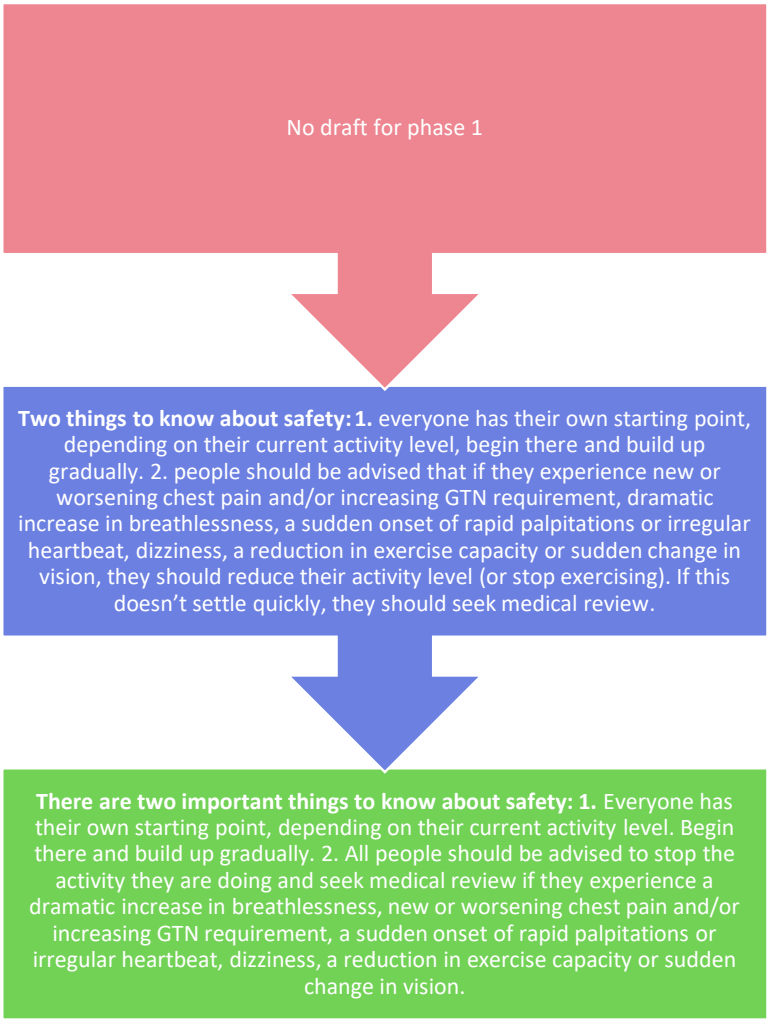
	Feedback themes	Actions taken
Headline 3	avoid use of 'non-compliance'	'non-compliance' removed
	simplify statement	message simplified
	a very important part of the overall message	
	important to emphasise the personalised/individualised aspects of conversations between healthcare professionals & individuals with long-term conditions	

Evolution of statement



HEADLINE 4

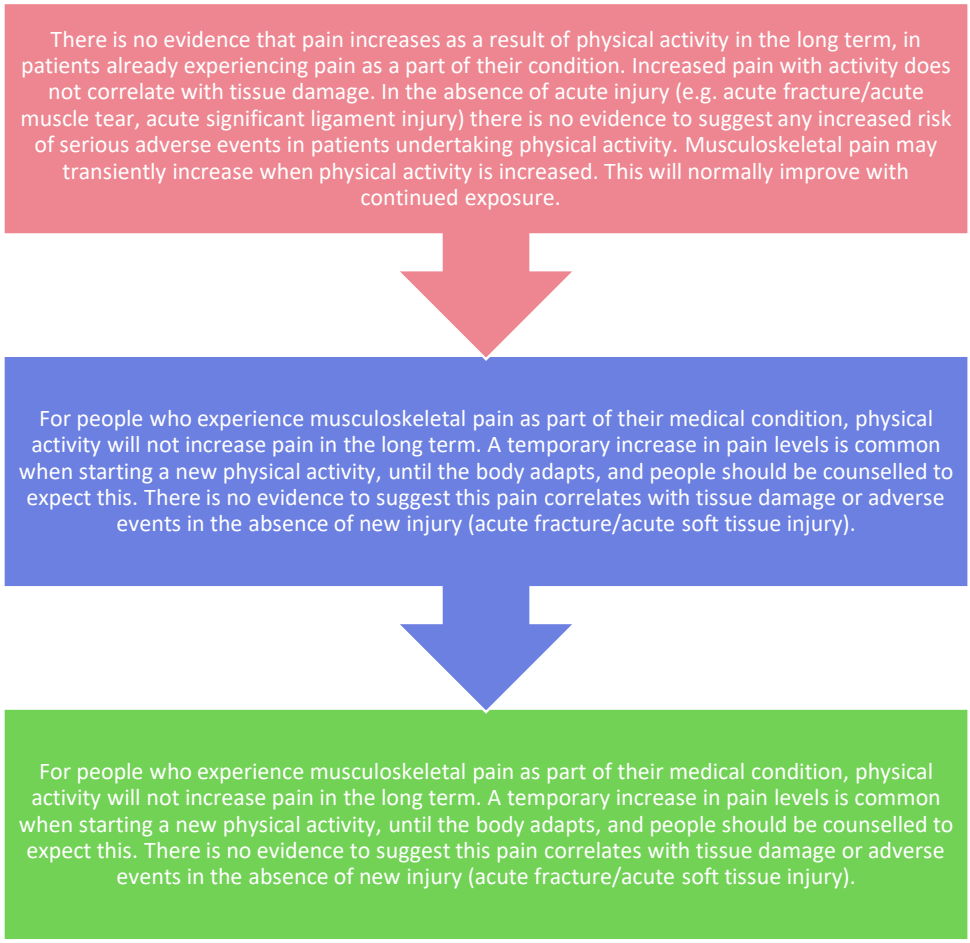
Evolution of statement



MUSCULOSKELETAL PAIN

	Feedback themes	Actions taken
Musculoskeletal Pain	consider bullet points/reduce length of statement	the statement has been adapted to reflect feedback, and simplified to negate the need for bullet points
	emphasise the potential short-term side effects such as increased pain	specific conditions are included in evidence summary
	reconsider use of 'no evidence'	
	Add in specific conditions such as arthritis, back pain, osteoarthritis	

Evolution of statement



FATIGUE

	Feedback themes	Actions taken
Fatigue	emphasise that physical activity can improve sleep, and evidence for reduced fatigue and improved wellbeing/psychological benefits specifically mention cancer-related fatigue & associated factors	cancer related fatigue is listed separately in the supporting evidence section but not separated in headline statement
	ME/CFS patients will feel strongly against this statement	specific reference is included in the supporting evidence about ME/CFS, suggesting that people are directed to specialist services for this group, as published literature is inconclusive

Evolution of statement

There is no evidence to suggest that increasing physical activity causes increasing fatigue in the medium or long term in patients already suffering from fatigue. Some short-lived fatigue is common after increasing physical activity in all populations. Chances of significantly increased fatigue can be reduced by gradually increasing levels of activity.

Appropriate regular physical activity helps reduce fatigue and improves wellbeing and sleep. A temporary increase in fatigue is commonly experienced when starting a new physical activity, until the body adapts. People should be counselled to expect this and advised to build up activity gradually. People experiencing fatigue related to chronic fatigue syndromes may benefit from specialist advice.

Regular physical activity helps reduce fatigue and improves wellbeing and sleep. A temporary increase in fatigue is commonly experienced when starting a new physical activity, until the body adapts. People should be counselled to expect this and advised to build up activity gradually. People experiencing fatigue related to chronic fatigue syndromes may benefit from specialist advice.

SHORTNESS OF BREATH

	Feedback themes	Actions taken
Shortness of Breath	patients should be advised to do what they can, rather than stop being physically active during an exacerbation or hospitalisation	specific disease recommendations have been included in supporting evidence – physical activity risk is sufficiently generic to maintain a symptom-based approach.
	reference the fear that people experience and the psychological impact	safety considerations are now addressed in Headline Statement 4
	distinguish between being physically active and doing physical activities	reference to recognising fear has been included in updated statement
	change 'no evidence' to 'balance of evidence' to improve credibility	the role of pulmonary rehabilitation has been referenced in the evidence statement, but is not within the scope of the symptom statement
	improve safety netting advice for this high-risk group	
	reference pulmonary rehabilitation	

Evolution of statement

There is no evidence to suggest increased risk of adverse events in breathless patients undertaking physical activity programmes. Feeling more breathless than usual is normal with increased physical activity in both patients who are breathless at rest and those who are not. Physical activity should be recommended dependent on severity of symptoms and gradually increased according to tolerance. Patients should be counselled regarding concerning features such as chest pain or dizziness.

It is normal for all people to feel more breathless than usual when increasing their activity level. The balance of evidence suggests that the increased risk of adverse events in breathless people when doing physical activity is very low. People should be counselled individually to gradually increase physical activity, taking into account their severity of symptoms and fear of breathlessness.

