Circulation

AHA SCIENTIFIC STATEMENT

Routine Assessment and Promotion of Physical Activity in Healthcare Settings

A Scientific Statement From the American Heart Association

ABSTRACT: Physical inactivity is one of the most prevalent major health risk factors, with 8 in 10 US adults not meeting aerobic and muscle-strengthening guidelines, and is associated with a high burden of cardiovascular disease. Improving and maintaining recommended levels of physical activity leads to reductions in metabolic, hemodynamic, functional, body composition, and epigenetic risk factors for noncommunicable chronic diseases. Physical activity also has a significant role, in many cases comparable or superior to drug interventions, in the prevention and management of >40 conditions such as diabetes mellitus, cancer, cardiovascular disease, obesity, depression, Alzheimer disease, and arthritis. Whereas most of the modifiable cardiovascular disease risk factors included in the American Heart Association's My Life Check - Life's Simple 7 are evaluated routinely in clinical practice (glucose and lipid profiles, blood pressure, obesity, and smoking), physical activity is typically not assessed. The purpose of this statement is to provide a comprehensive review of the evidence on the feasibility, validity, and effectiveness of assessing and promoting physical activity in healthcare settings for adult patients. It also adds concrete recommendations for healthcare systems, clinical and community care providers, fitness professionals, the technology industry, and other stakeholders in order to catalyze increased adoption of physical activity assessment and promotion in healthcare settings and to contribute to meeting the American Heart Association's 2020 Impact Goals.

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Physical inactivity is a persistent public health problem associated with a high burden of cardiovascular disease (CVD) and other noncommunicable chronic diseases (NCDs).[1,2] Recent estimates indicate that one third of the global population fails to meet physical activity (PA) guidelines[3] and that 9% of the overall global premature mortality, ≈5.3 million deaths, is directly attributable to physical inactivity, a figure comparable to the global smoking-related mortality (5.1 million).[4] In addition, inadequate PA commands a substantial economic burden, recently quantified as 11% of the aggregated healthcare expenditures in the United States or about $120 billion per year.[5]

Improving and maintaining recommended levels of PA leads to reductions in the metabolic, hemodynamic, body composition, epigenetic, and functional status risk factors that contribute heavily to the development of many leading NCDs. Therefore, PA has a significant role, in many cases comparable or superior to drug interventions,[6] in the prevention and management of >40 diseases beyond CVD such as obesity, diabetes mellitus, cancer, depression, Alzheimer disease, arthritis, and osteoporosis.[7–9]

Although a plethora of research and initiatives strongly recommend PA for the prevention and management of CVD, population levels of PA have remained flat for decades.[10] Only 52% of US adults report meeting the aerobic component of the PA guidelines (150 min/wk of moderate-intensity PA, 75 min/wk of vigorous-intensity PA, or an equivalent combination).[9] In addition, only 30% of adults report meeting the muscle-strengthening component of the PA guidelines (activities that are moderate or high intensity and involve all major muscle groups on ≥2 d/wk). When the 2 components of the guidelines are considered, 80% of US adults fail to achieve recommended levels of PA, making it one of the most prevalent major CVD risk factors.[11,12] Consequently, given its high prevalence and health and economic burdens, combating physical inactivity constitutes 1 of the 4 priority objectives in the World Health Organization's global action plan to control NCDs.[13] In this context, healthcare systems around the world are being called on to incorporate evidence-based PA assessment and promotion strategies[14] as part of the solution to the physical inactivity pandemic.[15–18]

A physically active lifestyle is 1 of 7 factors promoted by the American Heart Association's (AHA's) My Life Check - Life's Simple 7 to reduce the risk of CVD and to improve overall health.[19,20] PA also plays a central role in the AHA's 2020 Impact Goals to improve by 20% the cardiovascular health of all Americans and to reduce deaths caused by CVD and stroke by 20% by achieving goals that are similar to those included in Life's Simple 7.[20] Indeed, achievement of the 2020 AHA Impact Goals will be highly dependent on an increase in the percentage of Americans who meet the PA guidelines.[9]

The AHA has a long and rich history of scientific statements on the role of exercise, PA, and sedentary behavior for primordial, primary, secondary, and tertiary prevention of CVD.[21–26] PA and public health recommendations for adults,[27–29] older adults,[30] and children and youth,[31] as well as the risk of exercise-related acute CVD events,[22] and the role of exercise testing in various populations have also been published.[32,33] Other AHA statements have assessed the evidence on clinical and population-level lifestyle interventions for CVD prevention,[34–37] as well as a multisectorial policy approach for PA promotion in the form of the National Physical Activity Plan.[16] However, no scientific statements have addressed the routine assessment and promotion of PA in healthcare settings.

Although the National Physical Activity Plan includes some recommendations for clinicians and the healthcare sector on PA promotion, it does not include a detailed assessment of the evidence and the process for standardizing PA-related care in clinical settings. Whereas most of the modifiable CVD risk factors included in the AHA's Life's Simple 7 are assessed routinely in clinical practice (glucose and lipid profiles, blood pressure, obesity, and smoking),[38] PA is typically not assessed,[39] with the exception of a few healthcare systems.[40,41] In addition, Ross et al[42] recently published an AHA statement summarizing the evidence on the importance of assessing cardiorespiratory fitness as a "vital sign" in clinical practice.

The purpose of this statement is to provide a comprehensive review of the evidence on the feasibility, validity, and effectiveness of PA promotion in healthcare settings for adult patients. It complements and extends a previous AHA statement that provided a guide to the assessment of PA for clinical and research applications.[38] It also adds concrete recommendations for healthcare systems, clinical and community care providers, fitness professionals, the technology industry, and other stakeholders in order to catalyze increased adoption of PA promotion in healthcare settings and to contribute to meeting the AHA 2020 Impact Goals and beyond.

PHYSICAL INACTIVITY AS MAJOR RISK FACTOR FOR CVD

Epidemiological data examining the association between physical inactivity and cardiometabolic risk suggest an increased risk of developing diabetes mellitus and CVD.[43,44] By the same token, increasing sedentary activities such as television watching is independently associated with increased cardiometabolic risk and insulin resistance.[45–51]

The favorable impact of regular PA on traditional cardiovascular risk factors explains a significant portion of its salutatory impact. These favorable effects on traditional risk factors include increasing high-density lipoprotein cholesterol, reducing body mass index, improving insulin sensitivity, and reducing blood pressure, which, although often modest, significantly reduce risk at the population level.[52–56] However, a significant portion of the cardiovascular benefits of habitual PA are independent of its effects on traditional modifiable cardiovascular risk factors.[57–69] Increased occupational and leisure-time PA reduced cardiovascular risk across the entire spectrum of Framingham risk scores, further underscoring the ability of PA to modify risk beyond its impact on traditional markers.[70] Although the exact mechanisms behind PA as an independent modifiable risk factor remain incompletely elucidated, strong evidence suggests that regular PA slows and even reverses adverse vascular remodeling associated with aging, a critical factor in the eventual clinical manifestations of CVD.[71,72]

At the cellular level, repeated bouts of PA lead to favorable effects on vascular homeostasis in part through exposure to increased laminar shear stress, leading to increased endothelium-dependent vasodilation and reduced vascular inflammation.[60,73–78] PA also appears to have favorable systemic anti-inflammatory effects.[79] Physical inactivity results in impaired vascular endothelial function and increased vascular stiffness, characterized by impaired nitric oxide bioavailability, increased vascular inflammation, and increased pulse-wave velocity and secondary adverse vascular remodeling.[80–88] Adverse vascular remodeling of sedentary aging adults increases the risk of adverse cardiovascular events.[80,87,89,90] Cross-sectional and intervention studies suggest that regular PA appears to protect against this vascular aging.[91–96] Therefore, PA should be viewed as an important, modifiable cardiovascular risk factor with a favorable impact that is mediated by both its direct effects on cardiac function, the vasculature, and its impact on traditional risk factors and systemic inflammation. Understanding more fully the molecular transducers of the benefits of PA is the focus of a recent large, multicenter National Institutes of Health research program.[97]

