A grant from the American Physical Therapy Association supported the development of this clinical practice guideline with development approval from the Academy of Clinical Electrophysiology and Wound Management.
Methodology and outcomes from this clinical practice guideline (CPG) were presented at the 2018 and 2023 Combined Sections Meetings of the APTA.

Recommendation	Action Statement	Evidence Quality	Strength of Recommendation
I	Physical therapists and other healthcare providers who prescribe exercise for adults with a diabetic foot ulcer may prescribe interventions to maintain cardiovascular health and muscular fitness while minimizing weight bearing on the foot. In addition, an assistive device may be utilized as needed to improve balance and further reduce weight bearing in an adult with a current diabetic foot ulcer.	D	Weak
II	Physical therapists and other healthcare providers who evaluate physical fitness in adults with diabetes should measure physical fitness, including flexibility, strength, cardiorespiratory fitness, balance, and motor agility (Evidence quality: C; Recommendation strength: weak) AND may measure the level of physical activity such as step count and standing across the continuum of care of an adult with diabetes.	D	Weak
IIIa	Physical therapists and other healthcare providers who prescribe exercise should prescribe a progressive moderate to vigorous intensity exercise program including aerobic and resistance training to adults with diabetes after considering the patient's disease state and limits for exercise AND dependent on the patient's physiologic response to exercise in accordance with the patient's preference and resources.	A	Strong
IIIb	Physical therapists and other healthcare providers who prescribe exercise may use activity monitor-based counseling to increase physical activity.	B	Moderate
IV	Physical therapists and other healthcare providers managing patients with closed diabetic foot ulcers may titrate tissue reloading (e.g. standing, walking) on a newly closed diabetic foot ulcer, maintaining moderate to maximal offloading, **especially during the first three months**, slowly titrating return to shoe wear using a wear schedule.	D	Weak
V	All healthcare providers should encourage aerobic exercise or physical activity for adults with diabetes who are safe to exercise to optimize long-term quality of life as well as reduce health care costs.	C	Weak

Introduction

Diabetes (DM) continues to cause significant mortality and debility worldwide. In 2019, diabetes was the 7th leading cause of death and a major contributor to the world's leading cause of death, cardiovascular disease. The Centers for Disease Control and Prevention's (CDC) National Diabetes Statistics Report states that 37.3 million Americans have DM and another 96 million people have pre-diabetes.[1]

Hyperglycemia, a hallmark of diabetes, puts one at an elevated risk for diabetes-related complications. Included among complications of diabetes are vascular (micro- and macro-) changes as well as changes to the nervous system. Together, these changes increase the risk for plantar ulceration in people with diabetes. As many as 34% of people with diabetes experience plantar ulceration over their lifetimes.[2] Furthermore, those who have diabetic foot ulcerations that heal are at high risk for re-ulceration. Risk is highest immediately following wound closure with 40% re-ulcerating within 12 months. Over 3 years, nearly 60% of people experience re-ulceration.[2]

Given the prevalence of DM and the disease's impact on morbidity, healthcare providers must understand and have guidance on the most effective means of preventing and limiting the long-term comorbidities related to DM.[3,4] In reviewing the major causes of hospitalizations for people with DM, the 2nd most common discharge diagnosis after hospitalization is lower extremity amputation which usually is preceded by a diabetic foot ulcer (DFU).[5] Although numerous clinical practice guidelines (CPGs) exist for healing a DFU, there are gaps regarding how to best (1) assess physical fitness and mobility in adults with diabetes with or without a DFU; (2) incorporate exercise into the care plan to effectively aid in glycemic control, either in preventing an ulcer or while managing an ulcer; and (3) reload the diabetic foot after ulcer closure to avoid ulcer reoccurrence.[6–10]

In the 2023 Standards of Care in Diabetes, physical activity recommendations were given as part of the overall diabetes prevention recommendations.[3] These recommendations listed physical activity as a component of obesity and weight management for the prevention and treatment of type 2 diabetes, but do not specifically discuss how to incorporate physical activity into a plan of care for an adult with an ulcer or how to return to physical activity after ulcer closure.[3] These guidelines also did not discuss assessing overall mobility as an adult with DM ages.[4] Similarly, other guidelines regarding diabetes care for adults with DFU, at risk for a DFU, or with a history of a DFU, do not sufficiently address or provide tools for the fitness management of patients with DM and skin concerns.[6–8] What is not known is whether individual studies, reviews, or meta-analyses have tested or evaluated the answer to these important clinical questions, particularly in the context of healing or closed DFUs.

The purpose of this clinical practice guideline was to review and assess previously published guidelines and address gaps within the guidelines specific to the following: best screening tools/tests and interventions to prevent an initial DFU or future re-ulceration, best screening tools and interventions to assess and address mobility impairments, best tools to measure and interventions to address reduced physical fitness and activity, best approach to re-loading the foot after ulceration closure, and finally, whether improvement in physical fitness will positively change quality of life and healthcare costs. The authors believe that management of the DFU itself for healing has been appropriately guided in earlier CPGs.

Methods:

Guideline Development Group

APTA Academy of Clinical Electrophysiology and Wound Management (ACEWM) commissioned the development of an evidence-based CPG to address the paucity of information regarding people with DFU related to areas that physical therapists address. Members of the ACEWM attended the CPG Workshop and began the process of developing a Guideline Development Group (GDG). Initially there were two physical therapists who were Certified Wound Specialists (CWS®) (BA, CA) and another physical therapist in an academic position with a research agenda related to DFU (DW). An additional CWS® physical therapist who had attended the CPG Workshop the previous year (JH) was also included in the initial group. To add breadth to the team, another physical therapist academician with expertise in ankle-foot management was added (MC). Over the course of working on this document, two of the physical therapist members retired (CA, MC), one of whom agreed to continue as a consultant member (MC). After the first member of the GDG retired, a new CWS® physical therapist was added to the group (SS).

Review Team

At the time of the CPG Workshop, a number of stakeholders were identified to serve as members of the external review team. These members were included to add depth and breadth of expertise and included a patient, physician, podiatrist, physical therapist clinicians from other specialization areas as well as those with expertise in the field of DFU care. Some specific members of this group changed due to availability but the general group make-up remained.

Clinical Practice Guideline Review: The ADAPTE Process

Following review of CPGs related to the patient management of DFUs and published up to the year 2015 (See Appendix A), research questions were developed to address gaps in guidance within the existing CPGs. Research questions were determined following review of current practice guidelines. The intent of this clinical practice guideline was to adapt current guidelines to assist in clinical practice decision-making surrounding the management of people with diabetes and foot ulceration that was not presently being addressed by any previously published CPG. The ADAPTE process uses the **A**ppraisal of **G**uidelines for **RE**search & **E**valuation II (AGREE II) tool which is an international tool designed to assess the quality of CPGs. Assessment is performed in 6 domains (Scope and Purpose; Stakeholder Involvement; Rigor of Development; Clarity of Presentation; Applicability; and Editorial Independence) using a seven-point numerical scale where 7 is the highest score.[11] When possible, feedback was addressed. Using the AGREE II tool, the National Institute for Health and Care Excellence (NICE)[8] and Registered Nurses' Association of Ontario (RNAO)[9] CPGs were determined to sufficiently guide wound management concerns regarding these patients and accepted for the ADAPTE process. In 2017, the following questions were developed to facilitate additional clinical decision-making guidance in areas that were under-addressed.

1. In an adult with diabetes, what are the best screenings/tests and measures to prevent initial foot ulceration?
2. In an adult with diabetes, what are the best interventions to prevent initial foot ulceration?
3. What are the best interventions to reduce the risk of future ulcerations?
4. In an adult with diabetes, what are the best test/measures to assess mobility impairments?

5. In an adult with a current diabetic foot ulcer, what are the best interventions to address mobility impairments?
6. Across the continuum of care of an adult with diabetes, what are the best tests and measures to assess physical fitness and activity?
7. Across the continuum of care of an adult with diabetes, what are the best interventions to address reduced physical fitness and activity?
8. What are the best methods to progressively load tissue after ulceration closure to prevent recurrence in adults with diabetes?
9. In the adult with diabetes, does physical fitness and activity optimize long-term quality of life as well as reduce health care costs?

Literature Search Strategy:

In consultation with a medical librarian at Indiana University Health, search terms and a search strategy were identified to address each of these research questions. The following databases were searched according to the pre-established search terms (Appendix B): PubMed (Medline) and Cumulative Index to Nursing and Allied Health Literature (CINAHL). The search dates were inclusive from "1946 until present" when the searches were undertaken. Articles were restricted to human studies and English language only. References were reviewed for potential additional articles. The searches were initially carried out in January 2018. Over the time required during the first review process for this CPG, updates to other DFU CPGs were published. In 2019, the International Working Group on the Diabetic Foot (IWGDF)[6] published their CPG update which the GDG reviewed using the AGREE II tool. The GDG determined that questions 1-3, which were specific to prevention of an initial ulcer or re-ulceration, were sufficiently addressed by the updated IWGDF CPG. These questions were then removed from this work as the IWGDF guidance for this area was accepted as put forth within their 2019 guideline (ADAPTE process). After the literature review for question 4 found no research specifically addressing assessment of mobility impairments for adults with DM, the GDG reviewed the Clinical Practice Guideline developed through the Academy of Neurological Physical Therapists to guide outcome measure selection for people with neurologic conditions.[12] The GDG decided to move this CPG into the ADAPTE process and utilized the AGREE II tool. The GDG determined the CPG adequately guided the assessment of mobility impairments for people with DM who often have neurological involvement impacting their function. Thus, question 4 was also removed. The searches were re-run in March / April 2022, and again in February 2023 for the remaining questions 5-9 (Table 1) to locate any additional literature published since the last search. Only data from questions 5-9 will be reported here.

Studies to be included from the literature search were experimental, randomized controlled trials, systematic reviews, meta-analyses, and diagnostic or prognostic retrospective studies. Reviews that were non-systematic, descriptive studies, case reports, and non-scientific papers were excluded. The population was limited to adults with diabetes, but the type of diabetes was not specified (Table 2).

Literature Review and Extraction:

Covidence software (Veritas Health Innovation; www.covidence.org) was utilized for all of the literature reviews. Literature search results were imported into Covidence software where study duplicates were removed. Then, the titles and abstracts were independently reviewed by two reviewers using inclusion and exclusion criteria (Table 2). If the determination of the reviewers was conflicting, the reviewers came to consensus using discussion. If consensus could not be achieved, "maybe" was selected. Both

"yes" and "maybe" studies were moved forward in Covidence for full article review. Full text reviews were completed by two independent reviewers for inclusion or exclusion. If exclusion was chosen, the reason for exclusion was given. Any disagreements between reviewers, including reasons for exclusion, were discussed so that consensus could be achieved. Once an article was included, the studies were reviewed for risk of bias (Quality Appraisal) as well as for extraction of data. Studies were reviewed by two reviewers and consensus on outcome was achieved through discussion. If consensus could not be achieved, a third reviewer, a member of the GDG who served as the question champion, served as the tie-breaker. Data extraction was completed by the person serving as the tie-breaker. The accuracy of extraction was checked by the other reviewers.

Quality Appraisal:

Quality appraisal was completed consistent with the APTA CPG Manual[13] except that PEDro (Physiotherapy Evidence Database) was used to assess interventional studies, namely randomized controlled trials (RCT).[14] As such, systematic reviews were assessed using A MeaSurement Tool to Assess systematic Reviews (AMSTAR 2),[15] diagnosis studies and cohort studies used a Scottish Intercollegiate Guidelines Network (SIGN) checklist,[16] studies assessing measurement tools used the Consensus-based Standards for the selection of health status Measurement Instruments (COSMIN),[17] and prognosis studies used the Best Bets tool.[18]

Article appraisal was undertaken by members of the GDG team. Additional reviewers were trained to use the PEDro appraisal measure. Once training was completed and reviewers were consistent in their reviews, they were assigned interventional studies to review in pairs. All reviews were completed in duplicate such that consensus was achieved as described above.

Each article was given a Level of Evidence and the body of literature reviewed for each question was graded in a manner consistent with the APTA CPG Manual.[13] A table is included here as a brief summary of the meanings of levels of evidence (Table 3) and the grading of evidence. (Table 4)

Data Analysis and Results:

The original literature search was completed in March 2018 and the repeat search to ensure inclusivity of all studies was completed in March 2022 and again in February 2023. Articles were imported into Covidence software according to each question. Covidence software removed any duplication of literature within each question. Additional studies were removed because they were irrelevant through review of abstract and title. The remaining studies underwent full text review for inclusion. During the review process, IWGDFU published new guidelines that included information answering questions 1-3.[6] Question 4 was answered by a new published guideline by the Academy of Neurological Physical Therapists.[12] These questions were moved out of the guideline since the ADAPTE model was being used. (Table 5 below and PRISMA Diagrams)

Development of Action Statements:

Action statements were developed using the BridgeWiz (Building Recommendations In a Developer's Guideline Editor) software. This software was developed to aid in the authoring of unambiguous and actionable guidelines.[19] The CPG development team worked through the process as a group following completion of article quality appraisal and extraction. Findings will follow with the action statement recommendations listed first, according to each question.

External Review Process:

The external review process was consistent with that described by the APTA CPG Manual.[13] The process was designed to facilitate a comprehensive, quality report while mitigating risk for bias or lapses in process. At the outset of the project, stakeholders were identified that included a patient, representatives from medicine, podiatry, physical therapists from other specialization areas, as well as experts in DFU management (defined as people who have published in this area of practice). Additionally, methods experts were consulted. The draft document was sent to a group representing the above stakeholders for review, editing, and open comment. The feedback was taken and incorporated into the draft. The document was externally reviewed by representatives from the Academy of Clinical Electrophysiology and Wound Management (ACEWM), a CPG methodology expert, and association partners. The feedback from this body and any other delayed feedback was addressed and the subsequent document was posted on the ACEWM's website for public comment and review. Invitations for the public comment/review of the document were included in the ACEWM monthly newsletter, eblasts, and social media. Both ACEWM members and non-members were able to review and provide feedback. Suggested feedback and edits were considered and incorporated as appropriate. The document was submitted to the Physical Therapy Journal for editorial review concurrently to the secondary reviews and public feedback process. Comments were addressed.

Action Statements:

> **Recommendation I**: Physical therapists and other healthcare providers who prescribe exercise for adults with a diabetic foot ulcer may prescribe interventions to maintain cardiovascular health and muscular fitness while minimizing weight bearing on the foot. In addition, an assistive device may be utilized as needed to improve balance and further reduce weight bearing in an adult with a current diabetic foot ulcer. (Evidence quality: D, Recommendation Strength: Weak)

Question #5: In a patient with a current diabetic foot ulcer, what are the best interventions to address mobility impairments?

Aggregate Evidence Quality: This is rated as D level or theoretical evidence.(Table 4) Two systematic reviews and one scoping review were included that addressed a broader physical activity on adults with DFU rather than explicitly mobility impairments. The evidence within these reviews was thus described as theoretical.