It is normal for all people to feel more breathless when increasing their activity level. The balance of evidence suggests that the increased risk of adverse events in breathless people when doing physical activity is very low. People should be counselled individually to gradually increase physical activity, taking into account their severity of symptoms, and fear of breathlessness

CARDIAC CHEST PAIN

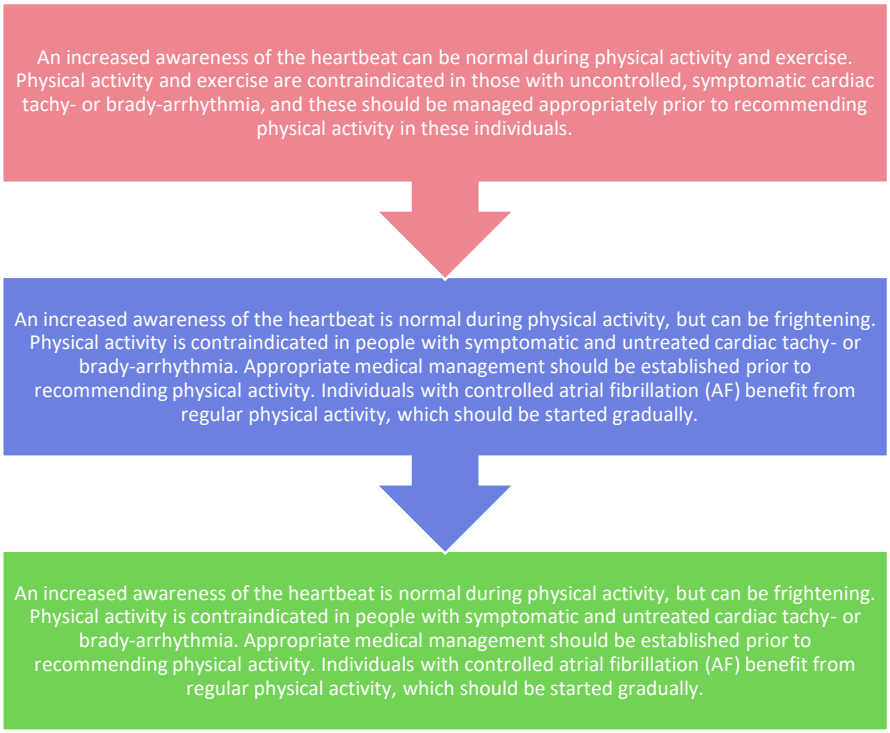
	Feedback themes	Actions taken
Cardiac Chest Pain	quantify the risks of adverse events, including the temporary short-term increased risk during exercise	It is not possible to accurately quantify risk from available evidence regarding individuals with long term medical conditions – this will be highlighted as an area for future work
	make language more accessible	published incidence data on complications from exercise in individuals with known ischaemic heart disease is derived from supervised cardiac rehabilitation programmes, therefore not generalisable to the target population for this consensus statement, and has not been included
	clarify differences between physical activity and exercise	safety statement has been removed as it is now in headline statement 4

Evolution of statement

PALPITATIONS

	Feedback themes	Actions taken
Palpitations	mention new palpitations that occur during activity	comment about new palpitations has been added to Headline Statement 4
	refer to atrial fibrillation specifically	atrial fibrillation is directly addressed in statement and supporting documentation
	consider including other triggers for palpitations, such as anxiety and thyroid disease	

Evolution of statement



DYSGLYCAEMIA

	Feedback themes	Actions taken
Hypoglycaemia	emphasise the long-term benefits of physical activity, including for decreased medication use and improved glycaemic control	significant changes have been made to the content and structure of this statement, so it has been included in Phase 2 (despite meeting consensus agreement in Phase 1)
	consider renaming to 'dysglycaemia'	title of statement has been changed to dysglycaemia
	reconsider reference to ketones in the main symptom statement	references to ketones have been removed from the Symptom Statement (included in supporting evidence)
	intensity of exercise is important, particularly in young people	comment on intensity of exercise is outside of the scope of this consensus statement
	increased risk of hypoglycaemia in those over 45y - more care is needed in this group	specific risks have been addressed in the evidence statement
	include complications of diabetes such as foot ulcers	diabetic complications have not been included in the symptom statement but have been included in the supporting evidence statement

Evolution of statement

COGNITIVE IMPAIRMENT

	Feedback themes	Actions taken
Cognitive Impairment	emphasise available support	title of statement has been kept as 'cognitive impairment' as the statement is following a symptom-based approach and is not limited to dementia
	consider the range of possible impairments and comorbidities in this broad group	statement has been updated to reflect other feedback
	consider changing the name of the statement to 'dementia'	
	address environmental considerations	

Evolution of statement

There is no evidence that physical activity may worsen cognitive impairment, and there are no general contraindications to recommendation of physical activity in this population. Strategies to maintain motivation, engagement and safety are important. Appropriate support is generally beneficial and physical activity should be individualised depending on level of function, communication ability, stage of disease and comorbidities. Individuals with cognitive impairment are at increased risk of falls and associated injury, and approaches to mitigate this should be considered.

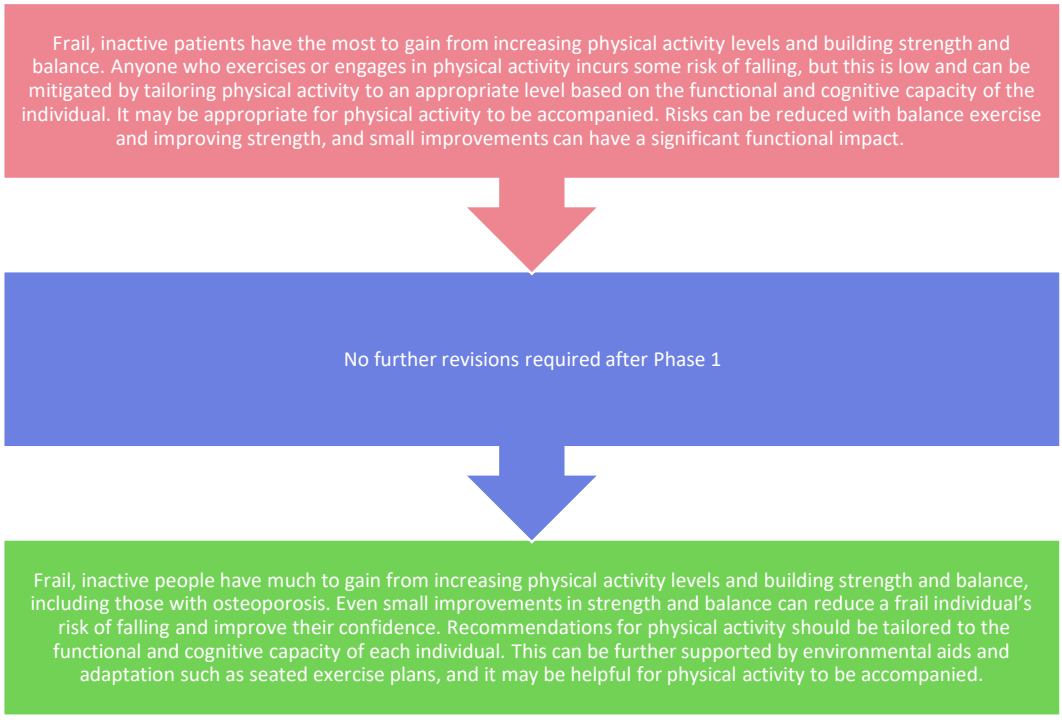
The balance of evidence suggests that the benefits of physical activity in people with cognitive impairment far outweigh the associated risks. Strategies to maintain motivation, engagement and safety are important. These should be individualised, depending on level of function, stage of disease, communication ability (including visual and hearing impairment), preferred environment and other medical conditions. People with cognitive impairment have an increased risk of falling so support from others is often beneficial.

The benefits of physical activity in people with cognitive impairment far outweigh the associated risks. Strategies to maintain motivation, engagement and safety are important and people will often benefit from support from others. Strategies should take into account level of function, stage of disease, communication ability (including visual and hearing impairment), preferred environment, risk of falling and other medical conditions.

FALLS AND FRAILTY

	Feedback themes	Actions taken
Falls & Frailty	a strong and positive statement	osteoporosis is now mentioned in the statement, and included in the supporting evidence
	include osteoporosis	wording updates have been amended as recommended
	change wording from 'the most' ('Frail, inactive patients have the most to gain…') as other groups also have a lot to gain from increasing physical activity levels	
	emphasise the importance of strength and balance	

Evolution of statement



Supplementary file 1. Rapid evidence review

SUMMARY OF EVIDENCE REVIEW PROCESS

A rapid review of the literature was done to establish what is known about the risks of physical activity (PA) and exercise in people with long-term conditions (LTCs). This was presented to the steering group during the consultation phase. Once the symptom-based approach and clinical priorities for the consensus statement were established by the steering group, this review was used in the creation of the symptom-specific evidence statements.

AIMS OF EVIDENCE REVIEW

Provide an overview of existing guidelines and/or recommendations that address the risks of PA for people with long-term conditions, including:

1. What has previously been done to understand the associated risks?
2. What conclusions or consensus were reached?
3. How were conclusions or consensus reached?

Where possible, and using the findings from Aim 1, summarise the nature and incidence of recognised risks (morbidity and mortality) from physical activity by long-term conditions.

METHODS

The approach adopted for this review was a Rapid Evidence Review. This reflected both the nature of the question, and the time and resources available.

In terms of selecting relevant literature the following AGREE II criteria were used:

- Target population: adults (18-64 years) and older adults (65 years+), patients with one or more chronic condition undertaking physical activity;
- Study designs: position statements', 'consensus statements', 'guidelines' and 'recommendations';
- Comparisons: not applicable;
- Outcomes: quantified or qualified risks of physical activity;
- Language: Available in English;
- Context: not applicable.