Economic Burden of Physical Inactivity

Insufficient PA also poses a huge economic burden on economies and health systems.[13,98] According to national estimates, inadequate PA was responsible for >11% of the US aggregated healthcare expenditures in 2014, with an excess per-capita cost of $1437 for inactive versus active adults (30% difference).[5] Analyses suggest that meeting PA guidelines is associated with a 20% reduction in healthcare expenditures and resource use among patients with CVD and with a 50% reduction in a comparison of individuals with CVD and those without CVD but with poor risk factor control.[99] The excess healthcare expenditure resulting from inadequate PA was estimated at $2500 among those with established CVD and $1200 among those without CVD but with underlying poor risk factor profiles.

Worldwide, physical inactivity was conservatively estimated to cost $53.8 billion to healthcare systems, with $13.7 billion in productivity losses and 13.4 million disability-adjusted life-years lost in 2013.[100] Although low- and middle-income countries account for 75% of the disease burden associated with physical inactivity, >80% of healthcare costs and 60% of indirect costs occur in high-income countries.[100]

EVIDENCE IN SUPPORT OF ROUTINE PA ASSESSMENT AND PROMOTION IN HEALTHCARE SETTINGS

To help healthcare professionals work together with patients to improve their PA, several effective approaches to increase PA have been developed, ranging from workplace, healthcare, and community-based interventions to policy and environmental strategies.[101] However, single-setting interventions typically result in only low to modest improvements in PA (0.16 to 0.68 effect size), leading to the conclusion that no single intervention will solve the problem of insufficient PA in the United States.[102] Rather, improving population levels of PA requires comprehensive efforts to maximize the potential benefits of setting-specific interventions under a coordinated multilevel approach.[8,11]

Different strategies with various levels of effectiveness have been used to incorporate PA promotion into healthcare settings.[103] Brief PA counseling, initiated by the physician or other healthcare provider (HCP), and the "green prescription" (written prescription plus behavioral change and follow-up strategies) have been used.[104] A recent review including 5 meta-analyses, 3 systematic reviews, and 2 literature reviews published over the last decade confirms that PA counseling by primary care providers has a small to moderate positive effect on increasing PA levels (standardized mean effect range, 0.17–0.28; risk ratio/odds ratio range, 1.22–1.42).[103] Better results have been obtained when interventions include multiple behavior-change resources and target insufficiently active patients with CVD risk factors and motivational readiness to change.[103,105,106] The number needed to treat for 1 sedentary adult to meet PA recommendations at 1 year was 12.[104] This is comparable to other preventive counseling interventions in primary care such as alcohol (number needed to treat, 9.1)[107] and smoking cessation (number needed to treat, 14).[108]

Furthermore, the US Preventive Services Task Force recommends lifestyle counseling by HCPs to promote PA (and healthy dietary habits) for individuals with CVD risk factors (Level of Evidence B)[14,109] and those without CVD or its risk factors (Level of Evidence C).[109,110] These recommendations are based on the results of a number of clinical research studies that have shown moderate but statistically beneficial effects of medium- to high-intensity lifestyle counseling therapy on reduction of various CVD risk factors, including blood pressure, blood cholesterol, and body fat. Benefits appear to be strongest when a structured program of dietary and PA counseling is provided by healthcare professionals. As a Level of Evidence B recommendation, this strategy must be included in new health plans under the Affordable Care Act's Prevention and Health Promotion activities,[111] but until now, it has not been widely implemented or standardized.

Linking multiple settings where PA can be promoted is critical for improving the likelihood of influencing behavior.[112,113] In response to common barriers to effectively delivering complex PA counseling solely in clinical settings, programs have integrated referral of patients to community-based PA resources and programs. These exercise referral schemes have also shown modest effectiveness.[114,115] Compared with usual care, more patients who received referrals for exercise by their primary care providers achieved PA recommendations (relative risk, 1.16), and reduced depression was noted.[115] Heath and colleagues[116] examined the feasibility of a clinic-based Physical Activity Vital Sign (PAVS) assessment and referral protocol to YMCA exercise programming compared with PAVS alone in a sample of adult patients seen for primary care visits in a southeastern US health system. They found improvements in self-reported PA after 12 weeks in the PAVS plus referral group (P<0.02). Another pilot implementation study in Mexico's largest healthcare system compared the effectiveness of brief counseling and an exercise referral program with increased moderate to vigorous PA (MVPA) among 220 adult hypertensive patients. After 24 weeks, minutes per week of objectively measured (accelerometer) MVPA increased by 40 and 53 minutes, respectively, in both intervention groups. However, participants attending at least 50% of the referral program sessions increased both their MVPA by 104 min/wk and compliance with aerobic PA recommendations (by 23.8%) compared with the brief counseling group (both P<0.05). Other meta-analyses and systematic reviews have shown that physician counseling (odds ratio, 1.42; 95% confidence interval, 1.17–1.73) and exercise referral systems (risk ratio, 1.20; 95% confidence interval, 1.06–1.35) promote improvements in patients' PA for up to 12 months.[103,104,114]

Cost-Effectiveness of PA Promotion in Healthcare Settings

Brief counseling, the green prescription, and exercise-referral strategies have also been found to be cost-effective.[117–119] For example, an economic analysis of the national exercise referral program in Wales showed a cost-effectiveness ratio of £12 111 per quality-adjusted life-year gained. Patients are referred by primary care professionals to a 16-week program delivered by qualified exercise professionals at local centers. There were significant cost savings in fully adherent participants (62% of the sample), and as a whole, the program was cost-effective with respect to existing payer thresholds in Wales, particularly for participants with mental health and CVD risk factors.[118] In a review, the cost to move 1 person to the "active" category at 12 months was estimated to range from €331 to €3673 and the cost utility from €348 to €86 877 per quality-adjusted life-year.[119] Therefore, many PA promotion interventions in primary care show similar or better cost-effectiveness than drug-based interventions that are well established in primary care such as cholesterol lowering (€58 882 per quality-adjusted life-year) or intensive glucose control (€32 610 per quality-adjusted life-year), despite these being above the cost-effectiveness threshold (£30 000) established by the UK National Institute for Health and Clinical Excellence.[119] In addition, claims data from older adults with and without diabetes mellitus in US Medicare plans show a 1-year reduction in total healthcare use and costs (about $1600 to $1900 lower than controls) among adults attending plan-sponsored fitness club benefits.[120–122]

Summary and Conclusions: Evidence in Support of Routine PA Assessment and Promotion in Clinical Practice

- Evidence supports the effectiveness and feasibility of PA promotion strategies in routine clinical practice.[123,124]
- Patient PA counseling helps improve patient outcomes.
- PA counseling and referral strategies can help lower healthcare use and costs.[120,121]
- Clinical-community links for PA promotion can augment effectiveness and help promote the maintenance of intervention effects.[17,125,126]
- PA promotion protocols are acceptable among HCPs[127] and have been successfully scaled to national levels with adequate sustainability.[118]
- Multicomponent lifestyle intervention approaches that include PA promotion for patients with CVD risk factors are supported by the US Preventive Services Task Force and can be implemented by leveraging clinical and community-based programmatic resources and personnel.
- Despite a growing body of evidence and policy support, more pragmatic implementation experiences are needed to deliver proven and sustainable models that can be successfully integrated into the modern fabric of US healthcare delivery.