Benefits: Prescribed exercise may preserve functional capacity, minimize trauma, improve wound healing, and reduce risk of falls.

Risk-Harm Cost: There are potential costs related to the cost of the assistive device, overall wound treatment, and any lost income due to participating in an exercise program.

Benefit-Harm Assessment: Preponderance of Benefit

Value Judgements: The guiding principle behind the question development was to help health care providers optimize the physical fitness and activity of adults with a current diabetic foot ulcer without harming the wound healing process. This is not widely considered a priority in these medically complex adults, but we recommend physical therapists and other healthcare providers who prescribe exercise to consider developing exercise programs for this population as the long-term impact to cardiovascular health and muscular fitness is a significant benefit.

Intentional Vagueness: The developers were intentionally vague about which interventions to utilize due to the lack of evidence supporting specific interventions. There are three systematic reviews (SR) published between 2000-2023 that assessed research of therapeutic exercise for adults with a DFU. All three SR found that there is a need for well-conducted RCTs to guide specifically which interventions are best to improve the cardiovascular health and muscular fitness of these adults without harming the healing response of the DFU.[20–22] In addition, the developers expect that the clinician will select interventions that address each individual person's needs and goals. See Appendix C for an example for how fitness could be improved or maintained while in the period of offloading.

Role of Patient Preferences: Although the spectrum of exercise intervention is limited due to the need to minimize weight-bearing on the foot, exercise program prescription still should incorporate the adult's preferences to increase adherence and therefore, optimize outcomes.[23]

Exclusions: Modifications should be made for any adult with disease conditions where a specific exercise intensity is contraindicated. Further, exercise should be performed only by adults within safe glycemic ranges. Colberg, et al.[24] provide detailed guidance on glycemic management with exercise.

Implementation and Audit: Clinicians may consider incorporating exercise prescriptions into their Electronic Medical Record (EMR) as part of the complete patient plan of care. Utilizing scripted phrases or drop-down menu choices may increase implementation and improve standardization to allow for better auditing of outcomes. Finally, an annual audit of clinician inclusion of exercise prescription in the care plan for an adult with a DFU would reinforce implementation.

Research Recommendation: Research is needed to determine the most effective interventions to use while prescribing exercise for the adult population with a diabetic foot ulcer. Although there is broad agreement that adults with diabetes benefit from exercise, there is little guidance on which interventions will provide that benefit while protecting the foot ulcer.

Supporting Evidence and Clinical Interpretation: In 2022, Brousseau et al.[20] published a scoping review to determine the impact of physical activity on adults with a DFU. Although they identified nineteen articles from seventeen studies, they were unable to make specific recommendations due to the lack of research, especially RCTs, with strong methodology. They specifically called for high level RCTs focused on physical activity prescription as there is no evidence to guide the components of physical activity. In 2022, Aagaard et al.[21] made similar recommendations in their systematic review that specifically looked for the impact that exercise has on health-related quality of life compared to the risk of harm that exercise may have on the DFU. Although there were 10 research articles related to exercise for adults with a DFU, none reported the impact on health-related quality of life and the methodology did not allow for reliable conclusions related to exercise and harm. Finally, Wendland et al.'s[22] systematic review investigated the evidence of whether to determine if exercise, physical activity, walking step characteristics, or limb loading affects healing outcomes in persons with DFU. Secondarily, they looked

at whether the quantity of exercise, stepping activities, or limb loading affect the length of time to wound closure in persons with DFU. Because of large variation in step activity and group metrics, it was determined that no specific exercise recommendations could be made, although exercise appeared to facilitate more rapid DFU healing. All three of these articles made consistent recommendations for more research on the effect of exercise on wound healing.

Question 6: Across the continuum of care of an adult with diabetes, what are the best tests and measures to assess physical fitness and activity?

> **Recommendation II:** Physical therapists and other healthcare providers who evaluate physical fitness in adults with diabetes should measure physical fitness, including flexibility, strength, cardiorespiratory fitness, balance, and motor agility (Evidence quality: C; Recommendation strength: weak) AND may measure the level of physical activity such as step count and standing across the continuum of care of an adult with diabetes. (Evidence quality: D; Recommendation strength: weak)

Aggregate Evidence Quality: There was a single, level II article assessing the psychometric properties of tests of physical fitness, including physical function.[25] This article lacked blinding and had <80% follow-up among the subjects. This is rated as C level or weak evidence.

Measuring the level of physical activity has been suggested by published expert opinion as helpful in increasing physical activity. This is rated as D level or theoretical evidence.[26]

Benefits: Measuring the physical fitness of a patient may facilitate the identification of a change in fitness that can affect functional ability and diabetes management. Early identification of decreased physical fitness provides a benefit to the patient and provider.

Measuring the physical activity of a patient may facilitate the identification of changes in activity which may indicate progression of the disease, new risk for falls, ulcerations, or functional decline.

Risk, Harm, Cost: No adverse events were reported in the Alfonso-Rosa et al. study.[25] When assessing various components of physical fitness, there is a risk that an individual could experience a fall or injury during testing. This risk is mitigated by careful training and the inclusion of safety behaviors learned as a part of physical therapist education.

The cost to the individuals who undergo testing is primarily their time and effort to be tested, including transport to the facilities for testing. If activity monitoring is employed, cost is in the device itself and potential risk for skin issues from the device, depending on the device utilized.

Benefit-Harm Assessment: Preponderance of Benefit

Value Judgments: Monitoring physical fitness in adults with diabetes as they age will positively impact the quality of their health. Utilizing consistent physical fitness testing tools that have been psychometrically tested for a population with type 2 diabetes, particularly those with minimally detectable change values, is helpful to recognize fitness change in this population. We recommend

that standardized protocols be used to support the reliability of these tests across time and individual patient care episodes. (Table 6)

Intentional Vagueness: The recommendation of who should evaluate the physical fitness of this population was intentionally vague to allow for inclusivity of all qualified healthcare providers. The type of fitness testing and activity monitoring within the recommendation was intentionally vague due to limited research to guide more specific recommendations. The studied tests are included in the supporting evidence and in Table 6 to provide some direction for clinicians.

Exclusions: Clinicians should use their clinical judgment when selecting tests and outcome measures. Certain tests should not be performed if contraindicated by the person's disease state. Care should be taken in cases where balance is compromised. Tests should not be performed if contraindicated (e.g., ambulatory test in the presence of a plantar diabetic foot ulcer).

Implementation and Audit: Clinicians and facilities should establish competencies of physical fitness tests, including tests of physical function, before performing them with their patients with diabetes. Please refer to Alfonso-Rosa RM et al.[25] for specific tests descriptions. Annual training and practice could help facilitate excellent reliability with the performance of acceptable tests, including the Hand Grip Strength Test, Chair Sit and Reach Test (CSRT), the Timed "Up and Go" (TUG) test, the 6-Minute Walk Test (6MWT), and the 30-Second Sit to Stand (30STS) test. Clinicians may also consider incorporating exercise prescriptions into their EMR as part of the complete patient plan of care. Utilizing scripted phrases or drop-down menu choices may increase implementation and improve standardization to allow for better auditing of outcomes. Finally, an annual audit of clinician utilization of performance testing would reinforce implementation.

Supporting Evidence and Clinical Interpretation:

Selecting outcome measures with established psychometric properties is helpful to determine when actual change has occurred and whether that change is clinically relevant. Some tests which assess physical fitness, including physical function, have been assessed for psychometric properties in people with type 2 diabetes. Included among these tests are the Hand Grip Strength Test, the CSRT, the TUG test, the 6MWT, and the 30STS test.[25] High Intraclass Correlation Coefficients (ICC) as a measure of relative reliability using a test-retest design were found for all the tests assessed. Additionally, minimally detectable change (MDC) scores were determined for each of the tests as well. See Table 6 for specific psychometric properties.[25]

The Hand Grip Strength Test can be used, with excellent relative reliability, to assess upper extremity (UE) strength on both the dominant and non-dominant sides. An MDC was given as 3.85 kg (dominant UE), 4.32 kg (non-dominant UE), and 4.13 kg for bimanual testing. The Hand Grip Strength Test is feasible because it requires commonly available equipment (handheld dynamometer) in clinical settings. The time required to administer the test is less than five minutes, including the minute rest required between measures.[25]

The CSRT can be useful to test lower extremity (LE) flexibility with excellent reliability for both sides. The MDC was 7.50 cm for the right side and 9.01 cm for the left. This test is clinically feasible since it only requires a ruler and a chair for the individual to sit in. It takes <5 minutes to administer.[25]

The TUG test can be used to assess motor agility and general mobility (physical fitness and physical function) and has excellent relative reliability and an MDC of 0.85 sec. These values, along with the short testing time (<5 minutes) and minimal required equipment, makes this test clinically feasible.[25]

The 6MWT can be used to assess the cardiovascular fitness of an individual. In individuals with type 2 diabetes, the test was shown to have excellent relative reliability and has an MDC of 27.37 meters. The 6MWT is feasible to assess cardiovascular fitness. It requires only a stopwatch and a hallway, both consistently available in clinics. This test takes less than 10 minutes to perform.[25]

The 30STS tests can be used to assess the strength of the LEs. The relative reliability of the test has been shown to be excellent. Furthermore, the MDC was found to be 3.35 repetitions. This test was feasible for its limited requirements, including short timeframe. Additionally, unlike other similar tests, the completion of any repetitions will provide useful information.[25]

A perspective paper addressing physical training and activity in people with diabetes and peripheral neuropathy suggests that baseline activity levels, from which to increase activity, may be quantified using an activity monitor.[26] Additionally, a meta-analysis has shown the use of activity monitors to be helpful in promoting physical activity.[27]

Related Outcome Measures: There is a difference of opinion on which outcome measure to utilize for assessment. Other outcome measures have been utilized clinically to assess physical fitness such as submaximal and maximal exercise testing (e.g., treadmill tests, cycle tests);[28–32] strength tests (e.g., 1-repetition max, strength dynamometry);[33] walking tests of various durations (e.g., 10-m shuttle);[34] and other sit to stand tests (e.g., 10 time sit to stand or 5 time sit to stand).[35] These tests do not have available psychometric properties for a population with type 2 diabetes, including MDC scores. These tests may be more feasible depending on the patient's fitness level (e.g., 2-minute walk test rather than a 6MWT for someone who is deconditioned).

Research Recommendation: Studies are needed to assess the psychometric properties of other physical fitness related outcome measures such as the 5 times sit to stand in a population with diabetes, including both type 1 and type 2 diabetes. Further study on the psychometric properties of the tests included within the study (Hand Grip Strength Test, CSRT, TUG, 6MWT, and 30STS test) should be undertaken to include a population that is more generalizable to the population of interest.

Studies are needed to assess specific activity monitors for their feasibility, reliability, and accuracy for assessing physical fitness and activity in a population with diabetes.

Question 7: Across the continuum of care of an adult with diabetes, what are the best interventions to address reduced physical fitness and activity?

> **Recommendation IIIa:** Physical therapists and other healthcare providers who prescribe exercise should prescribe a progressive moderate to vigorous intensity exercise program including aerobic and resistance training to adults with diabetes after considering the patient's disease state and limits for exercise AND dependent on the patient's physiologic response to exercise in accordance with the patient's preference and resources. (Evidence quality: A; Recommendation strength: Strong)
>
> **Recommendation IIIb:** Physical therapists and other healthcare providers who prescribe exercise may use activity monitor-based counseling to increase physical activity. (Evidence Quality: B; Recommendation strength: Moderate)

Aggregate Evidence Quality: Evidence for Recommendation IIIa included reports from 16 different randomized controlled trials (RCTs)[28,29,31,33,34,36–48] and three meta-analyses.[32,49,50] An additional 6 studies were interventional.[30,51–55] Because of the meta-analyses and RCTs, level I and II evidence predominated. This is rated as A level or strong evidence and risk of bias information can be found in Table 7. Evidence supporting Recommendation IIIb was a single meta-analysis that included 21 studies reporting activity monitor-based counseling in people with type 2 diabetes.[27] Because of the lower quality of studies included within this meta-analysis, the evidence quality is rated as B or moderate evidence.

Benefits: The benefit of including exercise, both aerobic and resistance training, to people who have diabetes, is improved cardiorespiratory fitness and strength. Using activity monitor-based counseling may also be effective for increasing physical activity.[27]

Risk, Harm, Cost: The risks associated with moderate to vigorous intensity exercise, including both aerobic and resistance training, are typical of exercise for everyone and include overuse injury, fatigue, and death. In addition to the typical exercise risks, hypoglycemic episodes also pose a risk for people with diabetes.[3] There may also be an increased risk for falls in the presence of peripheral neuropathy.[56]

Benefit-Harm Assessment: Preponderance of Benefit

Value Judgments: The guiding principle behind question development was to help healthcare providers optimize the physical fitness and activity of adults with diabetes. We recommend that physical therapists and other healthcare providers who prescribe exercise consistently develop exercise programs for this population because the long-term impact to cardiovascular health and muscular fitness is a significant benefit.

Intentional Vagueness: The specific type of exercise was intentionally left vague because the best exercise for an individual is the exercise that the individual will complete. The literature support for exercise included various interventions ranging from walking to dancing to yoga to sport to resistance training along with various intensities.[32,46,49,50,53,55] While not discussed in the included articles, previous studies report that improved self-efficacy and behavioral control likely increase exercise adherence.[23]

Role of Patient Preferences: Exercise intervention should incorporate the preferences of adults with diabetes to increase adherence, therefore optimizing outcomes.[23]

Exclusions: Modifications should be made for any adult with diabetes with disease conditions where a specific exercise intensity is contraindicated. Furthermore, exercise should be performed only by adults within safe glycemic ranges.[3]

Implementation and Audit: Clinics and facilities should establish consistent inclusion of exercise prescription with their patients with type 2 diabetes. Annual training could facilitate the incorporation of a variety of exercises within an exercise prescription. Public health approaches to encourage walking or other similar exercises may also be successful.

Inclusion of ticklers within the EMR may promote consistent exercise prescription to facilitate improved physical fitness and activity. Annual audit of follow-through may also serve to promote adoption of consistent exercise prescription among patients with diabetes.

Supporting Evidence and Clinical Interpretation:

Studies have assessed the effects of a variety of different activities including: 1)aerobic activity alone (AT);[29,31,33,37,39–42] 2)resistance (strength) activity alone (RT);[29,33,40–42] 3)aerobic activity combined with resistance (strength) training (ATRT);[40–42] and 4)sport (e.g. soccer, dance) on physical fitness .[28,30,53] All types of exercise resulted in improvement in physical fitness and activity. Combined exercise patterns improved activity consistent with the approach taken. High intensity interval training was especially helpful compared to continuous walking.[31,52] See Appendix D for findings. The selection of activity should also be considered in the context of an individual's overall health and ability to tolerate activity.[4,24] It is important to consider the response to exercise in the presence of diabetes when prescribing and supervising exercise.[3,4,24] Exercise and sport are not the only way to promote fitness and physical activity. A meta-analysis assessed the effect of activity monitor-based counseling in people with type 2 diabetes on physical activity compared to a control. With 8 pooled studies, an activity monitor-based counseling intervention was favored for increasing step count (physical activity) compared to a control without the intervention.[27]

Consideration for musculoskeletal-related comorbidities is important because orthopedic comorbidities and complications can affect response to loading and exercise. Thus, it is advisable to gradually increase the intensity of training. The American College of Sports Medicine could be used as a guide for the appropriate progression of exercise.[57]

Research Recommendation: Studies are needed to assess what are the best interventions to address physical fitness and activity in people with type 1 diabetes. Further investigation may be helpful to develop guidelines for intensity and timing of exercise to best address physical fitness and activity in all adults with DM.