The online search was conducted in September-October 2019 using four major databases including PubMed, Google Scholar, Scopus and Web of Science. The chronic conditions listed on the Moving Medicine website were used as search terms, and included: 'cancer', 'COPD' ('chronic obstructive pulmonary disease'), 'dementia', 'depression', 'falls' and 'frailty', 'inflammatory rheumatic disease', 'ischaemic heart disease', 'musculoskeletal pain', 'type 2 diabetes mellitus'. Additional search terms including 'mental health', 'rheumatoid arthritis', 'heart disease' and 'cardiovascular disease' were used to ensure that publications were not excluded due to different nomenclature used in different countries.

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Furthermore, the search also included conditions/symptoms that are typically associated with the chronic conditions listed on the Moving Medicine website; including 'Parkinson's disease', 'Alzheimer's disease', 'osteoarthritis', 'high blood pressure', 'hypertension', 'obesity', 'lower back pain'. The search terms 'adults' and 'older adults' were used to assess risk of physical activity under the heading of 'primary prevention'. Papers that reported on children and adolescents exclusively were excluded, as well as publications that exclusively covered conditions including fibromyalgia, HIV/AIDs and palliative care.

The search was targeted to 'position statements', 'consensus statements', 'guidelines' and 'recommendations' regarding PA and exercise prescription within each condition mentioned above. Search statements used (though not limited to) included: 'position statement on physical activity in (*insert condition*)', 'risks associated with being physically active', 'risks with physical activity prescription', 'risks with exercise prescription', 'practical considerations exercise prescription in (*insert condition*)' and 'consensus on the risks associated with physical activity'.

For publications where an academic body or organisation (such as the American Diabetes Association, ADA; or American College of Sports Medicine, ACSM) had more than one guideline or position statement, the most recent version was used.

In addition to the search for peer-reviewed publications and towards the end of the review process, an additional search for foundations, charities, and organisations that provide PA guidance for people with chronic conditions in the United Kingdom (UK) was conducted. Search statements for this component of the review process included, but were not limited to, statements such as '(*insert condition*) and physical activity UK', exercise and (*insert condition*) UK' and 'exercise prescription in (*insert condition*) UK'. It is important to note that the organisations and foundations identified in this component of the search process do not always give recommendations or discuss risk based on sound scientific evidence. For this reason, the results of this search are kept separate from the results generated from the primary search described above.

SUMMARY OF RESULTS

The findings of this rapid review suggest that there are condition-specific risks associated with the prescription of PA and/or exercise. However, these risks are outweighed by the benefits of PA for all conditions covered by this review. There is variability between conditions in terms of what has been done, and the specificity of recommendations or guidance.

The evidence is supportive of good prescription practice that involves a patient-centred approach, whereby PA and exercise prescription is tailored to the needs of the patient. A patient-centred approach can be demonstrated in several ways, such as:

- Knowing if and when supervised PA/exercise is required;
- Understanding the condition of the patient according to their symptoms, and not according to their diagnosis or disease exclusively;
- Considering the level of function of a patient according to their physical capabilities within their disease, and not according to their disease exclusively.

RESULTS IN RESPONSE TO AIMS

a) What has previously been done to understand the associated risks of physical activity in people with long-term conditions?

Seventy-nine relevant reports (reviews, consensus statements, position statements or guidelines) from around the globe were identified as relevant to this question. An overview of the work reviewed is shown in Table 1. It is worth noting that several references consider more than one condition. An overview of the search for foundations and/or organisations that provide PA guidance for people with chronic conditions is also shown in Table 1.

The majority of reports screened for this review primarily emphasise and report on the benefits of PA and/or exercise, and only some addressed the associated risks. When risks are addressed, (i) they are treated as secondary to the benefits; and (ii) they are not always specific to the condition in question.[1]

b) What conclusions or consensus were reached?

When risk is reported, it is discussed in one of three main ways:

1. The risks of PA are weighed against benefits, and the benefits of PA are usually stated to be greater than any potential risks;
2. Generic risks of PA or exercise-induced injury, that would also apply to a healthy population, are reported more often than condition specific risks;[2]
3. The risks of PA are addressed in a way that is not necessarily backed by empirical scientific evidence, but rather using a 'common sense' approach.

Specific risks and considerations as outlined in the various documents are summarised by condition in Table 1.

c) How were conclusions or consensus reached?

For the publications and documents included in this review, conclusions and consensus has been reached in the following ways:

1. For review papers (where recommendations are made following the either systematic or non-systematic review of evidence) the statements are "evidence based" though not always condition specific;
2. For consensus statements, position statements or guidelines, the consensus has been reached following panel discussions. The panels are either made up of medical professionals/clinicians, researchers/academics or a combination. No statements based on Delphi methods have been identified in this review;
3. For some publications including guidelines and position statements, the conclusion has been drawn based on expert opinions. These experts are professionals/clinicians, researchers/academics or a combination

Table 1: Overview of literature reviewed and findings, shown by disease.

Condition and references	Summary of findings	Additional PA considerations	Relevant UK Organisations
Cancer [3–13]	There is no evidence to suggest that PA may worsen the condition of an individual with cancer or undergoing cancer treatment. The risks associated with cancer largely depend on the type and site of cancer (e.g., physical activity following a surgery close to the arms may need to be adjusted). Overall, individuals with cancer are encouraged to exercise as tolerated, and to pay attention to signs/symptoms and the state of their immune system. Specific signs/symptoms or considerations to be aware of include lymphoedema, pain, and chemotherapy-induced peripheral neuropathy. Exercising while supervised may be required.	-Presence of lymphoedema -History of surgery -Presence of pain -Presence of chemotherapy-induced peripheral neuropathy -Be aware of the area affected by the cancer – particularly for bone cancer (for risk of fracture) -Exercise as tolerated (presence of signs/symptoms and state of immune system is particularly important) -Supervision may be required	-Cancer Research UK Exercise Guidelines -The BASES Expert Statement on Exercise and Cancer Survivorship -MacMillan Cancer Support Guidance -NHS – Guys and Thomas -Pancreatic Cancer UK Information and Support -Prostate Cancer UK Guidance -Lymphoma Action UK Guidance -Breast Cancer Now Information
COPD [3,4,6,7,14–21]	An important consideration for patients with COPD is the severity of the condition. As the severity of the condition increases, the level of risk increases. For high-risk, symptomatic COPD patients, PA should be replaced with pulmonary rehabilitation, in which case supervision may be required. There is evidence that PA should be avoided due to increased risk in COPD patients during an infective episode or if the patient is in the immediate recovery phase of an exacerbation. If a COPD patient exercises as tolerated and in a manner that is tailored to their condition, and in an environment that is not polluted, there is no evidence to suggest that PA may worsen the condition of an individual with COPD.	-Timing of exacerbations -Risk of infections -Co-morbidities -Exercise as tolerated (presence of symptoms is particularly important) -Supervision may be required -Prescription of exercise should be tailored	-British Lung Foundation Support -NHS Inform Living with COPD
Dementia [3,4,6,7,22–24]	There is no evidence to suggest that PA may worsen the condition of an individual with dementia. However, exercise and/or PA should be made safer for individuals with dementia, as these individuals tend to have issues related to forgetfulness, balance, gait, and proprioception. Furthermore, these issues can worsen as the disease progresses and therefore the stage of the disease is an important consideration. Prescription of PA should be tailored to the needs of the individual and should be supervised when needed.	-Forgetfulness during activities -Safety related to balance, gait and proprioception -Stage of the disease is important -Tailored prescription as per the needs of an older adults (where applicable -Supervision may be required	-Alzeimer's Society United Against Dementia Guidance -Department of Health: 'Nothing Ventured, Nothing Gained': Risk guidance for people with dementia

Depression [6,7,25–29]	There is evidence that a low risk of 'physical activity dependence' exists in the general population, and this risk may be somewhat higher for people with depression. However, this is extremely rare overall. There is also evidence that PA should not be prescribed to an underweight depressed individual as there is a potential link with disordered eating. Provided that an individual with depression exercises or is physically active in an environment or setting that is not related to the source or trigger of the depression (e.g., avoiding group activities for someone with social phobia) and is not underweight due to an eating disorder, there is no evidence to suggest that PA may worsen the depressive condition of an individual with depression.	-Source of depression (linked to self-esteem and also eating disorders) -Link timing of PA and exercise to depressive symptoms -Exercise dependence (and therefore a negative motivation)	-Mind Tips -Mental Health Foundation Guidance
Falls and Frailty [3,4,16,30–37]	There is evidence that anyone who exercises or engages in PA incurs some risk for an adverse event (including a fall with fracture), but this is at any age. Exercise and PA prescription should be tailored according to the individual's physical condition, level of function and presence of other disease(s) or disability. Supervision may be required for some individuals, and risk may be attenuated by making exercise and/or PA safe through changes to the home environment, selecting appropriate exercise equipment and footwear.	-Exercise (in general) increases acute risk of falls (and potentially fractures) -Presence of other diseases (Multi-morbidity) -Older adulthood is a special consideration and level of function is important -Supervision may be required -Safety (in terms of the home, exercise equipment and footwear) should be considered.	-Age UK guidance for older adults and guidance for falls prevention -National Osteoporosis Society / Royal Osteoporosis Society and British Geriatrics Society Consensus statement
Inflammatory Rheumatic Disease [3,4,6,16,38–42]	There is risk of harming a joint if improper technique is used when stretching, exercising and being physically active, especially if there is existing inflammation. In this regard, supervision may be required. Exercise and/or PA should be tailored according to the individual's physical condition (including the weight status of the patient), level of disability, the degree of pain and inflammation present in the joints needing exercise, as well as the personal preference of the patient. Another potential consideration is that of drug therapy (and the interactions with PA). It is necessary for post-exercise discomfort and pain to inform following exercise sessions. While some muscle soreness (or stiffness) is expected for an individual who is untrained, prescription should change if symptoms of the disease worsen.	-Supervision may be required -Presence of joint pain -Footwear is potentially important -Tailor exercise as per the needs and preference of patient, as well as disease activity (inflammation) -Be aware of medications and interactions with PA -Discomfort and pain post-exercise is important to inform following exercise sessions -Overweight or obesity may limit choice of PA/exercise	-National Rheumatoid Arthritis Society Guidance -ARMA: Arthritis and Musculoskeletal Alliance Guidance -Versus Arthritis, Arthritis Research UK Policy Position