Assessment of PA in Healthcare Settings and Electronic Health Records

A recommendation by the National Academies highlights the value of the electronic health record (EHR)

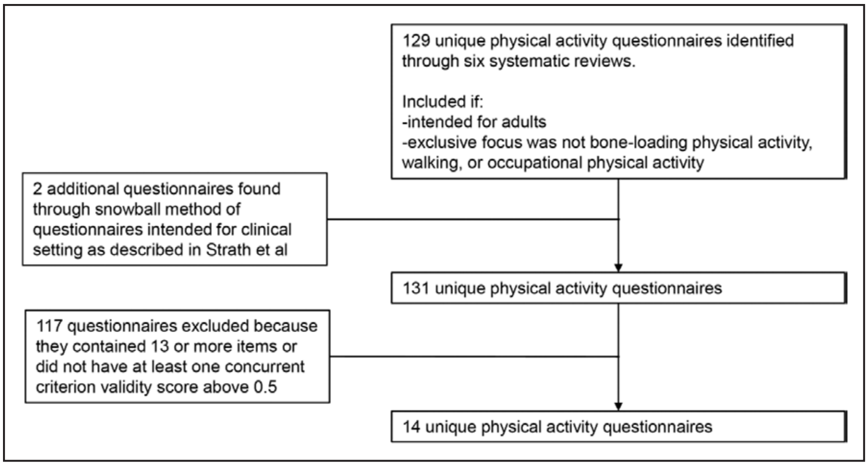

Figure 1. Overview of the literature search to identify candidate physical activity self-reported tools originally developed for or feasible to deploy in healthcare settings.

to provide information to the healthcare team related to health and treatment.[128] Providing information pertaining to PA in the EHR creates an opportunity for the HCP to discuss patients' or clients' PA habits. Discussion about PA can occur only if these measures are collected in a similar method across time and can be used between health record systems.

Two suggested methods adequate for capturing PA for the EHR are self-reports and wearable devices such as pedometers or accelerometers. An example of a self-report questionnaire that can ascertain compliance with the PA guidelines is called the Exercise Vital Sign (EVS), modified from the Behavioral Risk Factor Surveillance System.[129] The EVS consists of 2 questions that take approximately ≤1 minute to administer. Wearable activity monitoring (WAM) devices provide information on activity such as accelerometers counts, steps, and estimated minutes of PA at various intensity levels. These devices can be worn on clothing or the waist, wrist, or ankle to measure PA. There are numerous devices available, with many wrist-based devices or smartwatches now also tracking heart rate to enhance PA intensity estimation. However, to date, there is no widespread integration of patient-generated data from wearable devices into the EHR.[130] No matter which method is used, self-report or wearable devices, linking PA data to the EHR provides a forum for healthcare professionals to initiate discussion and counseling on increasing PA. In the following sections, we summarize the evidence on the most appropriate self-report and objective PA assessment methods in healthcare settings

SELF-REPORT TOOLS FOR ASSESSING PA IN HEALTHCARE SETTINGS

Using a review-of-reviews methodology, we considered systematic reviews of the validity, reliability, or feasibility of physical-activity questionnaires either developed for clinical settings or feasible to be used in clinical settings that were published by 2016. This search strategy yielded 6 reviews (Figure 1).[38,131–135] We then evaluated the validity, reliability, and clinical feasibility of the resulting questionnaires. Candidate PA self-reported tools were intended for adult populations and were excluded if their focus was solely on occupational PA, bone-loading, or walking PA. A questionnaire was included if its validity had been concurrently evaluated against a criterion measure (eg, accelerometry or doubly labeled water) and if at least 1 of its corresponding measures of validity (including Pearson correlation, Spearman correlation, sensitivity, specificity, Cohen κ, and intraclass correlation and excluding predictive values) was reported to be >0.5. To limit candidate questionnaires to those that would be feasible to use in clinical settings, only tools containing ≤12 items were included. Questionnaires were excluded if the authors could not find the original questionnaire.

After applying the initial inclusion and exclusion criteria for the questionnaires in the 6 mentioned systematic reviews,[38,131–135] we identified 129 unique questionnaires. Then, to ensure that we discovered all relevant questionnaires intended for the clinical setting, we used snowball searches for questionnaires intended for the clinical setting as reported by Strath et al.[38] This search led us to 2 additional questionnaires,[136,137] bringing the total candidate questionnaires to 131. We then excluded questionnaires with ≥13 items or without at least 1 concurrent criterion validity score >0.5, yielding 14 unique questionnaires.

Criteria for Scoring Self-Reported Tools

For each included questionnaire, the following information was collected: concurrent criterion validity, ability to assess compliance with the aerobic component of the PA guidelines, ability to assess compliance with the muscle-strengthening component of the PA guidelines, test-retest reliability, and clinical feasibility. The target population was also documented. This information was collected from the original article or validation studies.

Information on each domain was then categorized with a 3-star system (1 star=worst; 3 stars=best) based on prespecified criteria for each domain (detailed in Data Supplement 1). When multiple pieces of information for each domain were available from many studies, the results were averaged and presented to 1 decimal point (eg, 2.3 of 3 stars). Overall scores were averaged across categories with available data.

Characteristics of Top Questionnaires for Assessing PA in Healthcare Settings

We identified 14 PA questionnaires that met our criteria, which are summarized in Table 1. Eight of these tools were originally developed for clinical use. Length of the questionnaires ranged from 1 to 12 items, and questionnaires took from <1 to 5 minutes to complete. Assessment populations included ranged from middle-aged[155] and older adults[136] and a small sample of black women[137] to large samples of adults in primary care clinics[150] and a small sample of Mexican Americans.[156]

Reliability was reported for most questionnaires and ranged from a κ of 0.39 to 0.88. Criterion-referenced validity assessed against concurrent accelerometer use ranged from a Spearman correlation of 0.09 to 0.61. Sensitivity and specificity estimates were reported in 7 of the questionnaires (Rapid Assessment of Physical Activity, PAVS, EVS, General Practice Physical Activity Questionnaire, Marshall-Smith, Speedy Nutrition and Physical Activity Assessment, Stanford Brief Activity Survey).[136,137,150,155–157] Sensitivity ranged from 46% to 91% and specificity from 10% to 100%. Only 1 instrument had survey items for assessing muscle-strengthening activities.[138]

Based on the grading criteria previously described, the questionnaires average scores ranged from 1.8 to 2.6 (Table 1). The highest-scoring questionnaire was the Rapid Assessment of Physical Activity (average, 2.6),[138] followed by the single question by Milton et al[135,140] (average, 2.4), the PAVS (average 2.3),[41] and the EVS (average, 2.2). The information summarized from these instruments provides health systems and healthcare professionals the option to choose which self-report assessment is most feasible in their particular setting.

Best Practice Examples Integrating PA Questionnaires in Healthcare Settings

Given the competing priorities of HCPs, the best method to ensure that a PA assessment is administered at clinic visits is to integrate it into the clinical workflow. This can be done at patient check-ins, when vital signs are administered, or as part of the rooming process. Heron et al[145] tested different methods of administering the General Practice Physical Activity Questionnaire in 4 general practice clinics in Belfast, Northern Ireland. They found that the General Practice Physical Activity Questionnaire was most often completed (26.9%) when a receptionist distributed a paper copy during patient check-in, with the lowest completion (1.6%) when providers/nurses administered the paper form to patients. Time pressure was the primary reason that care providers cited for not completing the General Practice Physical Activity Questionnaire.