Question 8: What are the best methods to progressively load tissue after ulceration closure to prevent recurrence in adults with diabetes?

Recommendation IV: Physical therapists and other healthcare providers managing patients with closed diabetic foot ulcers may titrate tissue reloading (e.g. standing, walking) on a newly closed diabetic foot ulcer, maintaining moderate to maximal offloading, **especially during the first three months**, slowly titrating return to shoe wear using a wear schedule. (Evidence quality: D; Recommendation strength: Weak)

Aggregate Evidence Quality: This is rated as D level or theoretical evidence based on expert opinion.

Benefits: Progressively reloading tissue after ulceration closure may reduce an individual's risk of re-ulceration, allow scar tissue to mature, and lower the potential costs of re-ulceration to the larger healthcare system.

Risk, Harm, Cost: The cost of progressively re-loading tissue after ulceration closure includes the physical burden to the individual of remaining offloaded, the cost of appropriate diabetic footwear, the financial burden if the individual is unable to resume work roles, and the financial cost to the larger healthcare system for the prolonged treatment of the individual.

Benefit-Harm Assessment: There is a preponderance of benefit.

Value Judgments: The guiding principle behind the question development was to assist health care providers in protecting the newly closed wound tissue while transitioning the individual into their diabetic shoes, returning to full function, and avoiding re-ulceration.

Intentional Vagueness: The developers were intentionally vague about the exact steps to the transition to reloading as there is a paucity of evidence to support a specific approach.

Role of Patient Preferences: To prevent re-ulceration, reloading may be prioritized over patient preference. As a result, patient education promoting adherence is critical.

Exclusions: Patients who do not ambulate will not require reloading.

Implementation and Audit: Clinicians may consider adding a reloading schedule to their plan of care after closure of the DFU and include scripted phrases or drop-down menu options in the EMR to increase implementation and standardization for better outcomes. Finally, an annual audit of clinician use of a reloading plan would serve to reinforce implementation.

Differences of Opinion: Clinicians may have differences of opinion in the timeline and extent of reloading as well as devices utilized.

Supporting Evidence and Clinical Interpretation: For this question, the supporting evidence included expert opinion but no research studies. There were 3 articles which described the expert recommended process for re-loading the diabetic foot after ulceration closure.[58–60] The post-closure protection timeline given in each article varied: 3-4 weeks,[58] 1-3 months,[59] and no specific timeline.[60]

Research Recommendation: There is a need for observational and prospective studies that assess post-closure loading to prevent re-ulceration and better understand the mechanism of titration of steps and standing with return to function.

Question 9: In the adult diabetic population, does physical fitness and activity optimize long-term quality of life as well as reduce health care costs?

Recommendation V: All healthcare providers should encourage aerobic exercise, strength training, and/ or physical activity for adults with diabetes who are safe to exercise to optimize long-term quality of life as well as reduce health care costs. (Evidence quality: C; Recommendation strength: weak)

Aggregate Evidence Quality: Evidence included five interventional studies and one case control study. Five found that physical fitness and activity optimize long-term quality of life[61–65] and one demonstrated reduced healthcare costs for adults with diabetes.[55] Three of these were not randomized[55,62,65] and none were blinded. Five studies were level II quality,[55,61,63–65] one was level III.[62] This is rated as C level or weak evidence.

Benefits: Aerobic exercise or physical activity optimizes long-term quality of life and reduces health care costs.

Risk, Harm, Cost: The risks are similar to any exercise or activity, including both aerobic and resistance training, are typical of exercise for everyone and include overuse injury, fatigue, and death. In addition to the typical exercise risks, hypoglycemic episodes also pose a risk for people with diabetes.[3]

Benefit-Harm Assessment: There is a preponderance of benefit for aerobic exercise and physical activity for people with diabetes.

Value Judgments: The guiding principle behind the question development was to highlight benefits of engaging in aerobic exercise, strength training, or general physical activity for adults with diabetes. These may positively impact quality of life and reduce costs.

Intentional Vagueness: The recommendation of who should encourage aerobic exercise or physical activity for this population was intentionally vague to allow for inclusivity of all qualified healthcare providers. Additionally, the activity intensity within the recommendation was intentionally vague due to limited research on intensity's impact on quality of life and healthcare costs to guide more specific recommendations.

Role of Patient Preferences: Self-selected activity should be considered as appropriate. Patient preferences were not discussed in the included studies, but self-selection of activity and goals may improve adherence. Previous studies report that higher levels of self-efficacy and behavioral control with exercise improve adherence in those with chronic disease.[23]

Exclusions: For exercise safety, exercise modifications should be made for any adult with disease conditions where a specific exercise intensity is contraindicated. Further, exercise should be performed only by adults within safe glycemic ranges. Colberg, et al.[24] provide detailed guidance on glycemic management with exercise.

Implementation and Audit: Clinicians may consider incorporating exercise prescriptions into their EMR as part of the complete patient plan of care. Utilizing scripted phrases or drop-down menu choices may increase implementation and improve standardization to allow for better auditing of outcomes. Finally, an annual audit of clinician use of an exercise prescription would serve to reinforce implementation.

Differences of Opinion: None

Supporting Evidence and Clinical Interpretation: Aerobic exercise was predominant in the studies. Three studies utilized aerobic exercise solely,[55,63,65] two utilized a combination of aerobic exercise and strengthening,[62,64] and the last was a cross-sectional study which analyzed patients' fitness and Health-Related Quality of Life (HRQOL) prior to two aerobic exercise trials (Table 8).[61] The Abdelbasset et al.[63] study looked at the effect of aerobic exercise on quality of life in subjects with diabetes who sustained burns. Although this study focused on subjects with burns, they all had diabetes and therefore this study answered our question.

Research Recommendation: Research is needed that assesses HRQOL and includes cost analysis of healthcare. Additionally, research is needed that assesses the relationship of physical activity and exercise, based on intensity, to HRQOL and health care costs.

Discussion:

The purpose of this clinical practice guideline was to review and assess previously published guidelines and address gaps within the guidelines specific to identifying: screens and interventions to prevent an initial DFU or future re-ulceration, best screening tools and interventions to assess and impact mobility impairments, best tools to measure and interventions to address reduced physical fitness and activity, best approach to re-loading the foot after ulceration closure, and finally, whether improvement in physical fitness will positively change quality of life and healthcare costs. During the process of developing this CPG, some of the questions were answered by updates to a DFU-related CPG[6] and one question was answered by a CPG addressing mobility assessment in neurologically involved patients.[12] Given that people with diabetes often develop neurological changes (e.g., diabetic peripheral neuropathy), the GDG determined this was an appropriate reference to another clinical practice guideline.

With the GDG's focus on the remaining questions, the resulting importance of this guideline is to provide a review of literature to address how patients should be managed to best recognize and address deficits in fitness and functional mobility. These areas are commonly addressed by physical therapists and explicit guidance may improve consistent inclusion of these components within the standard of care. Beyond addressing fitness and mobility, prevention of initial DFUs as well as recurrent DFUs is also critical.

Exercise improves fitness and physical activity in adults with DM. This can be achieved with a broad range of exercises, especially if the exercise is patient-selected. While much emphasis in previous guidelines is on the effects of exercise on glucose management, blood pressure control, and other physiologic markers, exercise also has a positive impact on fitness, quality of life, and the cost of healthcare.[3] For patients to consistently benefit from exercise, healthcare providers should test the cardiovascular health and fitness of adults with diabetes whenever they access the healthcare system, rather than waiting until they present with a severe complication such as a DFU.

Offloading is critical for DFU healing is well-reported. Existing DFU CPGs provide clear direction for the treatment of DFUs until closure.[6,8,9] The direction of post-closure care including a plan for the reloading process is a critical step toward the reduction of DFU recurrence. Expert opinion provides some direction for the reloading process, but little data-driven evidence exists to clarify the process.

While some evidence is clear, there are several areas that have gaps in the literature and a definite need for focused research. The effects of exercise on the wound healing process and the assessment of methods to reload a newly re-epithelialized ulcer to prevent recurrence are research areas of high priority.

Limitations:

There are several limitations to the development and outcome of this CPG. While the literature search was comprehensive, the search was initiated within one facility (i.e., Indiana University Health) and subsequent searches occurred at a separate facility (i.e., Mercer University). The very nature of library holdings fluctuates. Literature meeting the inclusion criteria could have been missed because of selected search terms, holdings, or timing of the searches. Furthermore, any studies that were not written in the English language were not included. Other studies that may have been appropriate lacked psychometric data and thus full assessment regarding those properties was impossible.

The process of developing this CPG took 8 years. During this time, changes occurred within the GDG team and the APTA CPG Manual was updated. With the update, one of the quality appraisals utilized (the PEDro) was different than that described within the APTA Clinical Practice Process Manual.[13] Despite these changes, this document still went through appropriate systematic processes.

Plan for Implementation and Process for Guideline Update

A CPG Implementation Team was created to determine needed resources and materials to drive knowledge translation which includes education and integration into PT practice. This group identified activities and products that needed knowledge translation and will evaluate the effectiveness of the CPG in changing practice. To better implement these guidelines, beyond specifically identified strategies for each recommendation, a checklist (appendix E) can be used upon intake for all people with diabetes to facilitate prevention of initial ulceration and reulceration. Included within the checklist are the skin assessment, range of motion, monofilament testing, readiness to change assessment, and diabetes management (diabetes knowledge, control, and footwear). Also, resources to support implementation for electronic medical records (i.e., phrases, triggers) (Appendix F) and knowledge acquisition with journal club article support are available (appendix G).

Preliminary findings of the GDG for this guideline were presented at the APTA Combined Sections Meeting 2023. This CPG will be open access, with the support of APTA and ACEWM. The *Journal of Clinical Electrophysiology and Wound Management* has published the executive summary of this guideline. Awareness of this guideline will be further facilitated using social media highlights, ACEWM newsletters, and digital tools (e.g., a podcast). Additionally, further development of support materials is planned and will appear on the ACEWM website.

Clinical Practice Guidelines should be updated every 5 years following publication according to guideline development best practice. Planned updates will include repeated searches of the literature for new, best available evidence. A similar process will include use of software (e.g., Covidence) to facilitate the process to include or exclude articles (removal of duplicates, assessment by title/abstract, full text review), perform critical appraisal, and extraction. The ACEWM has a plan in place to ensure there will be a team for this process.

Summary:

Physical fitness and activity should be encouraged and measured in the adult with diabetes with and without foot ulceration, ideally using measurement tools with demonstrated psychometric properties (e.g., Hand grip test, CSRT, TUG, 6MWT, and 30STS test). Exercise and physical activity should be prescribed according to the adult with diabetes' physiologic response to exercise, skin integrity, and other comorbidities, while incorporating the patient's preferences and considering their resources. All healthcare providers should encourage aerobic exercise or physical activity in adults with diabetes safe to exercise to optimize long-term quality of life and reduce health care cost. Finally, following the closure of a DFU, tissue may be reloaded, maintaining moderate to maximal offloading, especially during the first three months; slowly titrating return to shoe wear using a wear schedule and appropriate "diabetic" footwear. Further research is necessary to better support specific guidelines for these recommendations, particularly those based on expert opinion.

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References

1. Centers for Disease Control and Prevention. *National Diabetes Statistics Report Website*. Accessed August 2, 2022. https://www.cdc.gov/diabetes/data/statistics-report/index.html.

2. Armstrong DG, Boulton AJM, Bus SA. Diabetic Foot Ulcers and Their Recurrence. Ingelfinger JR, ed. *N Engl J Med*. 2017;376(24):2367-2375. doi:10.1056/NEJMra1615439

3. ElSayed NA, Aleppo G, Aroda VR, et al. 5. Facilitating positive health behaviors and well-being to improve health outcomes: s*tandards of care in diabetes—2023*. *Diabetes Care*. 2023;46(Supplement_1):S68-S96. doi:10.2337/dc23-S005

4. ElSayed NA, Aleppo G, Aroda VR, et al. 12. Retinopathy, neuropathy, and foot care: s*tandards of care in diabetes—2023*. *Diabetes Care*. 2023;46(Supplement_1):S203-S215. doi:10.2337/dc23-S012

5. Centers for Disease Control and Prevention. Coexisting conditions and complications in the national diabetes statistics report. Published online September 2022. https://www.cdc.gov/diabetes/data/statistics-report/coexisting-conditions-complications.html

6. The International Working Group on the Diabetic Foot. IWGDF guidelines on the prevention and management of diabetic foot disease. Published online 2019:194.

7. Steed DL, Attinger C, Colaizzi T, et al. Guidelines for the treatment of diabetic ulcers. *Wound Repair Regen Off Publ Wound Heal Soc Eur Tissue Repair Soc*. 2006;14(6):680-692.

8. Coppini D. New NICE guidelines on diabetic foot disease prevention and management. *Pract Diabetes*. 2015;32(8):286-286. doi:10.1002/pdi.1974

9. Registered Nurses' Association of Ontario. Assessment and management of foot ulcers for people with diabetes (2nd ed.). Published online 2013.

10. Crawford P, Fields-Varnado M, Goldberg M, Bonham P, Flemister B, Wound Guidelines Task Force. Guideline for management of wounds in patients with lower-extremity neuropathic disease. Published online 2012.

11. Brouwers M, Kho M, Browman G, et al. AGREE II: advancing guideline development, reporting and evaluation in healthcare. *CMAJ*. 2010;182:E839-842.

12. Moore J, Potter K, Blankshain K, Kaplan S, O'Dwyer L, Sullivan J. A core set of outcome measures for adults with neurologic conditions undergoing rehabilitation: a clinical practice guideline. *J Neurol Phys Ther*. 2018;42(3):174-220.