Ischaemic Heart Disease [3,4,6,7,16,43–49]	Supervision during exercise and/or PA is recommended for patients with heart disease, especially higher-risk patients, who may also require monitoring throughout their PA and/or exercise. It is important to be aware of medications and the interactions with PA (e.g., beta-blockers attenuate heart rate response). Hypertensive patients should avoid the Valsalva manoeuvre during resistance training, and exercise should be avoided in the case of systolic BP >180 mmHg and/or diastolic BP >105 mmHg. There is evidence that anyone who exercises or engages in PA incurs some risk for an adverse event. However, the evidence suggests that it is unlikely that a cardiac event that occurs during or soon after exercise is because of the exercise. Rather, it is likely that the individual had an underlying condition that was exacerbated by exercise. Exceeding the recommended dose of exercise or PA may increase the risk for recurrent cardiovascular events. Provided that a heart disease patient exercises within their limitations and are risk-stratified correctly, there is no evidence to suggest that PA may worsen the condition of an individual with heart disease.	-Supervision is recommended -Acute risk of adverse event -Higher-risk patients need supervision and monitoring -Be aware of medications and interactions with PA -Presence of other diseases and conditions (particularly hypertension and obesity) -Hypertensive patients should avoid the Valsalva manoeuvre during resistance training. Exercise to be avoided in the case of systolic BP >180 mmHg or diastolic BP >105 mmHg	-Heart UK (Cholesterol Society) Guidance -Cardiomyopathy UK Guidance -British Heart Foundation Information
Musculo-skeletal pain [3,4,6,7,16,50–53]	For lower back pain specifically, it is important to determine whether the pain is acute or chronic. Thus, obtaining an accurate diagnosis is important before prescribing exercise or PA. Exercise should not be prescribed for individuals with acute lower back pain. Abdominal bracing may cause further harm in some back conditions and is therefore not recommended. Walking downhill may aggravate symptoms in individuals with spinal stenosis. For individuals with other forms of musculoskeletal pain, the evidence suggests that appropriate PA (that is tailored to the individual) is unlikely to cause harm.	-Differences between pain that is acute vs. chronic. Exercise not always indicated for acute back pain. Diagnosis is important before prescribing exercise or PA -Tailored prescription of exercise -Abdominal bracing may cause further harm in some back conditions -Walking downhill may aggravate symptoms in individuals with spinal stenosis. -Risk of increasing damage -Risk of increasing pain	-ARMA: Arthritis and Musculoskeletal Alliance Guidance -Versus Arthritis, Arthritis Research UK Policy Position
Type 2 Diabetes [3,4,6,16,44,54–63]	For type 2 diabetic patients, supervision is recommended depending on symptom severity. Tailored PA and/or exercise prescription is necessary. The evidence suggests that diabetic individuals with neuropathy (autonomic and peripheral) and retinopathy may be at an increased risk of injury during PA and/or	-Supervision is recommended -Tailored prescription necessary -Presence of peripheral neuropathy (footwear is important in this regard) -Presence of autonomic neuropathy	-Diabetes UK Guidance -My Diabetes, My Way Scotland NHS Guidance

	exercise. For patients presenting with retinopathy, the Valsalva manoeuvre during resistance training, and high-impact vigorous exercise, should be avoided. Footwear is important for diabetic patients. Additionally, diabetic individuals with poorly controlled glycaemia may need to modify their PA and exercise, as well as note their carbohydrate intake. Patients with diabetes are often overweight or obese and so it is important to note the presence of other diseases, and to also be aware of prescribed medications. Provided that a patient with diabetes is examined effectively (to determine the optimal dose when weighing risks versus benefits, e.g., running may be better for biological outcomes but may increase risk of injury), there is no evidence to suggest that PA may worsen the diabetic condition of an individual.	-Presence of retinopathy (patients should avoid the Valsalva manoeuvre during resistance training, and high-impact vigorous exercise) -Risk of hypo- and hyper-glycaemia -Be aware of medications and interactions with PA (also note carbohydrate intake) -Presence of other diseases and conditions (particularly obesity)	
Primary Prevention [1–3,64–77]	For adults and older adults that are 'apparently healthy', there is an acute risk of adverse event during vigorous exercise. There is also a general risk of (musculoskeletal) injury during vigorous activity for all healthy people, and this is reduced by proper warming-up, stretching, strength training, and balance training. It is important to note that the risk of injury is relative to the size of the increase in PA and that older age, as well as previous injury, increases risk of further injury. There is evidence that there is an attenuation (and perhaps a reversal) of benefits in the case of too much PA is a risk. However, "too much" is defined as being at the extreme of the PA continuum (e.g., people who participate in ultra-endurance events and who reserve little time for adequate rest).	-Acute risk of adverse event during vigorous exercise -General risk of injury (musculoskeletal injury) for all healthy people exists. Reduced by warming-up, stretching, strength training, and balance training. The risk of injury is related to the size of the increase in activity. -Previous injury increases risk of further injury -In older adults, risk of injury is increased (by comparison to adults due to limited functional ability, previous inactivity, previous illness) -Too much PA is a risk: there is an attenuation (and perhaps a reversal) of benefits at the extreme of the PA continuum (people who participate in ultra-endurance events and/or reserve little time for adequate rest)	-
Multi morbidity [6,78]		-Tailored prescription necessary -Be aware of any competing diseases.	-

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Supplementary file 2. List of contributors by group

Authorship group (n=5)

Name	Institution	Role
Dr Natasha Jones	Faculty of Sport and Exercise Medicine, Oxford University Hospitals NHS Foundation Trust	Consultant in Sport and Exercise Medicine, Clinical Director Moving Medicine
Dr Hamish Reid	Faculty of Sport and Exercise Medicine, Centre for Sport and Orthopaedic Medicine Bermuda	Consultant in Sport and Exercise Medicine, Clinical Director, Moving Medicine
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Stakeholder group (n=4)

Name	Institution	Role
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Sarah Ruane	Sport England	Strategic Health Lead
Dr Mike Brannan/Mr Jamie Blackshaw	Public Health England	National Leads for Diet, Obesity and Physical Activity
Dr Andrew Boyd	Royal College of General Practitioners, Clapham Park Group practice	GP Partner and RCGP Clinical Priority Champion, physical activity & lifestyle

PHYSICAL ACTIVITY RISK CONSENSUS GROUP MEMBERS

Steering Group (n=13)

Name	Role	Institution
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Catherine Lester	Consultant in Sport and Exercise Medicine	Moving Medicine Lead, Queen Mary University London
Chris Pugh	Professor of Renal Medicine, Honorary Consultant Physician	Oxford University and Oxford University Hospitals NHS Foundation Trust
Christopher Speers	Consultant in Sport and Exercise Medicine	Oxford University Hospitals NHS Foundation Trust
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Kim Gregory	Consultant in Sport and Exercise Medicine	University Hospitals Birmingham
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Nikant Sabharwal	Consultant Cardiologist and Head of the Nuclear Cardiology Department	Oxford University Hospitals NHS Foundation Trust
Sheera Sutherland	Renal Dialysis Research Nurse	Oxford University Hospitals NHS Foundation Trust
Tracy Barnett	Lead Physiotherapist, Physical Activity Pilot	Oxford University Hospitals NHS Foundation Trust
William Bird	GP and CEO of Intelligent Health Ltd	Intelligent Health Ltd

Delphi Group (n=29)

Name	Title	Institution	Bio
Perdy van den Berg	Diabetes Specialist Nurse in Primary Care.	Oxford Health NHS Foundation Trust	Diabetes Specialist Nurse in Primary Care. Formerly Clinical Lead, Oxfordshire Community Diabetes Service and Diabetes Quality Improvement Lead for Thames Valley Clinical Network (NHSE). Member of the NICE Guideline Development Group 2013-15 NG17 Type 1 Diabetes in adults: diagnosis and management and 2016 Quality Standard - diabetes in adults QS6.
Jordan Bowen	Consultant Physician in Acute and Geriatric Medicine	Oxford University Hospitals NHS Foundation Trust	Consultant Physician in Acute and Geriatric Medicine. Special interest in Acute Ambulatory Care and Complex Interface Care
Muir Gray	Consultant in Public Health	The Optimal Ageing Programme	Consultant in Public Health providing knowledge to support our aging population to live better via www.livelongerbetter.net. Additional special interest in teenagers with long term conditions.
Rob Andrews	Associate Professor of Diabetes/Honorary Consultant in Diabetes	University of Exeter	Expert in exercise and both Type 1 and Type 2 Diabetes.
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Chris Swindale	Respiratory Physiotherapist	Oxford Health NHS Foundation Trust.	Physiotherapist with 15 years' experience. 12 years' experience in Respiratory Care, the last 6 of which have been community based, with specific emphasis on COPD and other chronic lung conditions.
Paula Manning	Physiotherapist	Derbyshire Healthcare NHS Trust	Physiotherapist, working in mental health inpatients hospital and as a Physical Activity Clinical Champion for PHE, delivering free training to HCPs to encourage themselves and their patients to be more physically active.