Kaiser Permanente Southern California imbedded the EVS into the workflow of administering vital signs before rooming (Figure 2). While patients are being assessed for blood pressure, heart rate, temperature, weight, and alcohol and tobacco use, nurses or medical assistants ask the 2 EVS questions "How many days a week do you engage in moderate to strenuous exercise (like a brisk walk)?" and "On average, how many minutes per day do you exercise at this level?"

The EVS questions are imbedded into the EHR system with the other measures, and providers cannot complete the workflow until these questions are answered. This process eliminates the need for paper, handwriting interpretation, and resulting data entry errors. The system multiplies the responses of the 2 questions by the number of minutes of weekly MVPA and flags patients with PA levels below the recommended levels. This information is available to the clinician on the EHR vital section dashboard when she/he sees the patient. Product placement for the EVS is important because feedback indicates higher likelihood of use if located in the vitals section as opposed to social history or other EHR sections. The organization has an internal Wiki web page that provides resources for the EVS implementation and patient resources for increasing PA. Also desirable is combining the EVS with clinical decision support system features to enable adequate risk stratification and provision of appropriate patient education material tailored to the patient's clinical diagnosis and preferences. The EVS has been deployed into 5 Kaiser Permanente medical regions, with variations in workflow depending on regional preferences. In 2015, the percentage of adult members with an outpatient visit in which the EVS was documented ranged from 80% to 96% across regions. Furthermore, implementation of the EVS has been shown to promote favorable changes in PA-related care practices, with patients 14% more likely to report having discussed exercise with their primary care physician and a 14% increase in providing exercise referrals and resources to patients.[129] In addition, statistically significant improvements in metabolic outcomes and weight loss were detected from baseline to follow-up visits among patients served at medical centers that implemented EVS compared with patients in control medical centers.[40]

The predictive validity of EVS in relation to CVD risk factors was reported for a large sample (n=622 897) of adult patients.[158] Consistently active women had lower

Table 1. Characteristics of Self-Reported Tools for Assessing PA in Healthcare Settings

PA Questionnaire	Description	Target Age Group	Concurrent Criterion Validity	Can Assess Compliance With PAG Aerobic Component	Can Assess Compliance With PAG Muscle-Strength Component	Test-Retest Reliability	Clinical Feasibility	Average Score
Rapid Assessment of Physical Activity[138,139]	A 9-item questionnaire with the response options of yes or no to questions covering the range of levels of PA from sedentary to regular vigorous PA, as well as strength training and flexibility	Older adults	2.7	3	2	2.5	2.8	2.6
Single question (Milton et al[135,140])	"In the past week/past month, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job."	Adults	2.0	3	1	2.8	2.8	2.4
PAVS (Greenwood et al[41])	2 Questions: "How many days during the past week have you performed physical activity where your heart beats faster and your breathing is harder than normal for 30 minutes or more?" "How many days in a typical week do you perform activity such as this?"	Adults	2.2	3	1	NR	2.8	2.3
Kaiser Permanente Southern California EVS (Coleman et al[129])	2 Modified questions from BRFSS: "On average, how many days per week do you engage in moderate to strenuous exercise (like walking fast, running, jogging, dancing, swimming, biking, or other activities that cause a light or heavy sweat)?" "On average, how many minutes do you engage in exercise at this level?"	Adults	2.1	3	1	NR	2.8	2.2
Physical Activity Assessment Tool (Merriweather et al[141])	12-Item questionnaire including multiple choice and open response questions	Adults	2.5	3	1	2.2	2.2	2.1
Godin-Shephard 2-week PA recall[142,143]	Asks the participant to recall the amount of time in the previous week he/she spent in strenuous-, moderate-, and mild-intensity exercise. Examples for each intensity level are provided, including general PAs (eg, walking, dancing) in addition to structured exercise and sport examples (eg, aerobic dance, running, soccer) (description from this validation study)	Adults	1.8	3	1	2	2.6	2.1
Short Questionnaire to Assess Health-Enhancing Physical Activity[144]	11-Item questionnaire assessing habitual PA	Adults	1.3	3	1	2.5	2.4	2.0
General Practice Physical Activity Questionnaire[136,145]	2-Item questionnaire with multiple choices on PA during work and leisure time: "Please tell us the type and amount of physical activity involved in your work." "During the last week, how many hours did you spend on each of the following activities?"	Adults, older adults	1.8	3	1	2	2.4	2.0

(*Continued*)

Table 1. Continued

PA Questionnaire	Description	Target Age Group	Concurrent Criterion Validity	Can Assess Compliance With PAG Aerobic Component	Can Assess Compliance With PAG Muscle-Strength Component	Test-Retest Reliability	Clinical Feasibility	Average Score
BRFSS 2001 Physical Activity Questionnaire[146–148]	7 Questions used in the BRFSS on a rotating basis from 2001–2009	Adults	1.25	3	1	2.7	2.2	2.0
2-Question PA assessment (Marshall et al,[149] Smith et al[150])	2 Questions: How many times a week do you usually do ≥20 min of vigorous-intensity PA that makes you sweat or puff and pant (eg, heavy lifting, digging, jogging, aerobics, or fast bicycling)? Circle 1: ≥3 times a week, 1–2 times a week, none. How many times a week do you usually do ≥30 min of moderate-intensity PA or walking that increases your heart rate or makes you breathe harder than normal (eg, carrying light loads, bicycling at a regular pace, or doubles tennis)? Circle 1: ≥5 times a week, 3–4 times a week, 1–2 times a week, none.	Adults	2	2.5	1	2	2.4	2.0
Stanford 7-Day Recall, aka Stanford Usual Activity Questionnaire[151,152]	9-Item questionnaire originally used in 1985 in the Five-City Project	Adults, older adults	2	3	1	1.9	1.8	1.9
Suzuki questionnaire[153]	5-Item questionnaire designed to assess both energy expenditure and PA at work and at leisure; asks about time spent in activities by moderate, vigorous, strenuous intensity	Adults	2.5	1.5	1	2.3	2.4	1.9
Speedy Nutrition and Physical Activity Assessment[137]	Asks 1 question with 4 options: "Are you active for 30 minutes on 5 days of the week?" (1) No, and I have no plans to be more active. (2) No, but I have been thinking about being more active. (3) Sometimes I am active for 30 min but not all the time. (4) Yes, I am active for 30 min on 5 d/wk. Examples of activity are provided.	Adults	1.8	2	1	NR	2.8	1.9
Stanford Brief Activity Survey[154]	2 Items designed to assess occupational and leisure-time PA levels; separately classifies the level of occupational and leisure-time PA performed by an individual; each item provides examples of activities with increasing degree of intensity ranging from sedentary to high intensity	Older adults	2	2	1	2	2.2	1.8

Each column represents a scoring domain ranked from 1 (worst) to 3 (best) according to prespecified criteria detailed in Data Supplement 1. BRFSS indicates Behavioral Risk Factor Surveillance System; EVS, Exercise Vital Sign; NR, not reported; PA, physical activity; PAG, physical activity guidelines; and PAVS, Physical Activity Vital Sign.

systolic (−4.60 mm Hg) and diastolic (−3.28 mm Hg) blood pressures than inactive women. Consistently active patients also had lower fasting glucose (women, −5.27 mg/dL; men, −1.45 mg/dL) and random glucose and hemoglobin A_{1c} compared with consistently inactive patients, whereas active men had lower diastolic blood pressure than inactive men.[158]