13. APTA Clinical Practice Guideline Process Manual. Published online 2018.

14. Sherrington C, Herbert RD, Maher CG, Moseley AM. PEDro. A database of randomized trials and systematic reviews in physiotherapy. *Man Ther*. 2000;5(4):223-226. doi:10.1054/math.2000.0372

15. Shea BJ, Reeves BC, Wells G, et al. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ*. Published online September 21, 2017:j4008. doi:10.1136/bmj.j4008

16. Society BT. Scottish intercollegiate guidelines network. *Br Guidel Manag Asthma*. Published online 2016:58.

17. Mokkink LB, Terwee CB, Patrick DL, et al. COSMIN checklist manual. *Amst Univ Med Cent*. Published online 2012.

18. Mackway-Jones K, Morton R, Carley S, Emergency Department at Manchester Royal Infirmary. Best BETSs worksheets. https://bestbets.org/links/BET-CA-worksheets.php

19. Shiffman RN, Michel G, Rosenfeld RM, Davidson C. Building better guidelines with BRIDGE-Wiz: development and evaluation of a software assistant to promote clarity, transparency, and implementability. *J Am Med Inform Assoc*. 2012;19(1):94-101. doi:10.1136/amiajnl-2011-000172

20. Brousseau-Foley M, Blanchette V, Trudeau F, Houle J. Physical activity participation in people with an active diabetic foot ulceration: a scoping review. *Can J Diabetes*. 2022;46(3):313-327. doi:10.1016/j.jcjd.2021.07.002

21. Aagaard TV, Moeini S, Skou ST, Madsen UR, Brorson S. Benefits and harms of exercise therapy for patients with diabetic foot ulcers: a systematic review. *Int J Low Extrem Wounds*. 2022;21(3):219-233. doi:10.1177/1534734620954066

22. Wendland D, Kline P, Simmons L, Sinacore D. The effect of exercise, physical activity, stepping characteristics, and loading on diabetic foot ulcer healing: a systematic review. *Wounds Compend Clin Res Pract*. 2023;35(1):9-17. doi:10.25270/wnds/22007

23. Ricke E, Dijkstra A, Bakker EW. Prognostic factors of adherence to home-based exercise therapy in patients with chronic diseases: A systematic review and meta-analysis. *Front Sports Act Living*. 2023;5:1035023. doi:10.3389/fspor.2023.1035023

24. Colberg SR, Sigal RJ, Yardley JE, et al. Physical activity/exercise and diabetes: a position statement of the American Diabetes Association. *Diabetes Care*. 2016;39(11):2065-2079. doi:10.2337/dc16-1728

25. Alfonso-Rosa RM, Del Pozo-Cruz B, Del Pozo-Cruz J, Sanudo B, Rogers ME. Test-retest reliability and minimal detectable change scores for fitness assessment in older adults with type 2 diabetes. *Rehabil Nurs Off J Assoc Rehabil Nurses*. 2014;39(5):260-268. doi:10.1002/rnj.111

26. Kluding PM, Bareiss SK, Hastings M, Marcus RL, Sinacore DR, Mueller MJ. Physical training and activity in people with diabetic peripheral neuropathy: paradigm shift. *Phys Ther*. 2017;97(1):31-43. doi:10.2522/ptj.20160124

27. Vaes AW, Cheung A, Atakhorrami M, et al. Effect of 'activity monitor-based' counseling on physical activity and health-related outcomes in patients with chronic diseases: a systematic review and meta-analysis. *Ann Med*. 2013;45(5-6):397-412. doi:10.3109/07853890.2013.810891

28. de Sousa MV, Fukui R, Krustrup P, et al. Positive effects of football on fitness, lipid profile, and insulin resistance in Brazilian patients with type 2 diabetes. *Scand J Med Sci Sports*. 2014;24 Suppl 1(9111504, cac):57-65. doi:10.1111/sms.12258

29. Ng CLW, Goh SY, Malhotra R, Ostbye T, Tai ES. Minimal difference between aerobic and progressive resistance exercise on metabolic profile and fitness in older adults with diabetes mellitus: a randomised trial. *J Physiother*. 2010;56(3):163-170.

30. Andersen TR, Schmidt JF, Thomassen M, et al. A preliminary study: effects of football training on glucose control, body composition, and performance in men with type 2 diabetes. *Scand J Med Sci Sports*. 2014;24 Suppl 1(9111504, cac):43-56. doi:10.1111/sms.12259

31. Karstoft K, Winding K, Knudsen SH, et al. The effects of free-living interval-walking training on glycemic control, body composition, and physical fitness in type 2 diabetic patients: a randomized, controlled trial. *Diabetes Care*. 2013;36(2):228-236. doi:10.2337/dc12-0658

32. Boule NG, Kenny GP, Haddad E, Wells GA, Sigal RJ. Meta-analysis of the effect of structured exercise training on cardiorespiratory fitness in Type 2 diabetes mellitus. *Diabetologia*. 2003;46(8):1071-1081.

33. Cauza E, Hanusch-Enserer U, Strasser B, et al. The relative benefits of endurance and strength training on the metabolic factors and muscle function of people with type 2 diabetes mellitus. *Arch Phys Med Rehabil*. 2005;86(8):1527-1533.

34. Engel L, Lindner H. Impact of using a pedometer on time spent walking in older adults with type 2 diabetes. *Diabetes Educ*. 2006;32(1):98-107.

35. Vaz MM, Costa GC, Reis JG, Junior WM, Albuquerque de Paula FJ, Abreu DC. Postural control and functional strength in patients with type 2 diabetes mellitus with and without peripheral neuropathy. *Arch Phys Med Rehabil*. 2013;94(12):2465-2470. doi:10.1016/j.apmr.2013.06.007

36. Kirk A, Mutrie N, MacIntyre P, Fisher M. Increasing physical activity in people with type 2 diabetes. *Diabetes Care*. 2003;26(4):1186-1192.

37. Praet SFE, van Rooij ESJ, Wijtvliet A, et al. Brisk walking compared with an individualised medical fitness programme for patients with type 2 diabetes: a randomised controlled trial. *Diabetologia*. 2008;51(5):736-746. doi:10.1007/s00125-008-0950-y

38. Jakicic JM, Jaramillo SA, Balasubramanyam A, et al. Effect of a lifestyle intervention on change in cardiorespiratory fitness in adults with type 2 diabetes: results from the Look AHEAD Study. *Int J Obes 2005*. 2009;33(3):305-316. doi:10.1038/ijo.2008.280

39. Johnson ST, Bell GJ, McCargar LJ, Welsh RS, Bell RC. Improved cardiovascular health following a progressive walking and dietary intervention for type 2 diabetes. *Diabetes Obes Metab*. 2009;11(9):836-843. doi:10.1111/j.1463-1326.2009.01050.x

40. Reid RD, Tulloch HE, Sigal RJ, et al. Effects of aerobic exercise, resistance exercise or both, on patient-reported health status and well-being in type 2 diabetes mellitus: a randomised trial. *Diabetologia*. 2010;53(4):632-640. doi:10.1007/s00125-009-1631-1

41. Johannsen NM, Swift DL, Lavie CJ, Earnest CP, Blair SN, Church TS. Categorical analysis of the impact of aerobic and resistance exercise training, alone and in combination, on cardiorespiratory fitness levels in patients with type 2 diabetes: results from the HART-D study. *Diabetes Care*. 2013;36(10):3305-3312. doi:10.2337/dc12-2194

42. Senechal M, Johannsen NM, Swift DL, et al. Association between changes in muscle quality with etraining and changes in cardiorespiratory fitness measures in individuals with type 2 diabetes mellitus: results from the HART-D study. *PloS One*. 2015;10(8):e0135057. doi:10.1371/journal.pone.0135057

43. Dominguez-Munoz FJ, Villafaina S, Garcia-Gordillo MA, et al. Effects of 8-week whole-body vibration training on the HbA1c, quality of life, physical fitness, body composition and foot health status in people with T2DM: a double-blinded randomized controlled trial. *Int J Environ Res Public Health*. 2020;17(4). doi:10.3390/ijerph17041317

44. Szilagyi B, Kukla A, Makai A, Acs P, Jaromi M. Sports therapy and recreation exercise program in type 2 diabetes: randomized controlled trial, 3-month follow-up. *J Sports Med Phys Fitness*. 2019;59(4):676-685. doi:10.23736/S0022-4707.18.08591-2

45. Espeland MA, Rejeski WJ, West DS, et al. Intensive weight loss intervention in older individuals: results from the Action for Health in Diabetes Type 2 diabetes mellitus trial. *J Am Geriatr Soc*. 2013;61(6):912-922. doi:10.1111/jgs.12271

46. Winding KM, Munch GW, Iepsen UW, Van Hall G, Pedersen BK, Mortensen SP. The effect on glycaemic control of low-volume high-intensity interval training versus endurance training in individuals with type 2 diabetes. *Diabetes Obes Metab*. 2018;20(5):1131-1139. doi:10.1111/dom.13198

47. MacDonald CS, Johansen MY, Nielsen SM, et al. Dose-response effects of exercise on glucose-lowering medications for type 2 diabetes: a secondary analysis of a randomized clinical trial. *Mayo Clin Proc*. 2020;95(3):488-503. doi:10.1016/j.mayocp.2019.09.005

48. Duruturk N, Ozkoslu MA. Effect of tele-rehabilitation on glucose control, exercise capacity, physical fitness, muscle strength and psychosocial status in patients with type 2 diabetes: A double blind randomized controlled trial. *Prim Care Diabetes*. 2019;13(6):542-548. doi:10.1016/j.pcd.2019.03.007

49. Wibowo RA, Nuramalia R, Nurrahma HA, et al. The effect of yoga on health-related fitness among patients with type 2 diabetes mellitus: a systematic review and meta-analysis. *Int J Environ Res Public Health*. 2022;19(7). doi:10.3390/ijerph19074199

50. Nielsen PJ, Hafdahl AR, Conn VS, Lemaster JW, Brown SA. Meta-analysis of the effect of exercise interventions on fitness outcomes among adults with type 1 and type 2 diabetes. *Diabetes Res Clin Pract*. 2006;74(2):111-120.

51. Mendes R, Sousa N, Themudo-Barata J, Reis V. Impact of a community-based exercise programme on physical fitness in middle-aged and older patients with type 2 diabetes. *Gac Sanit*. 2016;30(3):215-220. doi:10.1016/j.gaceta.2016.01.007

52. Stoa EM, Meling S, Nyhus LK, et al. High-intensity aerobic interval training improves aerobic fitness and HbA1c among persons diagnosed with type 2 diabetes. *Eur J Appl Physiol*. 2017;117(3):455-467. doi:10.1007/s00421-017-3540-1

53. Krishnan S, Tokar TN, Boylan MM, et al. Zumba dance improves health in overweight/obese or type 2 diabetic women. *Am J Health Behav*. 2015;39(1):109-120. doi:10.5993/AJHB.39.1.12

54. Lehmann R, Kaplan V, Bingisser R, Bloch KE, Spinas GA. Impact of physical activity on cardiovascular risk factors in IDDM. *Diabetes Care*. 1997;20(10):1603-1611.

55. Di Loreto C, Fanelli C, Lucidi P, et al. Make your diabetic patients walk: long-term impact of different amounts of physical activity on type 2 diabetes. *Diabetes Care*. 2005;28(6):1295-1302.

56. Reeves ND, Orlando G, Brown SJ. Sensory-motor mechanisms increasing falls risk in diabetic peripheral neuropathy. *Medicina (Mex)*. 2021;57(5):457. doi:10.3390/medicina57050457

57. Gary Liguori. *ACSM's Guidelines for Exercise Testing and Prescription Eleventh Edition*. Eleventh Edition. WoltersKluwer; 2022.

58. McGuire J. Transitional off-loading: an evidence-based approach to pressure redistribution in the diabetic foot. *Adv Skin Wound Care*. 2010;23(4):175-190. doi:10.1097/01.ASW.0000363528.16125.a7

59. Mueller MJ. Mobility advice to help prevent re-ulceration in diabetes. *Diabetes Metab Res Rev*. 2020;36 Suppl 1(dcy, 100883450):e3259. doi:10.1002/dmrr.3259

60. Fernando ME, Woelfel SL, Perry D, et al. Dosing activity and return to preulcer function in diabetes-related foot ulcer remission. *J Am Podiatr Med Assoc*. 2021;111(5). doi:10.7547/20-166

61. Bennett WL, Ouyang P, Wu AW, Barone BB, Stewart KJ. Fatness and fitness: how do they influence health-related quality of life in type 2 diabetes mellitus?. *Health Qual Life Outcomes*. 2008;6(101153626):110. doi:10.1186/1477-7525-6-110

62. Molsted S, Jensen TM, Larsen JS, et al. Changes of physical function and quality of life in patients with type 2 diabetes after exercise training in a municipality or a hospital setting. *J Diabetes Res*. 2022;2022(101605237):5751891. doi:10.1155/2022/5751891

63. Abdelbasset WK, Abdelhalim NM. Assessing the effects of 6 weeks of intermittent aerobic exercise on aerobic capacity, muscle fatigability, and quality of life in diabetic burned patients: Randomized control study. *Burns J Int Soc Burn Inj*. 2020;46(5):1193-1200. doi:10.1016/j.burns.2019.12.013

64. MacDonald CS, Nielsen SM, Bjørner J, et al. One-year intensive lifestyle intervention and improvements in health-related quality of life and mental health in persons with type 2 diabetes: a secondary analysis of the U-TURN randomized controlled trial. *BMJ Open Diabetes Res Care*. 2021;9(1):e001840. doi:10.1136/bmjdrc-2020-001840

65. Wiesinger GF, Pleiner J, Quittan M, et al. Health related quality of life in patients with long-standing insulin dependent (type 1) diabetes mellitus: benefits of regular physical training. *Wien Klin Wochenschr*. 2001;113(17-18):670-675.

66. Look AHEAD Research Group, Wing RR. Long-term effects of a lifestyle intervention on weight and cardiovascular risk factors in individuals with type 2 diabetes mellitus: four-year results of the Look AHEAD trial.. *Arch Intern Med*. 2010;170(17):1566-1575. doi:10.1001/archinternmed.2010.334

67. Nwankwo MJ, Okoye GC, Victor EA. Effect of twelve weeks supervised aerobic exercise on ulcer healing and changes n selected biochemical profiles of diabetic foot ulcer subjects. *Int J Diabetes Res*. 2014;3(3):41-48.

68. Eraydin S, Avsar G. The effect of foot exercises on wound healing in type 2 diabetic patients with a foot ulcer: a randomized control study. *J Wound Ostomy Continence Nurs*. 2018;45(2):123-130.

69. Flahr D. The effect of nonweight-bearing exercise and protocol adherence on diabetic foot ulcer healing: a pilot study. *Ostomy Wound Manage*. 2010;56(10):40-50.

70. Honda H, Igaki M, Komatsu M, Tanaka S ichiro. Effect of moderate-intensity seated exercise on the management of metabolic outcomes in hypertensive individuals with or without exercise habits. *J Exerc Sci Fit*. 2021;19(1):51-56. doi:10.1016/j.jesf.2020.09.002

Table 1. Questions 5-9 described in PICO terms.