Nikant Sabharwal	Consultant Cardiologist and Head of the Nuclear Cardiology Department	Oxford University Hospitals NHS Foundation Trust	Consultant Cardiologist with interest in Exercise Medicine
Brian Johnson	GP, Honorary Medical Advisor to Public Health Wales	NHS	GP and Sport and Exercise Medicine practitioner, Honorary Medical Advisor to PHWales, RCGP Clinical Priority of Physical Activity and Lifestyle Steering group member, CEO of Motivate2Move.co.uk and Benefitfromactivity.org
Anushka Soni	Rheumatologist	Nuffield Department of Orthopaedics	Rheumatologist with a research interest in Musculoskeletal Pain Mechanisms. During my DPhil, I studied the impact of abnormal central pain processing in patients with osteoarthritis of the knee. I showed a relationship between the presence of neuropathic pain and central sensitization pre-operatively, and that this modified the patient's response to knee replacement surgery. Moving forwards, my work will use a combination of techniques, including neuroimaging and clinical pain quantification, to investigate pain related predictors of response to treatment in inflammatory arthritis as well as fibromyalgia.
Scarlett McNally	Consultant Orthopaedic Surgeon, Deputy Director of the Centre for Perioperative Care	Eastbourne District General Hospital	Consultant Orthopaedic Surgeon, Eastbourne D.G.H. since 2002. Elected council member of the Royal College of Surgeons of England, 2011-21. Lead author of 'Exercise the miracle cure and the role of the doctor in promoting it'. Other published work on the link with the economy and social care – we need environments and expectations to change to support everybody to be more active which would reduce need for social care (and improve mental and physical health). Deputy Director of the Centre for Perioperative Care (www.cpoc.org.uk aimed at getting people fitterbettersooner around an operation). Papers on www.scarlettmcnally.co.uk. Twitter @scarlettmcnally
Cliff Kilgore	Consultant Nurse for Intermediate Care and Older People	Dorset Healthcare NHS Trust	Consultant Geriatrician Nurse specialising in care of older people and visiting Fellow to Bournemouth University
Chris Pugh	Professor of Renal Medicine, Honorary Consultant Physician	Oxford University and Oxford University Hospitals NHS Foundation Trust	Professor of Renal Medicine, University of Oxford.

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Anna Lowe	Programme Manager, Physiotherapist	National Centre for Sport & Exercise Medicine, Sheffield.	Programme Manager at the National Centre for Sport & Exercise Medicine, Sheffield.
Rebecca Robinson	Consultant in Sport and Exercise Medicine	Sheffield Teaching Hospitals NHS Foundation Trust	Consultant in Sport and Exercise Medicine.
Rebecca Appelboam	Consultant in Intensive Care Medicine	Royal Devon and Exeter NHS Foundation Trust	Consultant in Intensive Care Medicine, involved in the follow up of survivors of intensive care in multidisciplinary clinics which patients are invited to 3 months after discharge from hospital. We tackle the psychological cognitive, and physical deficits that survivors experience, and provide support and advice to aid rehabilitation
Diana Greenfield	Consultant Nurse in Late Effects (of cancer treatments) and Honorary Professor in Cancer Survivorship	Consultant Nurse at Sheffield Teaching Hospital, Honorary Professor of The University of Sheffield	Consultant Nurse in Late Effects (of cancer treatments) and Honorary Prof in Cancer Survivorship. Diana Greenfield is a National Institute for Health Research (NIHR) Senior Nurse Research Leader. The views expressed in this article are those of the author and not necessarily those of the NIHR, or the Department of Health and Social Care.
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Sheera Sutherland	Renal Dialysis Research Nurse	Oxford University Hospitals NHS Foundation Trust	Renal Dialysis Research Nurse in Renal Rehabilitation

Julia Newton	Clinical Academic and Consultant in Rheumatology/Sport and Exercise Medicine	Oxford University Hospitals NHS Foundation Trust	Clinical Academic and Consultant in Rheumatology/Sport and Exercise Medicine
Sally Retallick	Lead nurse in Weald PCN	West Kent Health NHS	Practice Nurse in West Kent caring for a range of patients including those with long term conditions. Lead nurse in Weald PCN and Physical Activity Clinical Champion for PHE, delivering free training to HCPs to encourage themselves and their patients to be more physically active.
Andrew Murray	GP and Consultant in Sport and Exercise Medicine	The University of Edinburgh	GP and Consultant in SEM. Previous employment working full time in Public Health policy (Scottish Government). Current Vice-President Ramblers Scotland.
James Hull	Consultant respiratory physician	Royal Brompton & Harefield Hospitals Specialist Care	Consultant Respiratory physician with expertise in asthma, chronic lung disease and impact of exercise in this context
Marie Murphy	Professor of Exercise and Health, Dean of Postgraduate Research and Director of the Ulster Doctoral College.	Ulster University	Professor of Exercise and Health, Dean of Postgraduate Research and Director of the Ulster Doctoral College. Marie's research focuses on the effect of physical activity and exercise, in particular walking, on health and uses multidisciplinary approach that has included outcome measures ranging from the behavioural to the biochemical.
Tracy Barnett	Lead Physiotherapist, Physical Activity Pilot	Oxford University Hospitals NHS Foundation Trust	Senior Physiotherapist with a particular interest in neuro-rehabilitation. Physical Activity Champion for the Active Hospital Project at Oxford University Hospitals Foundation Trust. The project was commissioned by Public Health England to explore ways in which physical activity could be embedded into pathways in secondary care. Extensive work within Frailty pathways as part of this project.
Neil Heron	Consultant in Sport and Exercise Medicine; GP; Clinical Lecturer	Queen's University Belfast	Consultant in Sport and Exercise Medicine; GP; Clinical Lecturer with expertise in physical activity promotion.

Amit Mistry	Consultant in General Adult & Old Age Psychiatry; Honorary Lecturer	Oxford Health NHS Foundation Trust, Queen Mary University of London	General Adult and Old Age Psychiatry and Sports Psychiatry. Chair of the Royal College of Psychiatrists (RCPsych) Sport & Exercise Psychiatry Special Interest Group.

Supplementary file 3: Preparatory stage

This supplementary file details the three parts of the preparatory stage (1) practitioner consultation (2) Patient and Public Involvement project and (3) national service user survey.

1. PRACTITIONER CONSULTATION

Aim

To gain insight into the concerns and requirements of Healthcare Professionals (HCPs) around advice on risk when talking about Physical Activity (PA) to people living with long term conditions (LTC).

Methods

We distributed an online survey using the commercial Survey Monkey software[1] to two national primary care networks in the UK and the Moving Medicine ambassador network between October-November 2019. The Moving Medicine ambassador network is a network of multidisciplinary HCPs who have expressed an interest in the role of physical activity in the management of long-term conditions. The survey contained six open questions with free-text responses. Two questions collected data about respondent job role and place of work, and four around the perception and experience of risk when discussing physical activity with patients. The survey was tested with two HCPs not involved in the project prior to distribution. Responses were analysed through thematic analysis.

Results

57 responses were received (Doctor 42%, Physiotherapist 33%, Nurse 9%, other 16%). 53% worked in primary care, 28% in secondary care and 19% in other care settings. Responders were asked to select more than one answer for questions 3-6. Leading themes that emerged from the consultation are presented in table 1. Full results are presented in table 2 with subgroup analyses in tables 3 and 4.

Table 1. Summary of leading themes

Question		Theme 1	Theme 2	Theme 3
1	What risks are you concerned about when recommending physical activity to patients	Exacerbation of symptoms, causing complications	Demotivating or 'putting off' the patient	Appropriate recommendation of physical activity, tailored to the individual
2	Have you encountered any specific clinical issues or symptoms, related to physical activity, in your patients with long term conditions?	Psychological motivation, patient willingness to change	Worsening of symptoms	Patient concerns regarding worsening of another pre-existing condition
3	What have your patients with long term conditions asked you about their risks of physical activity?	Concerns about risk of worsening of current symptoms	Concerns regarding perceived barriers due to	General safety and development of new symptoms/ events eg pain/myocardial infarction

			other symptoms	
4	What information/ resources/ other would help you to manage risk in clinical practice, when recommending physical activity to people with long term conditions?	Advice regarding specific long-term conditions and safe prescription of physical activity	General advice to give patients about the benefits of physical activity	Leaflets/Posters/Online Resource/Mobile App for patients

Table 2. All results from practitioner survey

Question	Theme	Rank	Number of comments
1. What risks are you concerned about when recommending physical activity to patients?	Exacerbation of symptoms, causing complications	1	29
	Demotivating or 'putting off' the patient	2	9
	No concerns about risk	3	7
	Appropriate recommendation of physical activity, tailored to the individual	4	6
	Adequate support for the clinician recommending physical activity	5	4
	Patients own ability to be physically active	6	2
	Other[a]	7	1
2. Have you encountered any specific clinical issues or symptoms, related to physical activity, in your patients with long-term conditions?	No issues	1	17
	Psychological motivation, patient willingness to change	2	15
	Worsening of symptoms	3	12
	Patient concerns regarding worsening of another pre-existing condition	4	7
	Other[b]	5	7
	Fatigue	6	3
	Physical activity advice from non-clinical practitioners	7	2
3. Have you encountered any specific clinical issues or symptoms, related to physical activity, in your	No issues	1	17
	Psychological motivation, patient willingness to change	2	15
	Worsening of symptoms	3	12

patients with long-term conditions?	Patient concerns regarding worsening of another pre-existing condition	4	7
	Other[c]	5	7
	Fatigue	6	3
	Physical activity advice from non-clinical practitioners	7	2
4. What have your patients with long-term conditions asked you about their risks of physical activity?	Concerns about risk of worsening of current symptoms	1	21
	No questions from patients	2	17
	Concerns regarding perceived barriers due to other symptoms	3	10
	General safety of physical activity	4	8
	Development of new symptoms or risks[3]	5	4
	Other[d]	6	2
5. What information/resources/other would help you to manage risk in clinical practice, when recommending physical activity to people with long-term conditions?	Advice regarding specific long-term conditions and safe prescription of physical activity	1	15
	General advice to give patients about the benefits of physical activity	2	10
	Leaflets/Posters/Online Resource/Mobile App for patients	3	10
	When to refer to a physical activity specialist	4	5
	Specific guidelines or algorithms for recommendation of physical activity	5	4
	Not required	6	6
	Other[e]	7	6