PA questions similar to those in the EVS are also used to assess PA in the AHA's My Life Check - Life's Simple 7 and Heart360 tools[19] and the MyHeart Counts smartphone cardiovascular health study.[159] Details on the experience developing and implementing the PAVS at Kaiser Permanente and in other US healthcare systems have been published.[160,161]

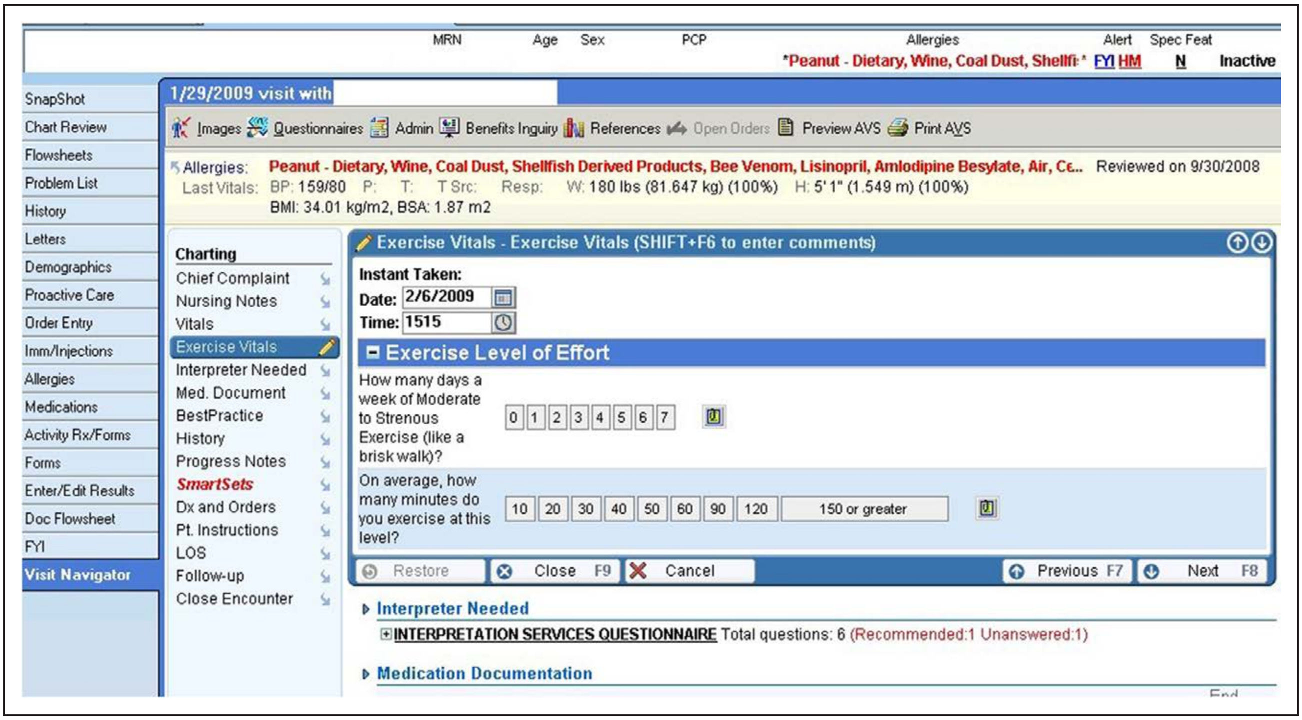

Figure 2. Exercise Vital Signs in the Kaiser Permanente EPIC electronic medical record.
BMI indicates body mass index; BP, blood pressure; BSA, body surface area; Dx, diagnosis; EPIC, Epic Systems Corporation Electronic Medical Records; H, height; PCP, primary care provider; and W, weight.
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Summary and Conclusions: Self-Reported Tools for Assessing PA in Healthcare Settings

- Routine PA assessment in clinical settings is feasible and valid and gives providers important information about their patients' cardiometabolic risk and general health status.
- Strategies are needed to catalyze increased adoption and consistent use of simple tools (eg, PAVS, EVS) to screen for physical inactivity and to become standard of care.
- Future work is needed to develop appropriate instruments to assess the muscle-strengthening component of the PA guidelines and to test their validity and clinical utility.
- On the basis of the collective experience of large healthcare systems pilot testing the PAVS and EVS, EHR companies should consider integration into the technology solutions they offer to healthcare systems so that interested providers have easily adoptable technologies available.

WAM DEVICES FOR USE IN HEALTHCARE SETTINGS

We aimed to identify and evaluate consumer-oriented WAM devices for potential integration into healthcare settings. Similar to the process for evaluating self-reported tools, we evaluated WAMs on the basis of their validity, ability to assess compliance with PA guidelines, patient feasibility, feasibility for healthcare system integration, and incorporation of evidence-based methods of behavior change. We focused on consumer-oriented rather than pure research-grade accelerometers by considering patient burden (cost, summary feedback, inclusion of behavior-change strategies) and feasibility for healthcare system integration.

To identify candidate WAMs, we initially considered key references and reviews of validity testing and behavior change features published by 2016. This yielded 9 WAM validation studies[162–169] and 2 reviews on the elements of behavior change in WAMs.[37,170] From these reviews, we used a snowball strategy to search academic (PubMed), gray (Google Scholar, manufacturer websites), and consumer-facing (technical reviews, manufacturer websites, and white papers) literature for additional sources of information (including manufacturer-sponsored validity testing) considered to be appropriate. In addition, we attempted to contact 9 WAM manufacturers with a request to communicate electronically, to schedule an interview, or to collect information via an online form we created. The goal of contacting the manufacturers was to request the information we aimed to collect for each device. Of the 9, 1 granted an interview. We also interviewed a technology professional from a southeast healthcare system that has incorporated WAMs into its patient portal to un-

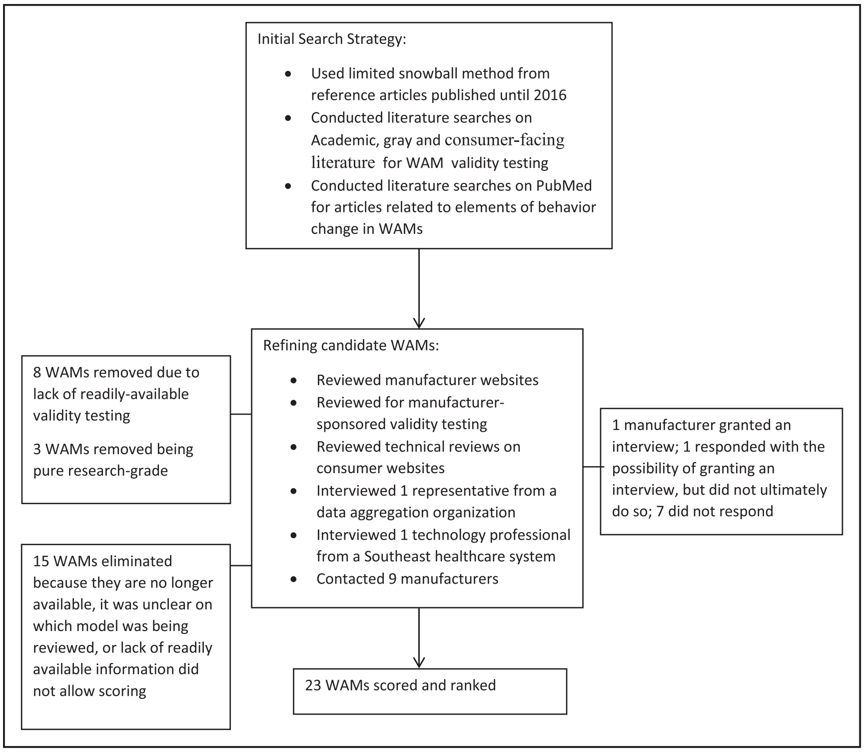

Figure 3. Overview of the literature search to identify candidate wearable activity monitoring (WAM) devices feasible to use in healthcare settings.

derstand its approach, as well as a representative from a large data-aggregation organization.