Question	Population	Intervention(s)	Comparator(s)	Outcome(s)
5	Adults with diabetes with current foot ulceration	Various fitness/exercise routines with various intensities including aerobic and resistance training	No change in exercise or standard exercise used as an alternative exercise	Improved mobility in the context of wound healing.
6	Adults with diabetes	Not applicable	Not applicable	Psychometric properties of tests and measures assessing physical fitness and activity
7	Adults with diabetes	Various fitness/exercise routines with various intensities including aerobic and resistance training	No change in exercise or standard exercise used as an alternative exercise	Physical fitness (e.g., VO_{2max}, VO_{2peak}, %METS, sit-to-stand test, 6-minute walk test, blood pressure)
8	Adults with diabetes with closed ulceration	Progressive reloading of recently closed ulceration	Lack of progressive reloading of recently closed ulceration	Presence or absence of ulcer recurrence
9	Adults with diabetes	Physical fitness and activity	Lack of physical fitness and activity	Quality of Life Measures; Health care costs

Table 2. Abstract Review Guidelines

Exclusion Criteria: • Non-adults or adults without diabetes • Non-scientific papers: Opinion papers, case reports, case series • Descriptive studies • Non-systematic literature reviews • Non-English • Animal studies • Subjects under 18 years old
Inclusion Criteria, including quality appraisal tool to be used: • Adult population • Experimental studies • RCTs---PEDro • Systematic Reviews—AMSTAR 2 • Meta-analyses—AMSTAR 2 • Retrospective (choice of diagnostic or prognostic) • Diagnostic/Prognostic–SIGN
Terms for exclusion of articles: • Wound care – treatment of ulcer • Pediatric population • Case study • Non-Peer-reviewed

Table 3. Level of Evidence Definitions

Level of Evidence	Definition
I	Evidence that comes from high quality systematic reviews, diagnostic studies, prospective, or RCT
II	Evidence from lesser-quality diagnostic studies or prospective studies or RCT
III	Evidence based on retrospective or case-control
IV	Evidence based on case series studies
V	Expert Opinion

Table 4. Grading of Evidence (modified from APTA CPG Manual Tables 7)

Grading of Evidence	Associated Level of Obligation	Defined
A	Strong	Recommendation based on high certainty for at least a moderate benefit/cost (based on level 1 or 2 evidence predominating)
B	Moderate	Recommendation based on high certainty for a slight or moderate benefit/cost or moderate certainty that benefit/cost is moderate (based on level 2 evidence predominating or one high quality RCT).
C	Weak	Recommendation with moderate certainty for slight benefit/cost or weak certainty for moderate benefit/cost (based on level 2-5 evidence)
D	Theoretical	Recommendation that is supported by basic science (not clinical trials) or peer-reviewed, published expert opinion
P	Best Practice	Practice recommendation according to practice norms where there is a clear benefit. Expert opinion.
R	Research	Limited/absent evidence or equivocal conclusions on present research

Table 5. Question status and literature included.

Question	Initial studies found	Excluded because of duplication	Excluded because irrelevant	Number of studies where full text review completed	Remaining studies
1	Removed because adequately addressed by the IWGDFU 2019 guideline[6]				
2	Removed because adequately addressed by the IWGDFU 2019 guideline[6]				
3	Removed because adequately addressed by the IWGDFU 2019 guideline[6]				
4	Removed because adequately addressed by the Academy of Neurological Physical Therapy Outcome Measure guideline.[12]				
5	268	18	246	4	3
6	117	0	85	32	1
7	71	1	38	32	28
8	107	5	64	38	0
9	138	3	116	19	6

Table 6. Psychometric data to assess fitness, including physical function.[25]

Fitness test(s) assessed	Construct Measured	Relative Reliability Parameter and Score: ICC (95% CI)	Parameter of Measurement Error: SEM	Parameter of Measurement Error: MDC	%SEM	%CV
Hand Grip Strength Test	Upper body muscular strength	Dominant arm ICC = 0.98 (.95 to .99)	1.4	3.89 kg	5.2	10.62
Hand Grip Strength Test	Upper body muscular strength	Non-dominant arm ICC = 0.98 (.96 to .99)	1.56	4.32 kg	6.3	10.52
Hand Grip Strength Test	Upper body muscular strength	Bimanual Grip Strength (kg) ICC = 0.98 (.96 to 1.00)	1.49	4.13 kg	5.8	9.55
Right Chair Sit and Reach Test (cm)	Lower body flexibility	ICC=.94 (.84 to .98)	2.7	7.5 cm	22	39.22
Left Chair Sit and Reach Test (cm)	Lower body flexibility	ICC = .93 (.82 to .97)	3.25	9.01 cm	26.4	47.56
Timed "Up and Go" (TUG) Test	Motor agility/mobility	ICC= .98 (.95 to .99)	0.31	0.85 sec	3.5	6.46
6-Minute Walk Test (6MWT)	Cardiorespiratory fitness	ICC=.99 (.96 to 1.0)	9.88	27.37 m	2.5	5.12
30-second sit to stand test	Lower body strength	ICC=.92 (.79 to .98)	1.21	3.35 times	9.6	17.6

CV: Coefficient of Variation; CI: Confidence Interval; ICC: intraclass correlation coefficient; MDC: Minimal Detectable Change; SEM: Standard Error of Measurement

Table 7. Risk of bias

Study	Specified Eligibility criteria	Randomization	Concealed allocation	Similarity of groups at baseline	Subject/ Provider blinding	Assessor blinding	At least 1 outcome for >85% of subjects	Intention to treat	Funding source reported
Lehmann R, et al., 1997[54]	+	-	-	NA	-	-	+	+	In kind support from Boehringer-Mannheim Switzerland and Novo-Nordisk Switzerland
Kirk A, et al., 2003[36]	+	+	+	+	-	-	+	-	None reported
Di Loreto C, et al., 2005[55]	+	+	-	+	-	-	+	-	None reported
Cauza E, et al., 2005[33]	+	+	-	-	-	-	+	-	Jubilaumsfond of the Austrian National Bank (Project no. 8537)
Praet SFE, et al., 2008[37]	+	+	+	+	-	+	+	+	Dutch Healthcare Innovation Foundation research grant from 'OZ-zorgverzekeringen' healthcare insurance company; Dutch Ministry of Health, Welfare and Sports grant; in kind supplies support from A. Menarini Diagnostics Benelux, RSscan International
Jakicic JM, et al., 2009[38]	+	+	-	+	-	+	+	+	NIDDKD; National Heart, Lung, and Blood Institute; CDC grants
Johnson ST, et al., 2009[39]	+	+	-	+	-	-	+	+	Heart and Stroke Foundation of Canada
Reid RD, et al., 2010[40]	+	+	+	+	-	+	+	+	DARE trial supported by grants from the Canadian Institutes of Health Research (grant MCT-44155) and the Canadian

									Diabetes Association (The Lillian Hollefriend Grant); and various other grants to support team members (see p. 639-640)
The Look Ahead Group, 2010[66]	+	+	-	+	-	+	+	+	DHHS through cooperative agreements from NIH; NIDDKD; National Heart, Lung, and Blood Institute; National Institute of Nursing Research; National Center on Minority Health and Health Disparities; Office of Research on Women's Health; CDC; Department of Veterans Affairs; among other facilities and research centers (see p. 1574 of reference)
Ng CLW, et al., 2010[29]	+	+	+	+	-	+	+	+	National Medical Research Council of Singapore (NMRC/0728/2003); In kind support of Abbott Laboratories;
Karstoft K, et al., 2013[31]	+	+	-	+	-	+	-	+	Danish Centre for Strategic Research in Type 2 Diabetes (grants 09-067009 and 09-075724); Danish National Research Foundation (02-512-55)
Espeland MA, et al., 2013[45]	+	+	-	-	-	+	+	+	NIDDKD; National Heart, Lung, and Blood Institute; CDC
Johannsen NM, et al., 2013[41]	+	+	-	+	-	+	+	+	National Institutes of Health (DK-068298)

Andersen TR, et al., 2014[30]	+	-	-	+	-	-	+	+	FIFA Medical Assessment and Research Center (F-MARC) and Nordea-fonden, Denmark
DeSousa MV, et al., 2014[28]	-	+	-	+	-	-	-	-	Grants from the State of Sao Paulo Research Foundation
Krishnan S, et al., 2015[53]	+	-	-	-	-	-	-	-	None reported
Senechal M, et al., 2015[42]	+	+	-	+	-	+	+	+	NIH Grant DK068298
Mendes R, et al., 2016[51]	+	-	-	-	-	-	-	-	Portuguese Foundation for Science and Technology (SFRH/BD/47733/2008)
Stoa EM, et al., 2017[52]	+	-	-	+	-	-	+	-	No external funding.
Winding KM, et al., 2018[46]	+	+	+	+	-	-	+	-	TryFonden; Danish National Research Foundation (DNRF55); Capitol Region of Denmark, Novo Nordisk Foundation, and Danish Diabetes Academy
Duruturk N, Özköslü MA, 2019[48]	+	+	+	+	-/+	+	+	-	Authors report no conflict of interest.
Szilagyi B, et al., 2019[44]	+	+	+	+	-	+	-	-	Authors report no conflict of interest.
MacDonald CS, et al., 2020[47]	+	+	+	+	-	+	+	+	TryFonden; Danish Council for Strategic Research, grants 09-067009 and 09-075724; Danish Diabetes Academy grant; In kind support by Bayer A/S

Dominguez-Munoz FJ, et al., 2020[43]	+	+	+	+	+	+	-	+	Regional Department of Economy and Infrastructure of the Government of Extremadura and European Social Fund (PD16008)

Table 8. Health related quality of life and costs description

Study	***Subjects***	***Type of Exercise***	***Effects on HRQOL***
Wiesinger 2001[65]	Type 1 DM, mean age 40 years, treatment and control groups	Aerobic exercise with stationary bike for 1 hour 2 times per week for 2 weeks, 3 times per week remainder of 4 months	Significant improvement in HRQOL in treatment group compared to control group
Bennett 2008[61]	Type 2 diabetes with mean age 56.9*	VO_2 peak fitness test used, no treatment intervention	Increased fitness correlated with higher HRQOL
Abdelbasset 2020[63]	Type 2 diabetes and burns, mean age 47.8 treatment group and 46.3 control group	Moderate intensity intermittent aerobic exercise 40 minutes per day 3 times per week for 6 weeks	Significant improvement in Burns Specific Health Scale score in treatment group compared to control group
MacDonald 2021[64]	Type 2 DM, mean age 53.6 treatment group with structured exercise and individual meal plans, 56.6 standard of care group	Aerobic exercise and resistance training 240-300 minutes per week	Significant improvement in HRQOL in treatment group compared to control group
Molsted 2022[62]	Type 2 DM, split into groups by municipality or hospital rehabilitation clinic, mean age 69.8 and 62.6 respectively	Aerobic exercise and strength training 1 hour 2 times per week for 12 weeks: interval aerobic exercise on ergometer bikes, circuit training with aerobic and strength training exercises	Positive changes in HRQOL for both exercise groups, more pronounced in municipality group
Study	***Subjects***	***Type of Exercise***	***Impact on costs***
Di Loreto 2005[55]	Type 2 diabetes and mean age 62 years	Moderate intensity aerobic exercise	Significant reduction in health care costs with energy expenditure of >10 METS/hour/week

Appendix A: Clinical Practice Guidelines Reviewed

Registered Nursing Association of Ontario (RNAO)

The National Institute for Health and Care Excellence (NICE)

Wound, Ostomy, and Continence Nurses Society™ (WOCN)

Steed, et al. 2006

International Working Group on the Diabetic Foot (IWGDF)--2019

Appendix B: Search Terms

Q5:

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) <1946 to Present>

Search Strategy:

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1 *Diabetic Foot/
2 "Outcome and Process Assessment (Health Care)"/
3 "Activities of Daily Living"/
4 1 and 3
5 limit 4 to (english language and humans)
6 "Activities of Daily Living"/ or Mobility Limitation/ or "Quality of Life"/ or Walking/
7 1 and 6
8 limit 7 to (english language and humans)
9 2 and 8
10 mobility.m_titl.
11 1 and 10
12 limit 11 to (english language and humans)
13 *Physical Therapy Modalities/
14 1 and 13
15 limit 14 to (english language and humans)
16 *Diabetic Foot/dh, dt, pc, rt, rh, su, th [Diet Therapy, Drug Therapy, Prevention & Control, Radiotherapy, Rehabilitation, Surgery, Therapy]
17 mobility.mp.
18 16 and 17
19 limit 18 to (english language and humans)
20 5 or 8 or 12 or 15 or 18

Interface - EBSCOhost Research Databases
Search Screen - Advanced Search
Database - CINAHL Complete
Search Strategy:

1. (MM "Diabetic Foot") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase
2. (MM "Diabetic Foot") Search Options: Expanders - Apply related words; Also search within the full text of the articles
   Search modes - Boolean/Phrase
3. (MM "Functional Assessment+") OR (MM "Functional Status") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase
4. (MM "Functional Assessment+") OR (MM "Functional Status") Search Options: Expanders - Apply related words; Also search within the full text of the articles
   Search modes - Boolean/Phrase
5. ((MM "Functional Assessment+") OR (MM "Functional Status")) AND (S2 AND S4) Search Options: Limiters - English Language; Human
   Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase

6. ((MM "Functional Assessment+") OR (MM "Functional Status")) AND (S2 AND S4) Search Options: Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase
7. (MM "Physical Mobility") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
8. (MM "Physical Mobility") Search Options: Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase
9. ((MM "Physical Mobility")) AND (S2 AND S8) Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
10. ((MM "Physical Mobility")) AND (S2 AND S8) Search Options: Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase
11. TI Mobility Search Options: Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase
12. TI Mobility Search Options: Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase
13. S2 AND S12 Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
14. S2 AND S12 Search Options: Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase
15. (MM "Physical Therapy+") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
16. (MM "Physical Therapy+") Search Options: Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase
17. S2 AND S16 Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
18. S2 AND S16 Search Options: Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase
19. (MM "Diabetic Foot/DH/DT/PC/RT/RH/SU/TH") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
20. (MM "Diabetic Foot/DH/DT/PC/RT/RH/SU/TH") Search Options: Limiters - English Language
Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase

21. Mobility Search Options: Limiters - English Language
Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase
22. Mobility Search Options: Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase
23. S20 AND S22 Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
24. S6 OR S10 OR S14 OR S18 OR S23 Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
25. S6 OR S10 OR S14 OR S18 OR S23 Search Options: Limiters - English Language
Expanders - Apply related words; Also search within the full text of the articles
Search modes - Boolean/Phrase

Q6:
Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) <1946 to Present>

Search Strategy:
---

1 *Physical Fitness/
2 exp *Diabetes Mellitus/
3 1 and 2
4 limit 3 to (english language and humans)
5 limit 4 to (clinical trial, all or consensus development conference or consensus development conference, nih or controlled clinical trial or evaluation studies or guideline or meta analysis or multicenter study or practice guideline or pragmatic clinical trial or randomized controlled trial or systematic reviews or validation studies)