[a] "fully understanding their individual barriers to exercise"
[b] "minor injury"; "screening tools used to access physical activity"; "people requiring support to get changed, eg for swimming – volunteers don't tend to want to support in this area and cost of carers makes a swimming session prohibitively expensive"; "exercise progression and the ability to access further information"; "improvement in physical fitness that translates into better function, or prolonged function in the face of decline; build friendships, confidence, sleep better etc"; "falls off bikes on roads – fractures clavicle, concussion"; "access to facilities, cost or transport problems"
[c] When stated – "will I have a heart attack"; "death, MI"; "heart attack"; "falls, joint pain"
[d] "can't motivate themselves to do any PA"; "do the risks of being physically active outweigh the risk of staying as I am?"
[e] "I think it would be really useful to understand how to manage symptoms rather than being disease specific. We tend to work in chronic diseases whereas what the patient worries about is the symptoms of the disease, this can be tricky with multi morbidity"; "supervised structured classes with time to make friendships"; "some of my SU's can't read, struggle to understand written messages"; "support from local ambassadors and motivators"; "history taking"; "some generic disclaimer type documents"

Subgroup Analyses

Table 3. Subgroup analysis of concerns around worsening of symptoms

Specific symptom of concern	Number of concerns
Respiratory	6
Musculoskeletal/ joint pain	5
Cardiac[a]	2
Medication related[b]	2
Dizziness	2
Blood glucose control	1
Falls	1
Psychological issues	1
Not specified	1

[a] When specified – hypertension; hypotension; angina
[b] Considerations with antipsychotic medication prescription; fluctuations of heart rate on chemotherapy

Table 4. Subgroup analysis of patient concerns regarding worsening of another pre-existing condition

Condition of concern	Number of concerns
Musculoskeletal/ joint pain	5
Blood glucose control	1
Not specified	1

Conclusion

This survey corroborates published data showing the HCPs feel they lack knowledge and skills to discuss PA with patients with LTCs. HCPs expressed a significant level of concern about discussing PA with people with LTC. Fear of aggravating symptoms was a common concern. Primum, non nocere (first, do no harm) is an important driver of medical practice and fear of conflicting with this was commonly expressed. Further to this HCPs felt that they lacked skills to discuss PA in a constructive way with patients and were concerned that they might demotivate patients further. HCPs highlighted the need for specific resources to help them discuss risk with patients.

2. PATIENT AND PUBLIC INVOLVEMENT

This Patient and Public involvement (PPI) project was undertaken in 2016.[2] Results and insight closely aligned with the objectives of this project and were therefore used to inform the development of this consensus statement.

Aim

To explore service users' views on how the National Health Service (NHS) could better support their needs.

Methods

The PPI team recruited forty participants living with multiple LTC's through hospital-based patient support networks across a range of conditions in the UK. Patients were interviewed either individually or in groups (patient preference) by semi-structured interviews. Interviews were recorded and transcribed and thematic analysis of interview transcripts was carried out.

Results

The participants' age range was 60-92, and the mean age was 74 (SD 7.4). There were four ethnic groups represented. 55% of the participants were female, and 45% were male. The mean number of co-morbidities was 2.85(SD 2.9). The analysis identified that although participants overwhelmingly stated they wanted to become more active, fear of exacerbating the symptoms of health conditions was a major barrier in keeping with published studies examining barriers to PA in multimorbid groups.[3–5] Symptoms of concern included breathlessness, fatigue, muscle weakness and anxiety about falling or 'getting stuck'.

'it is a bit like trusting a parachute; you get up there and trust the silk, you will find the most wonderful thing in the world, but actually doing it is hard'

Participants reported conflicting advice from HCPs about the risk of adverse events from PA.

'they told me I should never bend forward, never'

The following primary themes emerged from qualitative analysis: [2]

- Patients generally present concerns based on their symptoms or syndromes, not their underlying LTC's.
- Continuity of advice and simple messages reduce confusion and are therefore empowering for people living with LTC's.
- Addressing risk is an essential facilitator for people considering increasing their PA levels
- Cross-sector system support is required to improve the experience of inactive people with LTC's starting to become more physically active.

3. NATIONAL CONSULTATION

Stakeholder consultation with Sport England further informed our understanding of patient preferences through a related piece of work in the UK. In 2019, The National Centre for Sport and Exercise Medicine (NCSEM) at Sheffield Hallam University in collaboration with Sport England and RCGP clinical priority group engaged 361 participants in a national online consultation to inform approaches to improving physical activity support for people with LTCs.[6]

A frequently reported barrier to participation in PA initiatives was getting medical 'sign-off' to participate.

> *"People who are fit and healthy are told they need to see their GP prior to being able to exercise and this sends the* wrong *message … Patients who have a health condition but are safe and well managed should not be asked to see their GP."*

Triage processes are often unclear, with a lack of system support for the 'sign-off' process.

> *"…most aren't qualified to assess the risk for an individual of exercising and the current system doesn't give them the confidence to signpost or refer without fear of them being liable"*

People over 50 were more likely to have individual concerns with getting sign-off before participation in PA. Those under 50 emphasised the importance of HCPs having the knowledge, confidence and the right attitudes to have conversations about sport and PA with people with LTC's.

> *"If you have a health condition, it can be difficult to get medical clearance to participate in certain physical activities. Often this requires sign-off from a health professional, for a fee, who may not even feel qualified or confident to do this."*

Finally, our conclusions from our patient and public insight were presented to the Richmond Group of Charities who have done extensive patient facing work in this areas including the 'We are undefeatable' campaign in collaboration with Sport England. The Richmond group confirmed that key themes identified through our consultation process matched commonly held concerns heard reported by their membership groups.

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Supplementary file 4. Delphi survey qualitative feedback

Feedback themes are presented alongside actions taken alongside statement progression

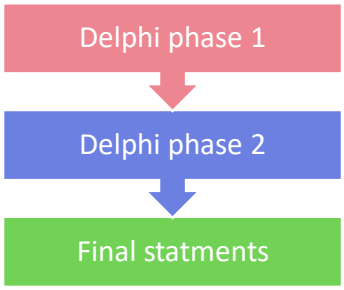
General feedback

Theme	**Actions taken**
Simplify wording & frame messages more positively	Messages reduced in length, statement wording simplified and standardised. Single sentence 'impact statements' added to headline statements to simplify messages and improve readability.
Reduce medical language	The use of 'patients' has been changed to 'people' or 'individuals'. Medical language simplified, but since this is a medical statement and not aimed at the general public or fitness professionals some medical language remains where it has been felt to provide extra clarity.
Remove the comment that there is 'no evidence' from several of the symptom statements	Wording of symptom statements amended to better reflect the balance of evidence.
Include more about benefits of physical activity in the symptom statements	The benefits of physical activity are not the main focus of this paper, so are not emphasised in this consensus statement.

Feedback on headline messages

Theme	**Actions taken**
consider order of the messages: start with patient barriers, address these and then describe benefits/what can be offered by healthcare professionals	this was not been changed, as consensus reached – however, bullet point headlines have added as suggested
shorten headlines and then give further information in a paragraph underneath	in response to overarching themes about safety considerations, we are now testing an additional 4th statement (see below) to directly address these concerns in the headline messages

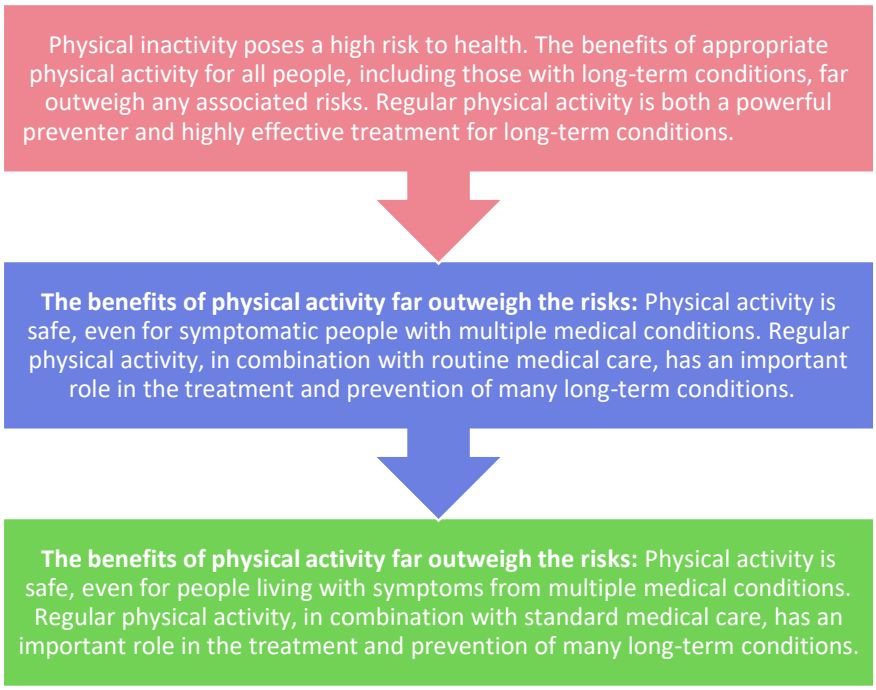
Evolution of each statement is subsequently presented in the following format:



HEADLINE 1

	Feedback themes	Actions taken
Headline Message 1	this message reassures that physical activity is appropriate/beneficial to all	statement simplified to reflect feedback
	simplify language and use physical activity, rather than inactivity	mental health is not specifically included, as this is not commonly reported as a specific risk in physical activity interventions
	some long-term conditions may not be preventable, although physical activity can help in their management	
	include mental health	
	it is important to reassure healthcare professionals that physical activity in those with long-term conditions is not dangerous	
	message reinforces the importance of discussion about physical activity between healthcare providers & those with long-term conditions	

Evolution of statement



HEADLINE 2

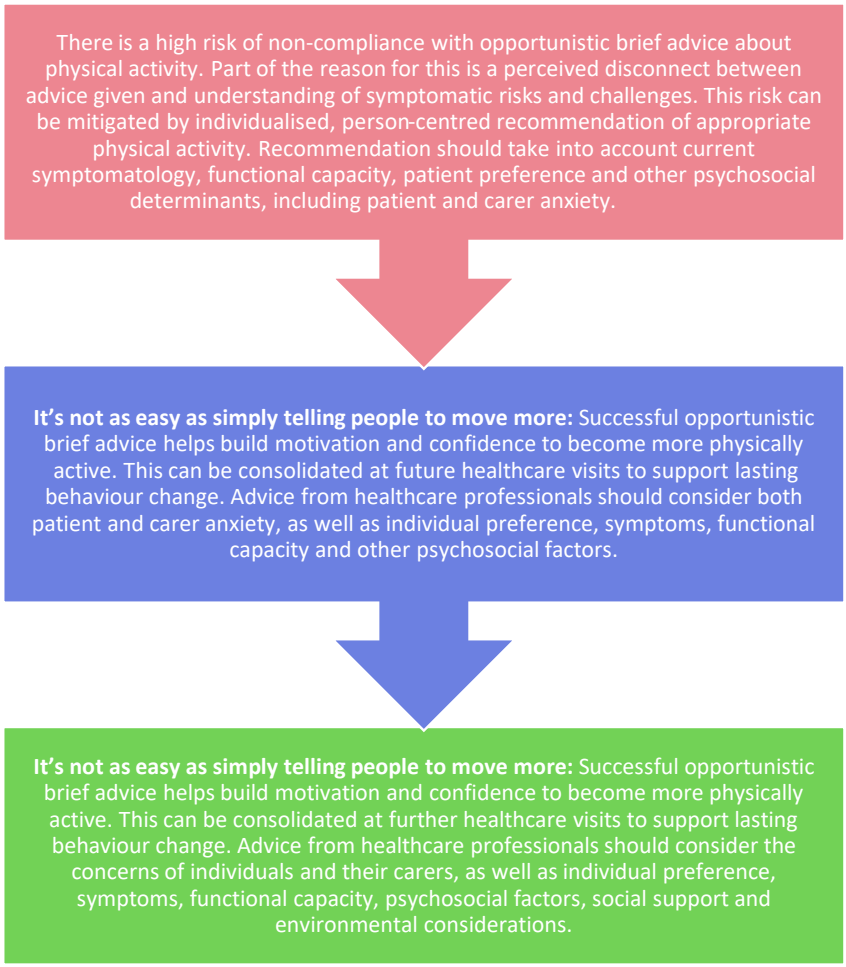
	Feedback themes	Actions taken
Headline Message 2	clarify 'tolerance'	statement simplified
	it is important to emphasise that increase in physical activity should be gradual	'tolerance' removed
	simplify language	
	this is a very important message emphasise low risk of physical activity	

Evolution of statement

HEADLINE 3

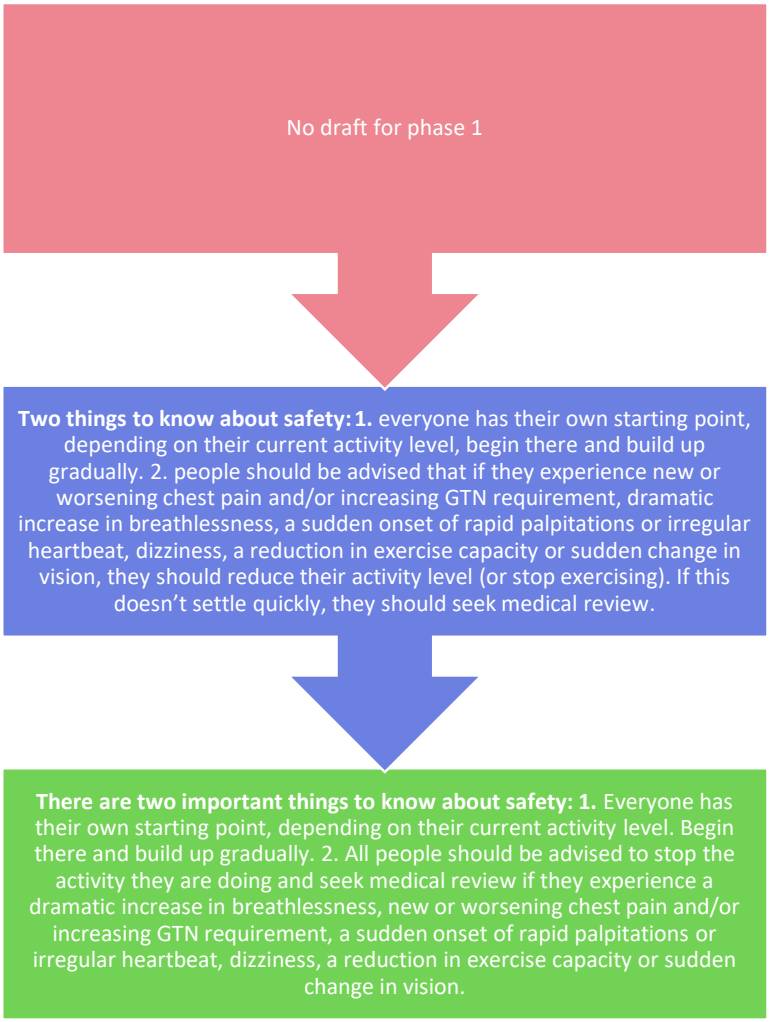
	Feedback themes	Actions taken
Headline 3	avoid use of 'non-compliance'	'non-compliance' removed
	simplify statement	message simplified
	a very important part of the overall message	
	important to emphasise the personalised/individualised aspects of conversations between healthcare professionals & individuals with long-term conditions	

Evolution of statement



HEADLINE 4

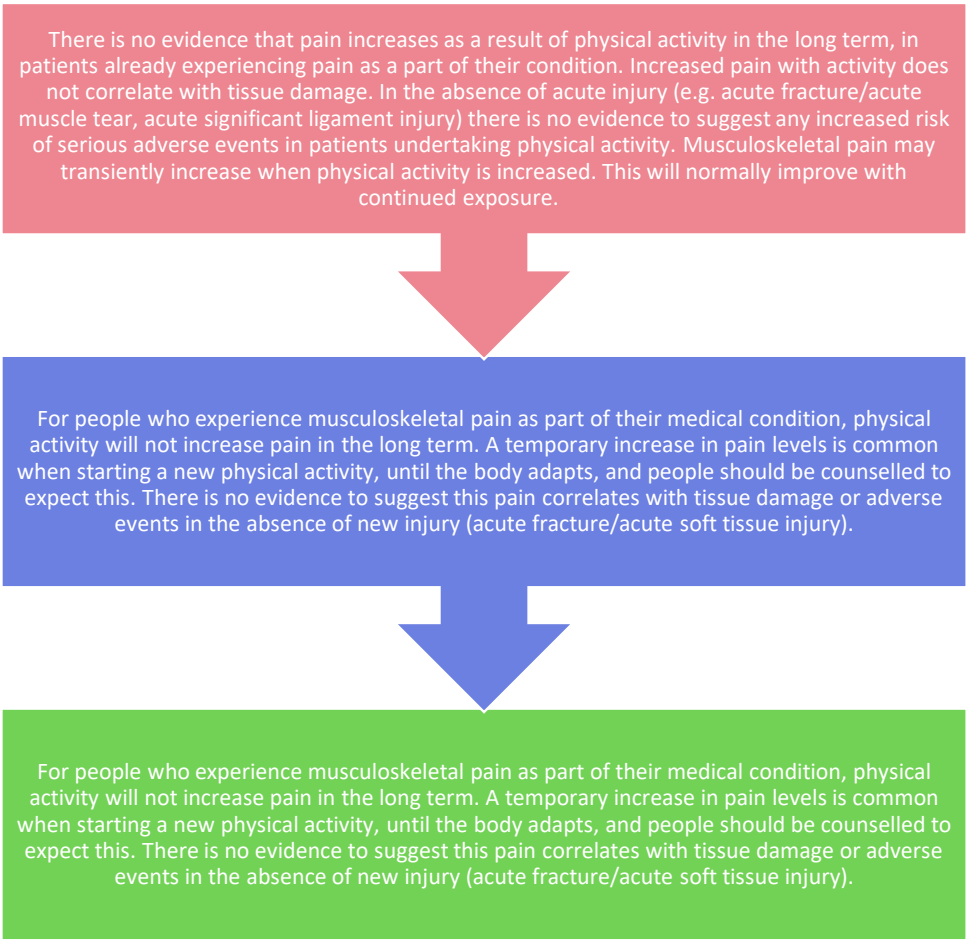
Evolution of statement



MUSCULOSKELETAL PAIN

	Feedback themes	Actions taken
Musculoskeletal Pain	consider bullet points/reduce length of statement	the statement has been adapted to reflect feedback, and simplified to negate the need for bullet points
	emphasise the potential short-term side effects such as increased pain	specific conditions are included in evidence summary
	reconsider use of 'no evidence'	
	Add in specific conditions such as arthritis, back pain, osteoarthritis	