From this initial search, we identified 49 candidate WAMs. We included a WAM in our final assessment if its validity had been evaluated, prioritizing independent studies. We also preferred validity testing that measured devices against a criterion measure such as double-labeled water or indirect calorimetry, but we accepted validation against a research-grade monitoring device such as the ActiGraph accelerometer, given the limited number of criterion-based validation studies. From this search, 23 WAMs were eligible for our final assessment (Figure 3). The remaining WAMs were no longer manufactured, did not have readily available validity testing, or did not have enough information available to complete the evaluation (Figure 3).

Criteria for Scoring WAM Devices for Use in Healthcare Settings

For each included WAM, the following information was collected: concurrent criterion validity estimates; ability to assess compliance with the aerobic component of the PA guidelines (no device assessed compliance with the muscle-strengthening component of the PA guidelines); patient feasibility, including WAM battery life, cost, summary feedback, and ability to download data; healthcare integration feasibility (open or available application program interface); and behavior-change strategies in the WAM or companion application (app) or software.

The above information was collected from the original article or validation studies. Information on each domain was then categorized with the use of a 3-star system (1 star=worst; 3 stars=best) based on prespecified criteria for each domain (detailed in Data Supplement 2). When multiple pieces of information for each domain were available from many studies, the results were averaged and presented to 1 decimal point (eg, 2.3 of 3 stars). Overall scores were averaged across categories with available data and presented to 1 decimal point.

Characteristics of Top WAM Devices for Use in Healthcare Settings

For the consumer-oriented WAMs, of a maximum score of 3, 2 WAMs scored >2.5, the Fitbit Zip (2.8) and Fitbit One (2.7). Up to 10 WAMs scored within the 2-plus range, and 10 scored in the 1 to 2 range. Of the 23 WAMs devices in the final assessment, 4 of them were Fitbit models.

The WAMs with a well-established and mainstream position in the consumer marketplace performed well in this evaluation. A good amount of information was readily available on these devices to facilitate their scoring.

As it becomes increasingly apparent what information healthcare organizations require, other devices may score better by making the information more prominent on their websites.

Almost all devices have a basic security premise available online, causing us to remove security as an evaluation criterion. These privacy policies outlined basic measures of data security.

Challenges in Identifying WAM Devices for Use in Healthcare Settings

In conducting this wearable device review, we encountered several challenges. First, we recognize the limitations of the validity assessment. We observed a high degree of heterogeneity in validation studies with study populations (age, functional status, clinical and sociodemographic characteristics), validity protocols (free-living versus laboratory, equipment), and study methods (reference criterion and validity assessment approach, PA metrics, etc) all varying significantly. Partially because of this heterogeneity, we found that well-established, mainstream WAMs are more frequently tested for different use cases and that this may have resulted in lower validity scores for these devices.

Other important WAM information such as data processing algorithms for derived PA metrics and details on application program interfaces, data access, sensor type, and technical specifications was not always available. It was difficult to determine whether devices measured total calories or only active calories. We therefore simply reported calories rather than total or active calories in the final assessment. In addition, in our review of validation studies, it was not always clear which exact model of a WAM the authors were analyzing. Furthermore, on occasion, some WAMs changed names or were discontinued. Therefore, it was difficult to determine whether researchers were analyzing the device of interest or if anything other than the name had changed with the device that might affect its scoring. This lack of clarity led to a best guess in some cases based on the year the study was conducted. Descriptions of behavioral techniques were also not always clear. Because correspondence with manufacturers proved to be challenging, additional information on these techniques was difficult to find. It also would have been beneficial to speak directly with manufacturers to gain a deeper understanding of their security practices apart from the privacy policies listed on their websites. Finally, a degree of subjectivity was included in the scoring for certain categories. In summary, we propose this scoring system as a starting point that can be refined as more information on the validity and feasibility of these devices is reported.

Integration of Patient-Generated WAM Data Into Clinical Workflow: Considerations and Best Practice Examples

The recent adoption by consumers of WAM devices has moved the discussion of PA to the forefront of preventive care in both the popular and medical media. The healthcare sector can leverage this cultural shift to better integrate PA assessment and promotion into routine care. This also aligns well with shifts toward care systems and payment models that promote health, prevention, and comprehensive disease management over episodic and reactive health care.

The initial challenge for HCPs is assessing the level of PA in their patients. As summarized in Table 1, several questionnaires are appropriate for use in healthcare settings and constitute adequate screening tools that can facilitate evaluation, tracking, and referrals to community-based PA programs.

Despite the growing use of WAMs, an ongoing challenge is that few of them collect and report PA data in a manner that enables assessment of compliance with the PA guidelines.[171,172] Most WAMs and mobile apps focus on daily step counting, with the somewhat arbitrary goal of 10 000 steps a day, rather than reporting the World Health Organization, Centers for Disease Control and Prevention, and AHA guideline metric of MVPA minutes per week,[130] largely because step counting is easier technically, with studies showing good accuracy. Estimating PA intensity has been more challenging, with suboptimal results when devices are studied systematically.[173,174] Many WAMs and smartphone apps report active minutes and calories burned as indicators of PA intensity, but little information has been available on the specific algorithms used and how these measures correspond to the guideline-based MVPA minutes.[130]

There are multiple challenges for HCPs to prescribe WAMs with confidence, despite the potential positive impact. First, as noted above, the feedback they provide often does not align clearly with the broadly accepted clinical and public health PA guidelines. There are also frequent updates to WAMs/apps and their firmware/software with no systematic way to ensure consistency and accuracy. Studies of their validity and clinical utility are valuable but are invariably several generations out of date by the time they are published. Although there has been discussion about having an organization, agency, or consortium perform routine validation studies, the logistics for doing so are challenging. The Consumer Technology Association, which develops standards across the electronics industry, has a Health and Fitness subdivision with a Physical Activity Standards Working Group, which has published a standard for step-counting accuracy of WAMs and is currently working on a heart rate accuracy (ANSI/CTA-2056).[175] Standardization of the output PA measures from WAMs and apps has been a goal for years but would be particularly important for broader adoption in healthcare settings and would facilitate EHR integration and privacy/security considerations. Organizations such as the Healthcare Information and Management Systems Society and Open mHealth.org[176] can help this effort by promoting guideline-based standardized data schemas and developing tools for data aggregation and visualization within the clinical workflow. Smartphone operating system providers could also require manufacturers to adhere to certain guidelines. These steps could help increase confidence for consumers and HCPs and systems. Ongoing dialogue involving clinicians, patients, researchers, and technology providers can be facilitated by organizations such as the AHA and Personal Connected Health Alliance and collaborative efforts such as Xcertia, involving the American Medical Association, AHA, and Healthcare Information and Management Systems Society.[177]