Interface - EBSCOhost Research Databases
Search Screen - Advanced Search
Database - CINAHL Complete
Search Strategy:
1. MM "Diabetes Mellitus+" Search Options: Limiters - Published Date; Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects Search modes - Boolean/Phrase
2. MM "Physical Fitness+" Search Options: Limiters - Published Date; Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects Search
3. MM "Physical Activity" Search Options: Limiters - Published Date; Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects Search modes - Boolean/Phrase
4. MM "Exercise+" Search Options: Limiters - Published Date; Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects Search modes - Boolean/Phrase

5. S2 OR S3 OR S4 Search Options: Limiters - Published Date; English Language; Human Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects Search modes - Boolean/Phrase
6. continuum of care Search Options: Limiters - Published Date; English Language; Human Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects Search modes - Boolean/Phrase
7. S1 AND S5 AND S6 Search Options: Limiters - Published Date; English Language; Human Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects Search modes - Boolean/Phrase
8. (MM "Patient Assessment+") OR (MM "Physical Therapy Assessment") OR (MM "Occupational Therapy Assessment") OR (MM "Outcome Assessment") Search Options: Limiters - Published Date; Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects
9. (MM "Functional Assessment+") Search Options: Limiters - Published Date; Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects Search modes - Boolean/Phrase
10. S8 OR S9 Search Options: Limiters - Published Date; English Language; Human Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects Search modes - Boolean/Phrase
11. S1 AND S5 AND S10 Search Options: Limiters - Published Date; English Language; Human Expanders - Also search for related words (synonyms and plurals); Also search within the full text of the articles; Apply equivalent subjects Search modes - Boolean/Phrase

Q7:
Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) <1946 to Present>
Search Strategy:
---

1 *Physical Fitness/
2 exp *Diabetes Mellitus/
3 1 and 2 (313)
4 limit 3 to (english language and humans)
5 limit 4 to (clinical trial, all or consensus development conference or consensus development conference, nih or controlled clinical trial or evaluation studies or guideline or meta analysis or multicenter study or practice guideline or pragmatic clinical trial or randomized controlled trial or systematic reviews or validation studies)
6 (intervention or interventions).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
7 5 and 6

Interface - EBSCOhost Research Databases
Search Screen - Advanced Search
Database - CINAHL Complete
Search Strategy:
1. (MM "Diabetic Foot/DH/DT/RT/RH/SU/TH") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
2. (MM "Diabetic Foot/DH/DT/RT/RH/SU/TH") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
3. (MM "Diabetic Foot/DH/DT/RT/RH/SU/TH") Search Options: Limiters - English Language; Human; Age Groups: All Adult

Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
4. (MM "Physical Fitness+") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
5. (MM "Physical Activity") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
6. (MM "Exercise+") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
7. S4 OR S5 OR S6 Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
8. S3 AND S7 Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase

Q8:
Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations and Daily <1946 to Present>
Search Strategy:
---

1 exp *Diabetic Foot/rh, th [Rehabilitation, Therapy] {Including Related Terms}
2 PRESSURE/
3 1 and 2
4 limit 3 to (english language and humans)
5 limit 4 to yr="1946 -Current"
6 limit 3 to (english language and humans)
7 limit 1 to yr="1946 -Current"
8 limit 2 to yr="1946 -Current"
9 limit 3 to yr="1946 -Current"
10 limit 4 to yr="1946 -Current"
11 limit 5 to yr="1946 -Current"

Interface - EBSCOhost Research Databases
Search Screen - Advanced Search
Database - CINAHL Complete
Search Strategy:
1. (MM "Diabetic Foot/RH/TH") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
2. (MM "Pressure+") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
3. S1 AND S2 Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent

subjects
Search modes - Boolean/Phrase

Q9:

Database:

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations and Daily <1946 to Present>

1 exp *Diabetes Mellitus/
2 exp *"Quality of Life"/
3 1 and 2
4 Time Factors/
5 3 and 4
6 limit 5 to (english language and humans)
7 physical.hw.
8 limit 7 to (english language and humans)
9 3 and 8
10 limit 9 to yr="1946 -Current"

Interface - EBSCOhost Research Databases
Search Screen - Advanced Search
Database - CINAHL Complete
Search Strategy:

1. (MM "Diabetes Mellitus+") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase
2. (MM "Quality of Life+") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase
3. S1 AND S2 Search Options: Limiters - English Language; Human
   Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase
4. (MH "Time Factors") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase
5. S3 AND S4 Search Options: Limiters - English Language; Human
   Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase
6. (MH "Physical Activity") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase
7. (MH "Physical Fitness+") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase
8. (MH "Exercise+") Search Options: Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
   Search modes - Boolean/Phrase

9. S6 OR S7 OR S8 Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
10. S1 AND S4 AND S9 Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
11. MM exercise+ OR MM physical fitness+ OR MM physical activity Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase
12. S1 AND S4 AND S11 Search Options: Limiters - English Language; Human
Expanders - Apply related words; Also search within the full text of the articles; Apply equivalent subjects
Search modes - Boolean/Phrase

Appendix C: Example exercise to improve or maintain fitness during offloading.

Aerobic activity using bicycle ergometer with a progressive increase in exercise intensity. Could use the guidance of the ACSM guidelines.[57,67]

Further specific exercise targeting maintenance or improvement of joint mobility would also be appropriate (e.g., toe, ankle, if able).[68,69]

Seated exercises with a progressive increase in exercise intensity. Consider resistance training as part of seated exercises.[70]

Appendix D: Question 7 Findings

Study	Study Design	Participant Characteristics				Intervention Characteristics		Fitness Assessment	Change in Fitness	Complications
		# Subjects	Age	Inclusion	Exclusion	Exercise	Comparator			
Lehman R, et al., 1997[54]	Pre-Post	20	33 (22-48) years	Well-controlled diabetes	Symptomatic CHD, autonomic neuropathy, and inability to increase the amount of PA	Each participated in a sports camp (1 week) to apply the knowledge from a diabetes self-management program. Instruction was given to exercise at least 3x/week for 45 min (total of 135 min/week) or if baseline activity was greater, to simply increase activity as much as possible. They encouraged biking, jogging, and hiking with HR between 50-70%VO_2 max a determined.	NA	Physical fitness was assessed with cycle ergometry, step test, and resting HR; Also assessed mean time of PA;	VO_2 max increased by 6% and max work increased by 11%; Table 2 p. 1606	mild hypoglycemic episodes occurred in virtually all the patients but frequency of severe hypoglycemic episodes decreased by 0.14 before sport to 0.10 per patient during and after sport.
Kirk A et al., 2003[36]	RCT	70-->35 male, 35 female	mean age 57±7.9 years	In either contemplation or preparation stage of	presence of medical conditions preventing exercise	Exercise consultation--30 minute 1-on-1 session based on TTM. Looked at	Received a leaflet about exercise and diabetes	PA; Peak exercise on motorized TM (peak oxygen	Exercise group: median ↑ of 128 min moderate	Not described

				exercise behavior change; not meeting PA guidelines but wanted to be more active; T2DM		current activity, benefits, barriers, and costs of becoming more active; suitable activities; social support; goal setting; and relapse prevention. Aim to accumulate 30 min of moderate PA most days of the week. Support phone calls at 1 and 3 months.		uptake calculated)	activity and 153 min of total activity; Exercise group recorded significant ↑ in total exercise duration and peak gradient; Control group had a ↓ in peak oxygen uptake	
Boule NG, et al., 2003[32]	Systematic Review and Meta-analysis	seven studies with a total of n=266	Mean age 57±7.9 years	At least 8 weeks long; inclusion of VO_2 max--obtained during maximal exercise test (with direct measure or validated estimation of oxygen	Not a structured, supervised intervention; studies that included drug co-intervention; absence of randomized control group; not T2DM; non-human; not with a maximal	Mean exercise characteristics: 3.4 sessions per week, 49 min per session for 20 weeks; intensity ranged from 50-75% of VO_2 max		maximal exercise test (with direct measure or validated estimation of oxygen consumption);	↑11.8% in VO_2max in exercise group and a ↓1% in the control group; one study with high intensity exercise had a large ↑ in VO_2 max; exercise intensity predicted	

				consumption); T2DM	aerobic test as the fitness test;				standard mean difference in VO_2 max.	
DiLoreto C., et al., 2005[55]	Post hoc analysis of a those randomized to a counseling intervention	182 patients randomized to the intervention; 3 didn't complete; 1 dropped out of follow-up; 2 died of unrelated causes;		T2DM of at least 2 years; age >40 years;	patients with illnesses that could decrease life expectancy or cause cardiac, liver, or renal failure	Counseling session of at least 30 min conducted by a physician and designed to advise on PA; follow-up call at 1 month and then by 15 min sessions every 3 months in the outpatient clinic; 2-year study		Secondary outcomes included BP and heart rate	Reduction in BP in groups 11-20; 21-30; 31-40; >40; reduction in HR in groups 21-30; 31-40; >40--->Full benefit at 21-30 (average EE of 27 METS/hwk…so recommended as a target; This corresponds to about a 3-mile daily walk	
Cauza E., et al., 2005[33]	RCT	22 randomized into a 4-month ST program	ST group: 56.2±1.1 y; ET group: 57.9±1.	All participants with a fasting glucose concentration of 126	Presence of rapidly progressive or terminal illness, MI, uncontrolled arrhythmias,	ET Group: systematic ET performed on a cycle ergometer on 3 nonconsecutive days/week; first 4	ST Group: systematic ST on 3 nonconsecutive days with 10 min warmup on cycle; first 2	VO_2 peak; maximal strength dynamometry	ST group: highly significant changes in the max strength of all muscle	

		; 17 randomized into a 4-month ET program	4 y; all T2DM	mg/dL or greater; met the WHO criteria for the diagnosis of T2DM; aged 50-70; no limits for body weight or BMI	3rd degree heart blockage; elevated BP (>200/100mmHG on therapy), nephropathy, severe peripheral or autonomic neuropathy, or diabetic proliferative retinopathy. Also, severe musculoskeletal and neurologic abnormalities; OK to have mild peripheral neuropathy	weeks, trained 15 min/session, 3x/ week; exercise sessions increased by 5 minutes every 4 weeks. Total exercise time per week (excluding warmup and cooldown, was 90 minutes in the last 4 weeks.	weeks with low weight exercises; at 3rd week, 3 sets per muscle per week; one set with 10-15 reps without interruption; If more than 15 reps were successfully performed at a given weight, the weight was increased so that 10 reps could be performed; All major muscle groups were worked--UE/LE see p. 1529;		groups and more LBM; Peak VO_2 improved by 8% for ET group and 1% for ST group; maximum workload improved significantly (by 12%) for both groups; strength improvement for ET group ranged from 0% to 15% for leg press;	
Praet SFE, et al., 2008[37]	RCT	92 patients with T2DM	60±9 years	People with T2DM diagnosed for more than 3 months prior to screening;	Presence of (silent) cardiac or peripheral vascular disease, orthopaedic limitations	Brisk walking: consisted of three 60 min exercise sessions; first 3 months participants were supervised by certified exercise	Medical fitness program: 3 exercise sessions per week; endurance type exercise consisted of	Peak oxygen uptake capacity was estimated based on maximum workload capacity	HR and BP decreased but were not different between the two groups.	See Table 2 p. 741. Mostly musculoskeletal concerns were reported.

					and/or diabetic foot ulceration.	trainers and a PT; After 3 months, certified trainers guided and supervised the training sessions and the PT was consultative. During the intervention period the intensity increased and averaged 75±5% of max HR.	interval type exercise on a home trainer, elliptical trainer or rowing ergometer with an average intensity of 73±2% of max HR. Training was tailored to individual performance capacity.	during cycling ergometry. Also resting HR and BP were assessed.	There were not differences in workload capacities between the groups.	
Jakicic JM, et al., 2005[38]	RCT	Data from 4376 overweight or obese adults with T2DM	58.7±6.8 years	45-74 years old; BMI≥25 kg/m2 (≥27 kg/m2 if currently taking insulin); type 2 diabetes mellitus determined by self-report with verification	Inadequate control of comorbid conditions; HbA1c > 11%; Blood pressure ≥ 160/100 mmHg; Fasting triglycerides ≥600 mg/dL; presence of factors that may limit adherence to interventions or affect	Intensive lifestyle intervention (ILI) designed to achieve and maintain weight loss through decreased caloric intake and increased physical activity.	Control condition is given diabetes support and education.	Graded TM test (preferred speed with grade increased by 1% at 1-min intervals through test	Improvement in unadjusted fitness in ILI (22.2±30.4%, N=1687) versus DSW (6.6±22.5%, N=1643) (P<0.0001). Adjusted fitness--change in ILI group was 5.06 greater than the fitness change ofr	

					conduct of the trial (see listed in Table 1 p. 612 in referenced article); Underlying diseases likely to limit life span and/or affect the safety of the interventions (see Table 1 p. 612)				DSE. For each year of age, there was a significantly lower change in fitness. Those without a CVD history had a 2.10% higher change in fitness than those with a history of CVD.	
Johnson ST, et al., 2009[39]	RCT	N=41	56.5±7.2 years	People with type 2 diabetes; 40-70 years old; not on insulin; able to walk; not enrolled in another physical activity program; no GI disorders; previous	history of CV disease at prescreening; If higher CV risk but not history--evaluation by cardiologist before entering phase 2; at information session, participants were asked to walk at	First phase (weeks 1-12), participants increased daily steps using a pedometer; Each participant set own daily goal according to baseline measure. Weeks 1-4 participants attended weekly group of supervised walking session and weeks 5-12		BP and HR	In first 12 weeks, participants increased walking by 1562 steps/day and had significant decrease in body weight, BMI, and systolic and diastolic BP. After phase 2,	

				attendance and completion of at least 11 regional diabetes education course.	their self-selected normal speed for 15 min. Anyone who exceeded 5.0 km/h were excluded to avoid potential for run rather than walk to increase speed of gait in second phase of study.	walking sessions were held once weekly but were option. A manual and logbook were given to help facilitate goal setting and recording steps/day. At week 12, participants were randomized to either group targeting walking speed (Enhanced Lifestyle Program--ELP) or group targeting total daily steps (Basic Lifestyle Program--BLP). Weeks 13-16. all were asked to attend 1 weekly session in their assigned program (included supervised walking session). Weeks 17-20, they were to attend 2 weekly booster sessions. Weeks 21-24 they were			ELP had significantly lower HR	

						to attend 1 weekly booster session in their assigned program. (Figure 1) ELP--weeks 13-16 they were taught to walk 10% faster during a 30-minute walk and incorporate that pace into 30 min/day walk 3 days/week until the end of the study.				
Reid RD, et al., 2010[40]	RCT with parallel group design	218 inactive people with type 2 diabetes mellitus	54.2±7.1 years	Type 2 diabetes mellitus (defined by ADA) for at least 6 months and baseline HbA1V of 6.6-9.9%	Excluded if: 1. receiving insulin therapy; 2. exercising ≥ 2 times/week for ≥20 min per session or doing ST during the previous 6 months; 3. changes in oral DM medications during previous 2 months; 4. changes in	6-month exercise intervention at 8 community-based exercise facilities, supervised by personal trainers. Participants exercised 3x/week with training progressing in length and intensity. **Aerobic group** exercised on TMs and/or bicycle ergometers. Progression was from 15-20 min per session at 60%	6-month exercise intervention at 8 community-based exercise facilities, supervised by personal trainers. Participants exercised 3x/week with training progressing in length and intensity. **Combined exercise group** did full AT plan	SF-36 physical component score	Resistance exercise led to clinically but not statistically significant improvements in the SF-36 physical component score compared with aerobic exercise.	