Evolution of statement



FATIGUE

	Feedback themes	Actions taken
Fatigue	emphasise that physical activity can improve sleep, and evidence for reduced fatigue and improved wellbeing/psychological benefits specifically mention cancer-related fatigue & associated factors	cancer related fatigue is listed separately in the supporting evidence section but not separated in headline statement
	ME/CFS patients will feel strongly against this statement	specific reference is included in the supporting evidence about ME/CFS, suggesting that people are directed to specialist services for this group, as published literature is inconclusive

Evolution of statement

There is no evidence to suggest that increasing physical activity causes increasing fatigue in the medium or long term in patients already suffering from fatigue. Some short-lived fatigue is common after increasing physical activity in all populations. Chances of significantly increased fatigue can be reduced by gradually increasing levels of activity.

Appropriate regular physical activity helps reduce fatigue and improves wellbeing and sleep. A temporary increase in fatigue is commonly experienced when starting a new physical activity, until the body adapts. People should be counselled to expect this and advised to build up activity gradually. People experiencing fatigue related to chronic fatigue syndromes may benefit from specialist advice.

Regular physical activity helps reduce fatigue and improves wellbeing and sleep. A temporary increase in fatigue is commonly experienced when starting a new physical activity, until the body adapts. People should be counselled to expect this and advised to build up activity gradually. People experiencing fatigue related to chronic fatigue syndromes may benefit from specialist advice.

SHORTNESS OF BREATH

	Feedback themes	Actions taken
Shortness of Breath	patients should be advised to do what they can, rather than stop being physically active during an exacerbation or hospitalisation	specific disease recommendations have been included in supporting evidence – physical activity risk is sufficiently generic to maintain a symptom-based approach.
	reference the fear that people experience and the psychological impact	safety considerations are now addressed in Headline Statement 4
	distinguish between being physically active and doing physical activities	reference to recognising fear has been included in updated statement
	change 'no evidence' to 'balance of evidence' to improve credibility	the role of pulmonary rehabilitation has been referenced in the evidence statement, but is not within the scope of the symptom statement
	improve safety netting advice for this high-risk group	
	reference pulmonary rehabilitation	

Evolution of statement

There is no evidence to suggest increased risk of adverse events in breathless patients undertaking physical activity programmes. Feeling more breathless than usual is normal with increased physical activity in both patients who are breathless at rest and those who are not. Physical activity should be recommended dependent on severity of symptoms and gradually increased according to tolerance. Patients should be counselled regarding concerning features such as chest pain or dizziness.

It is normal for all people to feel more breathless than usual when increasing their activity level. The balance of evidence suggests that the increased risk of adverse events in breathless people when doing physical activity is very low. People should be counselled individually to gradually increase physical activity, taking into account their severity of symptoms and fear of breathlessness.

It is normal for all people to feel more breathless when increasing their activity level. The balance of evidence suggests that the increased risk of adverse events in breathless people when doing physical activity is very low. People should be counselled individually to gradually increase physical activity, taking into account their severity of symptoms, and fear of breathlessness

CARDIAC CHEST PAIN

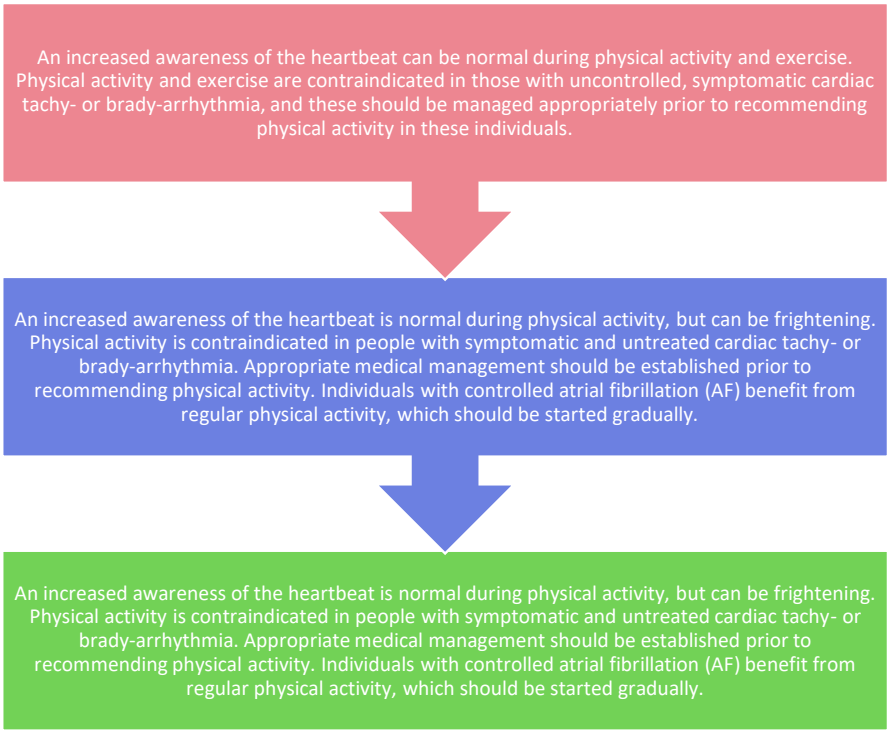
	Feedback themes	Actions taken
Cardiac Chest Pain	quantify the risks of adverse events, including the temporary short-term increased risk during exercise	It is not possible to accurately quantify risk from available evidence regarding individuals with long term medical conditions – this will be highlighted as an area for future work
	make language more accessible	published incidence data on complications from exercise in individuals with known ischaemic heart disease is derived from supervised cardiac rehabilitation programmes, therefore not generalisable to the target population for this consensus statement, and has not been included
	clarify differences between physical activity and exercise	safety statement has been removed as it is now in headline statement 4

Evolution of statement

PALPITATIONS

	Feedback themes	Actions taken
Palpitations	mention new palpitations that occur during activity	comment about new palpitations has been added to Headline Statement 4
	refer to atrial fibrillation specifically	atrial fibrillation is directly addressed in statement and supporting documentation
	consider including other triggers for palpitations, such as anxiety and thyroid disease	

Evolution of statement



DYSGLYCAEMIA

	Feedback themes	Actions taken
Hypoglycaemia	emphasise the long-term benefits of physical activity, including for decreased medication use and improved glycaemic control	significant changes have been made to the content and structure of this statement, so it has been included in Phase 2 (despite meeting consensus agreement in Phase 1)
	consider renaming to 'dysglycaemia'	title of statement has been changed to dysglycaemia
	reconsider reference to ketones in the main symptom statement	references to ketones have been removed from the Symptom Statement (included in supporting evidence)
	intensity of exercise is important, particularly in young people	comment on intensity of exercise is outside of the scope of this consensus statement
	increased risk of hypoglycaemia in those over 45y - more care is needed in this group	specific risks have been addressed in the evidence statement
	include complications of diabetes such as foot ulcers	diabetic complications have not been included in the symptom statement but have been included in the supporting evidence statement

Evolution of statement

COGNITIVE IMPAIRMENT

	Feedback themes	Actions taken
Cognitive Impairment	emphasise available support	title of statement has been kept as 'cognitive impairment' as the statement is following a symptom-based approach and is not limited to dementia
	consider the range of possible impairments and comorbidities in this broad group	statement has been updated to reflect other feedback
	consider changing the name of the statement to 'dementia'	
	address environmental considerations	

Evolution of statement

There is no evidence that physical activity may worsen cognitive impairment, and there are no general contraindications to recommendation of physical activity in this population. Strategies to maintain motivation, engagement and safety are important. Appropriate support is generally beneficial and physical activity should be individualised depending on level of function, communication ability, stage of disease and comorbidities. Individuals with cognitive impairment are at increased risk of falls and associated injury, and approaches to mitigate this should be considered.

The balance of evidence suggests that the benefits of physical activity in people with cognitive impairment far outweigh the associated risks. Strategies to maintain motivation, engagement and safety are important. These should be individualised, depending on level of function, stage of disease, communication ability (including visual and hearing impairment), preferred environment and other medical conditions. People with cognitive impairment have an increased risk of falling so support from others is often beneficial.

The benefits of physical activity in people with cognitive impairment far outweigh the associated risks. Strategies to maintain motivation, engagement and safety are important and people will often benefit from support from others. Strategies should take into account level of function, stage of disease, communication ability (including visual and hearing impairment), preferred environment, risk of falling and other medical conditions.

FALLS AND FRAILTY

	Feedback themes	Actions taken
Falls & Frailty	a strong and positive statement	osteoporosis is now mentioned in the statement, and included in the supporting evidence
	include osteoporosis	wording updates have been amended as recommended
	change wording from 'the most' ('Frail, inactive patients have the most to gain…') as other groups also have a lot to gain from increasing physical activity levels	
	emphasise the importance of strength and balance	

Evolution of statement