The other major practical challenge to routine PA assessment and prescription is how to review PA data within the clinical workflow. Consumer devices provide near-continuous daily measures of PA, which would be overwhelming for the provider to review on a regular basis or in the context of a clinic visit. Thus, software solutions are needed to summarize average PA and trends. Efforts are ongoing to integrate PA data from WAMs/apps into the EHR, which should make the data as easy to review as a laboratory result. Similarly, efforts are needed to make it easy to "prescribe" PA and to provide referrals to community programs and fitness professionals through the EHR. For example, EPIC, the Mayo Clinic, Stanford, and others have integrated Apple's HealthKit[178] data into the EHR. This step enabled HCPs to monitor the patient's objective PA and other data collected through iPhones, the Apple Watch, and other apps/WAMs that link to the Apple HealthKit ecosystem to support clinical counseling and to monitor lifestyle interventions. Other health systems have begun integrating HealthKit data into their Cerner EMR in 2015.[179] Google's similar Fit platform has also recently integrated PA and other health data with EPIC. The Ochsner Health System has developed a prescription system that refers patients to their "O Bar" for guidance on downloading and using mobile health devices/apps to monitor PA, sleep, blood pressure, glucose, and weight.[180]

Of course, measuring and prescribing PA, while critical, does not automatically translate into behavior change. To this end, UnitedHealthCare in collaboration with Qualcomm recently rolled out the United Motion program in which eligible participants can track their daily goals and earn financial incentives that can be applied toward their healthcare plan.[181] Participants can earn up to $4/d in credits by achieving 300 steps in 5 minutes an hour apart at least 6 times per day (frequency), completing 3000 steps in 30 minutes at least once per day (intensity), or completing at least 10 000 steps per day (tenacity). Other insurers and employers are leveraging the popularity of WAMs by providing incentives for their broad use. Many large employers have become self-insured to try to manage rising healthcare costs, so they are incentivizing healthy behaviors such as regular PA. Employers have seen secondary benefits of increased employee productivity and satisfaction.

Summary and Conclusions: Consumer-Oriented WAM Devices in Healthcare Settings

- The recent explosion of WAMs and improved software and technology partnerships open opportunities for integrating objective PA data to improve the quality of care and health status of patients with CVD risk.
- However, it is important to note that consumer-oriented WAMs rarely summarize PA data consistently with public health recommendations (eg, MVPA) and in a way that clinicians can understand and use to guide clinical management; in addition, work is still needed to ensure sound validation efforts.
- There is a need to develop software platforms that can process data in a clinically meaningful way and integrate data into EHRs for maximum reach and meaningful use of the data.
- There is also a need for validation efforts tied to guideline-recommended PA metrics for newer technologies and pragmatic trials exploring feasibility, adoption, and effectiveness for CVD risk reduction clinical applications. The model proposed in this document is a starting point.

BARRIERS FOR ROUTINE INTEGRATION OF PA ASSESSMENT AND PROMOTION INTO US CLINICAL PRACTICE

Although conceptually simple, the implementation of protocols for PA assessment and promotion in US clinical settings, as well as standardized community links for PA referrals, is hindered by barriers at multiple levels. For instance, barriers include inadequate provider reimbursement, training, and self-efficacy; insufficient healthcare system support; and scarcity of certified community resources to refer for evidence-based PA programming.[182,183] Similarly, poor care coordination and the inability to follow the progress of a referred patient are important barriers to establishing sustainable clinical-community links for PA-related care.[184]

These barriers are perpetuated by fragmentation of preventive care in the United States and may explain the lack of standardized PA community-referral programs. The US national health promotion objectives have included a specific target to increase the proportion of primary care providers who routinely assess and counsel their patients on PA. Occasional surveys of primary care practitioners and patients suggest that there has been little improvement over the last decade in PA assessment and promotion in clinical visits. The rates of provider-initiated PA counseling continue to be unacceptably low (<35%), particularly among women and racial minorities.[39] Rates for PA counseling among patients with CVD (41.2%), hypertension, (44.2%), obe-

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sity (46.9%), and diabetes mellitus (56.3%) are also suboptimal.[39] These persist even though PA counseling is a national Healthy People 2020 objective (PA-11)[185] and is included in the National Physical Activity Plan,[186] the National Prevention Strategy,[187] and recommendations by many leading professional/scientific organizations.[27,188] PA counseling rates are also lower in the United States than in countries with private, public, or mixed healthcare systems that have integrated PA promotion in primary care, including Brazil, Switzerland, Canada, Sweden, and the United Kingdom. Not surprisingly, the prevalence and economic burden of physical inactivity and NCDs are significantly higher in the United States than in most high-income countries.[1,5,98]

Financial Barriers, Quality of Care, and Payment Models

Among the multitude of barriers faced by providers in assessing and promoting patient PA is financial reimbursement for the time spent counseling at the point of care.[183] Reimbursement for medical services is dependent on a number of factors, including diagnostic codes (*International Classification of Diseases, 10th Revision*); consultation, prevention, and treatment (CPT) codes; and medical record documentation in support of these codes. Although *International Classification of Diseases, 10th Revision* codes for lack of physical exercise (Z72.3) and exercise counseling (Z71.89) exist, commercial and government payers do not recognize them as standalone billable diagnostic codes.

CPT codes are used to indicate the medical service provided. In the ambulatory setting, these include, among others, codes for preventive care, as well as evaluation and management (E&M) codes. Additional codes for nutritional counseling exist, but there is no specific CPT code for PA counseling. Physicians and physical therapists may use therapeutic exercise codes (CPT 97110) when teaching patients exercises to develop muscle strength and endurance, joint range of motion, and flexibility.

Healthcare Effectiveness Data and Information Set metrics are used to determine practice quality. There are Healthcare Effectiveness Data and Information Set measures for PA counseling for pediatric and older adult populations, but there is no measure for adults between 18 and 65 years of age. Furthermore, there are no Healthcare Effectiveness Data and Information Set metrics to track PA referrals. These factors result in a cascade of barriers to routine delivery of PA preventive counseling. The introduction of appropriate CPT codes for PA-related care may provide a reasonable starting point for improvement.

PA assessment has been recommended as part of the health risk assessment for Medicare patients,[189] and PA counseling can be incorporated into routine well-adult visits, Medicare annual wellness visits, and the care for chronic disease management. In a representative sample of US primary care physicians, only 45% reported billing for energy balance (PA and diet counseling activities), and just 3% received incentive payments for this care. Healthcare practices with full EMRs or those that bill for energy balance care provided this service more often and more comprehensively.[190]

The work relative value unit (wRVU) system of reimbursement is an additional barrier to office-based PA counseling. Providers paid on wRVUs have little financial incentive to spend time counseling patients on healthy lifestyle given the low wRVU value assigned to counseling compared with other medical services. For example, a knee joint aspiration and injection has a wRVU of 0.79,[191] in contrast to a wRVU value of 0 for a follow-up visit solely to assess a patient's progress with his or her exercise prescription. When one considers the amount of time required and the complexity of counseling a patient on behavior change, the wRVU system that provides a "value" based on the relative level of time, skill, training, and intensity to provide a given service falls far short.

However, physicians have adopted other billing and coding mechanisms to achieve adequate reimbursement for the time spent counseling patients on PA and other aspects of healthy lifestyle. One such strategy is to "bill for time" with E&M codes. For example, 99214 (established patient E&M visit) can be used to bill if >50% of the 25-minute office visit was spent face-to-face with the patient counseling and coordinating care.[192] The wRVU value for a 99214 E&M visit is 3.014. To use the 99214 code, the *International Classification of Diseases, 10th Revision* codes for lack of physical exercise must be combined with additional diagnostic codes denoting CVD and metabolic risk factors such as obesity, diabetes mellitus, and hypertension. In addition, the physician must adequately document in the medical record what was discussed and prescribed to the patient.