					antihypertensive or lipid-lowering agents in the previous month; 5. change of ≥ 5% in body weight during the previous 2 months; 6. serum creatinine of more than 200 µmol/l; 7. had proteinuria >1 g/24 h; 8. BP >160/95 mmHg; 9. PA restricted due to disease; 10. had other medical conditions making participation inadvisable; 11. completed < 12 scheduled exercise	max HR to 45 min per session at 75% max HR. **Resistance group** performed eight different exercises on weight machines each session, progressing to 2-3 sets of each exercise at a weight that could be lifted for a max of 8 reps.	plus the full ST plan. Personal trainer met each participant individually at least 1x/week for 4 weeks, every 2 weeks for next 2 months, then 1x/month.			

					sessions during the run-in period.					
The Look AHEAD Research Group, 2010[66]	RCT	5145 participants were randomized, 2570 to ILI and 2575 to DSE	mean age 58±6.8 years	45-74 years old; BMI≥25 kg/m2 (≥27 kg/m2 if currently taking insulin); type 2 diabetes mellitus determined by self-report with verification	Inadequate control of comorbid conditions; HbA1c > 11%; Blood pressure ≥ 160/100 mmHg; Fasting triglycerides ≥600 mg/dL; presence of factors that may limit adherence to interventions or affect conduct of the trial (see listed in Table 1 p. 612 in referenced article); Underlying diseases likely to limit life span and/or affect	Intensive lifestyle intervention included diet modification to achieve and maintain weight loss through decreased caloric intake (designed to induce at least a 7% weight loss) and increased physical activity (exercise goal was at least 175 minutes of physical activity/week, using activities similar in intensity to brisk walking).	Control condition is given diabetes support and education.	BP; Max ET at baseline and a Submax ET at years 1 and 4. (Changes in fitness were computed as the difference between estimated metabolic equivalents at the point that the participants achieved or exceeded 80% of age-predicted max HR or RPE of at least 16)	At year 1, fitness increased by 20.4% in ILI participants and by 5.0% in DSE participants between baseline and year 1. Across 4 years, ILI group had a mean increased in fitness (%METS) by 12.74 whereas the DSE group at an increase of 1.96 (Table 1 p. 1568).	

					the safety of the interventions (see Table 1 p. 612)					
Ng CLW, et al., 2010[29]	RCT	N= 60	RT group: 57±7 years; AT group: 59±7 years	50 or older; T2DM with HbA1c between 8-10% in past month; for ≥20 min and climb one flight of stairs unaided without stopping; sedentary (never participating in structured exercise/sport)	uncontrolled DM with HbA1c >10%; expected ↑treatment for glycemic control or dyslipidemia in next 8 weeks; CHF, unstable angina, or acute MI within the last year; proliferative diabetic retinopathy; uncontrolled HTN; advanced arthritis likely to limit mobility; respiratory co-morbidities; significant proteinuria	**Progressive ST**: in each session, 9 resistive exercises [seated leg press, straight leg raises; hamstring curls; biceps, triceps, anterior and middle deltoids with free weights; hip abductors and extensor with machine] in 3 rounds of circuit with one set of 10 reps for each exercise per circuit; intensity of 65-70% 1-RM. Completed sessions over 8 weeks.	**Aerobic group**: in each session, 50 min of aerobic exercise--10 minutes on bicycle and 20 minutes each on TM/elliptical [TM, stationary upright bicycle, stationary recumbent bicycle, elliptical]; intensity of 65-70% HR max. Completed sessions over 8 weeks.	Peak oxygen consumption (measured during Submax ET with modified Bruce protocol); resting BP	Table 3--both RT group and AT group with improved peak volume of oxygen, but control was more; BP ↓d AT group	

					or CRI; very low caloric diet prescribed or drugs for obesity; RD; inability to monitor BG or comply with exercise					
Karstoft K, et al., 2013[31]	RCT	32 people (control group =8; continuous walking group =12; interval walking group =12)	Control group: 57.1±3.0 years; Continuous walking group: 60.8±2.2 years; Interval walking group: 57.5±2.4 years	T2DM	Use of exogenous insulin, weight instability (>2 kg/6 months), physical activity (>150 min/week), and evidence of liver, renal, and cardiopulmonary disease and diseases contraindicating physical activity.	All received a pedometer to be worn throughout the study. **CWT Group**: had target EE rate and were instructed to perform CWT above the target. **IWT group**: had target EE rate set for 70% Peak EE rate and were instructed to perform IWT consisting of cycles of 3 min of fast walking (above target) and 3 min of slow walking (below target). All training subjects were prescribed 5	All received a pedometer to be worn throughout the study. **Control group:** instructed to continue their habitual lifestyle for 4 months.	Maximal oxygen consumption was measured by indirect calorimetry during an incremental exhaustive TM walking test. BP	IWT subjects improved their relative VO_2max by 4.4 ±1.2 mL/kg/min and their absolute VO_2max by 249 ±85 mL/min. No changes were found in the Control or CWT groups. No changes were found in BP across groups.	IWT reduced hyperglycemic episodes without leading to hypoglycemic episodes.

						training sessions per week, 60 min/session for 4 months.				
Johannsen NM, et al., 2013[41]	RCT	N=196	Overall mean age:57.1 ±8.1 years; Control group mean age: 58.2±8.4 years; RT group: 58.3±8.5 years; AT group: 55.7±7.9 years; ATRT group: 56.7±7.6 years	Participants in HART-D study with complete baseline and follow-up data; sedentary (aerobic < 20 min, <3 days/week and no RT); men and women 30-75 years with type 2 diabetes (HbA1c 6.5-11.0% inclusive) and a BMI ≤48.0 kg/m2, fasting triglyceride level<500mg/dL, and blood pressure	Presence or medical history of stroke, advanced neuropathy or retinopathy, or other serious medical condition contraindicated for exercise or that may prevent adherence to the study protocol.	**AT Group**: participated in TM walking 3-5 days/week at moderate to vigorous intensity ~150 min of PA/ week. ; **ST group**: 3 days/week of ST [2 sets of 4 UE exercises and 3 sets of 3 LE exercises, and 2 sets of abdominal crunches and back extension exercises]; **ATST Group**: participated in TM walking 3-5 days/week at moderate to vigorous intensity; 2 sessions of ST each week comprising one set of 10-12 reps for all 9 resistance exercise;	**Non-exercise Control Group**: offered weekly stretching and relaxation classes; able to maintain their normal daily physical activity level (confirmed with step counters);	Exercise testing using a TM to get VO_2 peak	The change in V)2 peak was significantly greater after ATRT than in the control and RT groups. Increase in max estimated METs was greater after both AT and ATST compared with the control and RT groups.	

				<160/100 mmHg.						
Vaes AW, et al., 2013[27]	Systematic review and Meta-analysis	Total of 2908 (Type 2 DM=2763; COPD=145)	Mean age reported as 47.0 to 70.9 year in group with diabetes; 61.2 to 65.7 years in patients with COPD.	Patients with type 2 DM, COPD, or CHF; RCTs with activity monitor-based counseling intervention vs. a control intervention or usual care; primary outcome of objective physical activity; secondary outcome of generic and/or disease-specific health-related outcomes.	Not an RCT assessing activity monitor-based counseling versus another intervention or control	Variations by study of activity monitor-based counseling	Variations by study including maintenance of normal activity, usual care, and encouraged increase in daily steps.	Number of steps; BP	Intervention favored greater number of steps (physical activity); Intervention favored lowering of systolic blood pressure	None reported.
Andersen TR, et	Prospective interventio	22--12 in football group	49.8±1.7 years	T2DM; no changes in anti-	History or presence of CV disease or	FG: 1 hour of supervised football training	Control group were instructed to	Maximal cycling testing to get	In FG, VO_2 peak after 12 and 24	

al., 2014[30]	n--quasi-experimental	and 10 in control group		diabetic meds for 3 months; no history or symptoms of CV disease or cancer; no diabetes complications [nephropathy, retinopathy, neuropathy]	cancer; diabetic complications, T1DM, treatment with β-blockers; musculoskeletal complaints that could interfere with football	was performed twice a week for 24 weeks. Training sessions consisted of small-sided games played on a 20m wide and 40m long indoor court surrounded by walls. Subjects played 5x10 min games mixed with 2 min passive rest.	continue their sedentary lifestyle.	at VO_2 peak, time to exhaustion, maximal HR	weeks of training was 10% and 11% higher while it remained unchanged in control group.	
DeSousa MV et al., 2014[28]	RCT	44 (Football and diet group = 22; Diet group = 22)	Age range 48-68 years	T2DM	CV disease and hyperpara-thyroidism; diabetic foot; started on insulin; unable to keep training schedule	**Football and Dietary Group:** Football training intervention: program ran 3x/ week for 12 weeks. Football sessions consisted of 3v3 to 7v7 friendly games--held outdoors on natural grass or indoors on a wooden court on rainy days. Each session lasted 40 min including 10	**Dietary Group**: individually calculated to provide a reduction of 500-1000 kcal in energy intake per day for each of the participants. Diet was balanced and rich in fiber [45-60% CHO, 15-20% Protein, 20-30% fat].	VO_2 max and max HR tested before and after intervention with a standardized protocol on a TM.	At 12 weeks, VO_2 max increased by 10±4% in the football group.	

						min low-intensity warm-up followed by 2x12 min periods of play interspersed with 3 min of passive rest.				
Krishnan S, et al., 2015[53]	Quasi-experimental	41 women completed baseline testing (18 DM and 23 with DM); 6 dropped out within first month due to strenuousness of Zumba, 4 more dropped out in second month due to knee, ankle, or	At baseline (N=41): 49±12.1 years; Remaining 28 age: 50.5±1.8 years.	Female volunteers 18-65 years of age with BMI 25-40 kg/m2; both people with and without type 2 diabetes	Excluded if taking insulin, were regular exercisers (more than 3 hours per week of moderate to high intensity; history of MI; had a pacemaker; were pregnant or lactating; or were unable to commit to the intervention.	Participants completed a 16-week dance intervention (Zumba®) with classes held 3 times per week (1 hour/class) and it was led by a certified Zumba® instructor. Intensity of workout ramped up during weeks 1-3 including instructor walking through moves before completing them.	N/A	Cardiorespiratory endurance was assessed with the Rockport walking test; muscular endurance was assessed with the chair stand test; flexibility was assessed with the sit-and-reach test.	The absolute scores for participants with diabetes improved with all three fitness tests. Statistical testing was only done with pre- to post- for the whole combined group (N=28).	6 dropped out within first month due to strenuousness of Zumba, 4 more dropped out in second month due to knee, ankle, or joint inflammation;

		joint inflammation; toward end of 3rd month, 3 more dropped out for personal reasons. Completing the study: N=28 overweight/obese women (14 with DM, 14 without DM)								
Senechal M, et al., 2015[42]	RCT	N=196	Overall mean age:57.5 ±8.0 years; Control group mean age: 59.1±8.	Participants in HART-D study with complete baseline and follow-up data; sedentary (aerobic <	47 were excluded due to low exercise compliance (<70%) and 19 were excluded because they had missing	**AT Group**: participated in TM walking 3-5 days/week at moderate to vigorous intensity ~150 min of PA/ week. ; **ST group**: 3 days/week of ST [2 sets of 4 UE	**Non-exercise control group**: offered weekly stretching and relaxation classes; able to maintain their normal daily physical activity level	Exercise testing using a TM to get VO_2 peak and time to exhaustion and estimated METs.	Change in muscle quality after 9 months of exercise training was positively associated with change in absolute	

			3 years; RT group: 58.3±8. 3 years; AT group: 56.0±7. 8 years; ATRT group: 57.0±7. 8 years	20 min, <3 days/week and no RT); men and women 30-75 years with type 2 diabetes (HbA1c 6.5-11.0% inclusive) and a BMI ≤48.0 kg/m2, fasting triglyceride level<500mg/dL, and blood pressure <160/100 mmHg.	data for muscle quality index, including eight for DXA and 11 for muscle strength.	exercises and 3 sets of 3 LE exercises, and 2 sets of abdominal crunches and back extension exercises]; **ATST Group**: participated in TM walking 3-5 days/week at moderate to vigorous intensity; 2 sessions of ST each week comprising one set of 10-12 reps for all 9 resistance exercise;	(confirmed with step counters);		and relative VO_2 peak as well as time to exhaustion. No associations were observed with change in estimated METs. They found that those with T2DM who performed both AT and ST and had greatest increase in muscle quality significantly improved CRF measures (absolute and relative VO2 peak, time to exhaustion, and estimated METs	

									compared to the control group.	
Mendes R, et al., 2016[51]	Non-experimental pre-post evaluation	60 volunteers with T2DM (30 women, 30 men); 43 participants were included in the final analysis. [Exclusion by: dropout (7); <65% adherence (6); dietary changes (1); by accident, illness or surgery with hospitalization	62.51 (5.92) years	55 – 75 years; T2DM≥ one year; HbA1c <10%; pharmacological regimen stable ≥ 3 months; major complications of diabetes screened and controlled; no limit to gait or balance; independent community living; No supervised exercise program in last 6 months;	Drop out; adherence to program <65%; participation in other supervised exercise sessions; changes in dietary pattern; accident, illness, or surgery with hospitalization; pathology with limitation in the performance of program activities	Participants engaged in *Diabetes em Movimento* ®, a community-based exercise program. Exercises held 3x/week on non-consecutive days during 9 months. This exercise program was prepared according to international exercise recommendations for people with T2DM; Exercise sessions were conducted in groups of 30 participants, supervised by exercise professionals and lasted 70 minutes (warmup-5 min; AT-30 min; ST-20 min;		Aerobic fitness assessed through the 6MWT; muscle strength (lower limbs) assessed through the performance in 30CST; agility/balance assessed with the TUG; flexibility (lower limbs and lumbar spine) assessed through the performance in CSRT	Significant improvement in: 6MWT (from 660.05± 74.86 to 714.15± 93.48; 30CST 16.68± 3.29 to 21.49± 3.54; TUG 6.15±0.98 to 5.27±0.76; and CSRT: -6.89±11.83 to 0.20±11.55 (Table 2 p. 218)	13 adverse events were recorded during the course of the exercise sessions; 6 symptomatic hypoglycemia (blood glucose < 72mg/dL); 4 musculoskeletal injuries; and 3 non-specific indispositions. None influenced adherence results.

		(2); pathology with limit in performance of program activities (1)		non-smokers in the last 6 months; dietary pattern stable ≥ 6 months.		agility/balance exercise-10 min, and flexibility exercise-5 min)				
Stoa EM, et al., 2017[52]	Non-randomized; two training groups occurred at two different times (5 months separated the two training groups)	N=43 sedentary, overweight individuals with T2DM; Data only included for 38 of the 43 people that initially were included in the study	MIT group: 59±10 years; HAIT group: 59±11 years	Individuals diagnosed with T2DM, aged 20-70 years and no contraindications for testing or training.	Medical contraindications to physical testing and exercise according to the ACSM guidelines, sickness for 2 consecutive weeks or more in the last month before testing, illness during the last week before physical testing, diseases or injuries lasting more than 1 week	**HAIT Group**: 4x4 min at an intensity between 85-95% HR_{peak}. All exercise sessions were supervised and carried out outside (walking/ running). All occurred 3x/week. Groups were matched for total work. All subjects used HR monitors to ensure training intensity.	**MIT Group**: continuously moderate work at 70-75% HR_{peak}. All exercise sessions were supervised and carried out outside (walking/ running). All occurred 3x/week. Groups were matched for total work. All subjects used HR monitors to ensure training intensity.	Fitness was assessed with anthropometric measurements, lactate threshold, work economy, and VO_2max. FatOx test was also completed. Blood pressure was also assessed.	Body fat decreased significantly in both groups. Waist and hip circumferences decreased significantly in both groups. VO_2max decreased in the HAIT group only. VO_2FatOx changed in both groups but HAIT had a larger change when compared	3 subjects dropped out due to illness of pain. (Figure 1)

					during the 12-week intervention period, change in diet habits, and <75% of training sessions completed during the intervention. HbA1c data was excluded if the participants had to change their medication during the intervention period.				to the MIT group. HAIT value increased while MIT value decreased. Lactic threshold improved in both groups from before to after intervention. Systolic BP significantly decreased; Diastolic BP in both groups decreased significantly with intervention.	
Winding KM et al., 2018[46]	A parallel 3-group, prospective design	29 enrolled initially (n=8 CONTROL; n=10 END; n=11 HIIT);	CONTROL: 57 ± 7 years; END: 58± 8 years; HIIT: 54 ± 6 years	T2DM	treated with exogenous insulin; were smokers; had unstable weight (change >5 kg/6 months); had	**HIIT Group**: 20 minutes/ session (HIIT), 3 d/wk. Each training session was initiated with a brief 5-minute standardized warm-up (40% of	**END Group**: 11-week bicycle intervention consisting of either 40 minutes/session 3d/wk. Each training session	Absolute VO2peak and Relative VO2peak; Peak workload (watt); BP; HR	In the **Control group**, fitness values remained the same pre- and post-	None reported

		final study population after dropout and including reallocation consisted of 26 participants (CON, n = 7; END, n = 12; HIIT, n = 13)			illness that contraindicated physical training; or demonstrated evidence of renal, liver or cardiovascular disease	Wpeak), after which the HIIT group performed 20 minutes of cycling consisting of periods of 1 minute at 95% Wpeak and 1 minute of active recovery (20% Wpeak); Including the warm-up, the total duration of the exercise protocol was 75 minutes per week	was initiated with a brief 5-minute standardized warm-up (40% of Wpeak), after which the END group performed 40 minutes of cycling at 50% of Wpeak; Including the warm-up, the total duration of the exercise protocol was 135 minutes per week		assessment: Absolute VO2peak ($2.3\pm_{0.5}$ and $2.3\pm_{0.4}$), Relative VO2peak (27.2 ± 9.1 and $_{26.3\pm}6.8$), Peak workload ($158\pm_{29}$ and $_{155\pm}33$), Systolic BP ($139\pm_{7}$ and $_{143\pm}9$), Dystolic BP (87±7 and 85±5), and Resting HR ($73\pm_{14}$ and $_{69\pm}8$). In the **Endurance group**, fitness values improved except for BP for pre- and post-assessment: Absolute VO2peak (2.3±0.6 and	

									2.5±0.7), Relative VO2peak (27.8±5.5 and30.3±7.5), Peak workload (164±46 and 190±58), Systolic BP (134±17 and 133±22), Dystolic BP (82±7 and 79±9), and Resting HR (67±12 and 61±9). In the **HIIT group**, fitness values improved except for BP for pre- and post-assessment: Absolute VO2peak (2.4±0.5 and 2.8±0.5), Relative VO2peak (28.8±4 and34.2±6.3	

									), Peak workload (178±44 and 203±49), Systolic BP (140±14 and 139±16), Dystolic BP (85±5 and 84±5), and Resting HR (69±12 and 62±9).	
Durutur k N and Özköslü MA, 2019[48]	Double-blind RCT	TR group: n=23 (11 female); Control group: 21 (7 female); Abstract reports that 25 in each group.	TR group: 52.82 ± 11.86; Control group: 53.04 ± 10.45	Ages between 18–65 years and diagnose of type 2 DM at least 6 months	Participants who is clinically unstable or who have neuromuscular disease, unstable cardiovascular diseases, musculoskeletal disease, pregnancy, lactation, and inability or unwillingness to comply with the	**TR Group**: performed breathing and callisthenic exercises, three times a week, for 6 weeks, at home by internet-based video conferences	**Control Group:** received education session and continued current medications.	6min walk testing, physical fitness and muscle strength dynamometer measurement	Sit-up, sit-and-reach test, back scratch, lateral flexion and time up go tests were significantly improved in the TR group. No significant change in the control group over the study period. Significant differences	None reported.

					required exercise.				between groups for the sit-up, back scratch, lateral flexion, and time up go tests. 6MWD in TR significantly increased after training but the control group diminished. This significantly differed between groups. Also muscle strength significantly improved in the TR group and significantly improved over the control group.	

Szilagyi B, et al., 2019[44]	RCT	Allocated: Sports intervention group=122; Control=123; Analyzed: Sports intervention group =103; Control=105	Intervention group: mean age = 61.83 (48-71 years); Control group: mean = 60.1 (45-75 years)	Intervention group: mean age = 61.83 (48-71 years); Control group: mean = 60.1 (45-75 years)	Participation in another exercise program in last 12 weeks or currently; not having regular visits to diabetes clinic; not following MD's prescribed diet; diagnosis of diabetes form that is not type 2; glucose concentration >16.6mmol/L or >13.3mm/L with ketones in urine; HR>100bpm; untreated HTN (>180 mmHg systolic, >105 mmHg diastolic; drop in	**Intervention Group**: Table II--12 week sports therapy program led by a PT (3x/week with PT and 1/week at home); 12 week recreation sports program without the help of a PT from the previously learned exercise program (4x/week)	**Control Group:** No participation in any recreation exercise or sports therapy or modified physical activity	Physical fitness was assessed with a battery of five tests: two measured standing muscle stamina (biceps, femoral, and gluteal muscles), two tests flexibility (1. lumbar spine and ischiocrural muscles, 2. infra- and supraspinatus, subscapularis, latissimus dorsi, pectoralis major and triceps muscles), and one cardiorespiratory stamine with 6 MWT.	Muscle mass; right and left arm curl; chair stand; 6MWT all improved significantly in the intervention group. Retention rate in therapy was also >80%; (93% in the first 12 weeks and 84% in the 2nd 12 weeks; Control group had 95% attendance rate for the first 12 weeks and 85% for the second 12 weeks);	Not complications per se, but "patients who did not exercise but have only followed a diet and medication treatment regimen physical activity and physical fitness level have significantly declined within a 6-month study period."

					systolic >20 mmHg not because of meds); untreated high-risk proliferative retinopathy, retinopathy with significant inner eye bleeding; untreated chronic renal insufficiency; severe autonomic neuropathy; unstable angina pectoris, severe resting, untreated EKG changes; thrombophlebitis or intractable thrombi, active or suspected myocarditis, acute or			Reliabilitly was 0.87-0.98 with Cronbach coefficient.		

					untreated heart failure, significant or severe aortic stenosis, clinically significant obstructive hypertrophic cardiomyopathy, suspected or known aneurysm, clinically significant atrial or ventricular arrhythmias, 3rd degree heart block, untreated metabolic disease (thyrotoxicosis or myxedema, acute infection or high fever, and chronic infectious diseases)					

MacDonald CS, et al., 2020[47]	RCT	Control (standard care)=31; Lower tertile = 21; Intermediate tertile=20; upper tertile = 20 people.	Control (standard care)=56.8±8.3; Lower tertile = 52.3±8.5; Intermediate tertile= 53.7±10.1; upper tertile = 53.8±8.9 years.	Diagnosis of T2DM within last 10 years; 18 years old; BMI of 25 or greater but less than 40 kg/m2. No severe comorbid conditions, insulin use, or HbA1C >9%. Also had to attend the 12-month follow-up assessment with registered exercise on the Polar watch.	Not meeting inclusion criteria.	**U-TURN Group**: In addition to standard care (see control), they were also given a high-volume exercise intervention with at least 240 minutes of aerobic and resistance exercise each week in phase 1 (first 4 months), and >300 minutes of aerobic and resistance exercise per week in phases 2 and 3 (last 8 months) with concomitant dietary counseling.	**Control:** All received standard care (medical counseling, lifestyle advice, and T2DM education), pre-specified algorithms for glucose-lowering meds was followed based on glycemic control;	VO2max and relative VO2max	Change in physical fitness across groups: Change in relative VO2max (mL O2/kg/min): Control: -0.2 (-3.5 to 3.2); Lower tertile: 2.6 (0.0 to 5.1); Intermediate tertile: 7.9 (5.4 to 10.5); Upper tertile: 9.6 (7.3 to 11.9); Significant changes in the upper tertiles--Table 2 p. 495.	None reported.
Dominguez-Munoz FJ, et al., 2020[43]	RCT	90 people randomized--> 45 into the WBV	Mean age not reported.	Men and women with T2DM diagnosed between 40-85 years	T1DM; reason that exercise is contraindicated; be under psychotropic	**WBV Group**: Intervention per Table 1, p. 3 of 11	**Placebo Group:** similar to WBV group except no vibration	Blood pressure; Chair-stand test (LE strength); TUG	Systolic BP significantly improved in both groups but were not	None reported.

		group and 45 into the PG; All were analyzed .		old; completed Informed consent.	or neurotoxic treatment; exposure to neurotoxins; receive radiation therapy; high risk of non-diabetic neuropathy; have or had a job with high exposure to mechanical whole-body vibrations; have performed whole-body vibration exercises prior to this intervention.		actually delivered.		different between groups; TUG and Chair-stand significantly improved within both groups but not between groups.	
Wibowo RA, et al., 2022[49]	Systematic review and Meta-analysis	10 studies were included ;		Population students with adults with T2DM; Intervention and comparison studies comparing yoga to	Failing to meeting inclusion criteria.	**Yoga Intervention:** Various types of yoga including Hatha yoga and integrated yoga; sessions varied in length (30 min to 90 min) and frequency per	**Control:** Inactive control or active controls with walking or balance activity. (Table 1)	CRF (Forced vital capacity; 6MWT), muscle strength (Chair stand), body composition, and balance were assessed.	Low quality evidence that yoga benefits muscle strength and CRF compared to inactive control.	None reported.

				another exercise intervention or control; inclusion of at least one health-related fitness measure; RCT or study with control group (quasi-experimental)		week across studies. (Table 1)				

Appendix E: Intake Checklist to Prevent Initial Ulceration and Re-ulceration

Category to Assess	**Date Assessed**	**Findings**	**Action Needed**
History of a previous ulcer			
Skin Assessment (i.e., ulcer, bulla, callous, fissure, ingrown toenail, xerosis)			
Range of Motion:			
• Metatarsophalangeal Joints			
• Ankle			
Presence of deformity?			
Sensation Testing:			
• Monofilament testing			
• Vibration testing		128 Hz tuning fork: R: Intact Diminished Absent L: Intact Diminished Absent Biothesiometer: R:_____V L:_____V	
Presence of pedal pulses:			
• Dorsal pedis pulse		R: Yes No L: Yes No	
• Posterior tibialis pulse		R: Yes No L: Yes No	
Diabetes Management:			
• Diabetes Knowledge			
• Glycemic Control		A1C Score:	
Appropriate Footwear?		Yes No	
Readiness to Change Stage		Pre-contemplation Contemplation Preparation Action Maintenance	

Appendix F: Additional Resources

Support for Implementation for Electronic Medical Records:

Smart phrases:

Question #5: Exercise prescripts for adults with a DFU

- Assessment:
  - The patient will benefit from _____ exercise to improve cardiovascular health as measured by increasing activity tolerance by _____ minutes.
  - Plan to add _____ exercise to improve muscular fitness as demonstrated by improved (transfer speed, balance).

Question #6 & #7

- Assessment:
  - In addition to the prescribed interventions for the primary problem list, patient also will benefit from _____ exercise to increase physical activity as measured by _____ increase in daily step count.
  - In addition to the prescribed interventions for the primary problem list, patient also will benefit from _____ exercise to increase physical activity and gait speed as measured by _____ increased distance in 6-Minute Walk Test.
  - In addition to the prescribed interventions for the primary problem list, patient also will benefit from _____ exercise to increase flexibility and balance as measured by _____ increase in Chair Sit and Reach Test.
  - In addition to the prescribed interventions for the primary problem list, patient also will benefit from _____ exercise to improve lower extremity strength for increase dynamic balance as measured by _____ increase 30-second sit to stand test.

Question #8

- Plan:
  - Once patient's wound has re-epithelialized, will continue current offloading to monitor for signs of trauma.
  - As patient has remained re-epithelialized x2 weeks, will reduce offloading by _____ layer(s) for 2 more weeks.
  - Patient has remained closed x4 weeks and therefore will reduced offloading to _____layer of padding.
  - Patient has remained closed x6 weeks and ready to transition to new DM shoes next week with appropriate wear schedule.
  - Patient is now in new DM shoes with following wear schedule:
    - Wear shoes twice daily – each time for only 1 hour.
    - Check feet after one hour. After 20-30 min and check if any redness and if goes away. If redness does not go away wear cast shoe until follow up with therapist.
    - Stay off feet.
    - If there are no signs of tissue injury, increase shoe wearing time one hour at a time for each time.
    - Given cut out in cast shoe to wear at other times not in shoe. If needed add cast padding to foot. See later in week (2x per week again). After 3 visits decrease frequency to weekly. Continue to see weekly x 1 month then every 2 weeks.

Appendix G: Journal Club Template:

*Consider reviewing the CPG using the AGREE II tool in preparation of a review of the CPG.

*Presentation and Discussion of CPG

I. Introduction/Background for CPG
    - Purpose
    - Specific Questions Posed
II. Methods: Literature Review Process
    - Process for CPG
    - Discussion of general rules/strategies
    - Quality of Literature/Literature Biases
    - Critical Appraisal of Literature
III. Results: What are the Recommendations?
    - Discussion of literature review findings
    - Specifically discuss all of the recommendations.
        - Importance
        - How Implement
        - Challenges to Implementation
    - Discussion of Tables
IV. Critiques
V. Summary of Implications for Practice