More recently, another financial barrier to office-based PA counseling has arisen: high-deductible health plans. In this instance, patients typically have lower monthly premiums but higher out-of-pocket costs associated with higher deductibles. PA counseling done within the context of a preventive care visit is likely covered without charge to the patient.[193] However, subsequent visits aimed at assessing progress on PA goals would count against a patient's deductible. With a charge of $108 for a 99214, 25-minute office visit, patients are less inclined to return for follow-up visits if they are personally responsible for the cost of that visit.

As healthcare shifts from a largely revenue-based system to a cost-based system in which value is prioritized over volume, the incentives start to shift from disease management to health promotion and disease prevention because a healthy person costs less than a sick one. In this scenario, physician reimbursement is likely to be dependent in part on keeping patients healthy. Intermountain Healthcare includes as a component of physician remuneration the achievement of clinical excellence goals. For several years, clinicians in the employed physician division (Intermountain Medical Group) have had PA assessment and counseling as a clinical excellence goal. Physicians who meet the threshold for both PA assessment and counseling are paid 100% of the value for achieving clinical excellence in this designated area.

Strategies exist in support of reasonable reimbursement to physicians for time spent counseling patients about PA. In the context of a preventive care examination, such counseling is an imperative. For subsequent E&M visits, whether for chronic disease management or follow-up on preventive care recommendations, physicians should consider the "bill for time" approach and ensure that their documentation is in support of the level of care, complexity, and face-to-face time spent with the patient.

Logistical and Workflow Barriers for PA Assessment and Referrals

The Exercise Is Medicine Global Health Initiative was cofounded by the presidents of the American College of Sports Medicine and the American Medical Association in 2007 with a goal of making PA assessment and exercise prescription a standard part of the disease prevention and treatment paradigm around the world. Therefore, it provides an excellent opportunity to understand barriers and to develop best practices for the logistical implementation of the 3 core elements of PA integration into health care: assessment, counseling, and referral.

HCPs working in a variety of settings and specialties report that requiring physicians to facilitate the EHR-based PA assessment can be too burdensome with the limited time available during an office visit. However, this barrier can be overcome by delegating the actual assessment of PA levels to another member of the healthcare team such as a nurse or medical assistant. After the PA assessment is done and recorded in the EHR, it is hoped that the physician or other provider will review each patient's self-reported minutes per week of PA and use this either to congratulate the patient for meeting guidelines or to provide the patient with brief PA counseling (1–2 minutes) and, when possible, use motivational interviewing, shared decision making, and other proven behavior-change strategies.[160,161]

However, some HCPs report time or knowledge barriers that make it unlikely that anything beyond brief physician counseling could be currently scalable as a healthcare system solution without engaging other members of the healthcare team. For this reason, some large healthcare systems are pilot testing programs linking healthcare teams with local resources by providing the patient with a PA "navigator." The role of the navigator is to assess the physician-referred patients' physical and motivational readiness to change, determine exercise preparticipation risk,[194] and then either encourage patients to engage in self-directed PA or refer them to appropriate community resources to increase their likelihood of compliance with the PA prescription and behavior change.[160]

Although patients can be referred to either self-managed or community-based PA professionals/programs, Exercise Is Medicine has found that healthcare systems are often unwilling to refer patients outside their system unless the professional/program referred to is part of a network where quality can be ensured and controlled. Such assurances are provided by the Exercise Is Medicine network and its credentialed exercise professionals,[195] which appears to be a major factor in its appeal to healthcare systems such as the Greenville Health System. Implementing solutions for integrating certified fitness professionals registries and clinical workflow can also facilitate the referral process.[196] Furthermore, the development of relational geo-coded databases of PA programming and other health ecology resources (medical fitness centers, gyms with certified programming and personnel, parks, trails, community centers, etc) classified by age, clinical conditions, insurance benefits, and other factors (cost, activities offered, etc) can enable the provision of a robust, personalized list of potential places and programs when integrating into the clinical workflow, EHR, and patient portals.[197]

Skills, Self-Efficacy, and Role Modeling

Although recommended as the first line of prevention and management of chronic disease, HCPs often do not deliver effective behavioral-change counseling in their clinical practice. Adequate knowledge, attitudes, and specific counseling skills are frequently lacking for most practicing clinicians.[183,198] Medical education in lifestyle medicine has been proposed by the AHA,[199] the American College of Lifestyle Medicine, the Exercise Is Medicine Initiative, and the Lifestyle Medicine Education Collaborative[126,191,200] as an urgent and necessary intervention to equip all providers with the necessary knowledge, skills, and abilities to effectively and efficiently counsel their patients toward adopting and sustaining healthier behaviors. Lifestyle medicine curricula, including exercise, nutrition, behavioral change, and self-care, have recently evolved in all levels of medical education. Doctors' and medical students' PA habits are important predictors of their counseling practices, but the relevance that students give to PA counseling decreases significantly during medical school.[201–206] These findings support the behavioral value of providers in practicing what they preach. Doctors should be encouraged to reflect on how their attitudes and behaviors may influence the care they give.[207] This encouragement should be part of continuing medical education and become part of our professional standards, paying more attention to doctors' personal health practices to advise their patients with commitment and integrity.[208.209]

Although doctors and other HCPs are well positioned as role models and health counselors in most countries around the world, modern sedentary lifestyles are affecting doctors and HCPs in a manner similar to the general population. Life as a doctor or medical student poses particular challenges and stressors, which can adversely affect PA habits and quality of life.[210–212] From an undergraduate level, practicing physicians, particularly those involved in academic medicine, should be role models for healthy and active lifestyles. Being aware of the physical and mental health benefits of exercise through regular personal experience can be a powerful determinant of counseling attitudes, empathy, and personal skills for PA practice. It also matters for patients; they perceive the counseling from self-consistent doctors to be more powerful and motivating.[213–216]

Summary and Conclusions: Strategies for Overcoming Barriers for Routine Integration of PA Assessment and Promotion in US Clinical Practice

- The increasing emphasis on provision of prevention-oriented care with the implementation of the Affordable Care Act, population health management frameworks, and latest US Preventive Services Task Force recommendations offers clear opportunities for integrating comprehensive PA assessment promotion strategies in US health care and accelerating its implementation.
- At the clinical level, incentivizing physicians to elevate the status of PA counseling for annual wellness and NCD management visits could be achieved by educating primary care providers, standardizing coding schemes, developing appropriate reimbursement strategies, establishing a Healthcare Effectiveness Data and Information Set measure for adults, and implementing innovative payment models for PA-related care.
- Models should be used that leverage continued education and practice transformation initiatives to educate and empower providers and health systems and to drive implementation of PA assessment and promotion strategies.
- At the community level, networks of certified PA programs with existing personnel and resources should be established to standardize exercise interventions for different clinical subpopulations and to accommodate the continuum of primordial to tertiary prevention programs.

ROLE OF HEALTHCARE SYSTEMS AND PROVIDERS IMPLEMENTING PA PROMOTION

We are currently faced with addressing the global crisis of NCDs and must adequately prepare healthcare professionals to address the needs of those with higher risk.[217,218] A recent expert review highlighted the urgent need for all healthcare professionals (physicians, physical/occupational therapists, nurses, dieticians, behavioral therapists) to address the burgeoning NCD crisis using team-based and patient-centered medical home approaches for lifestyle management.[217]

Role of Physicians

Physicians, often the central coordinators for care teams, need to play an active role in supporting and integrating assessment of PA into vital sign assessment. Physicians should have a clear understanding of the most current CVD risk reduction strategies to begin this process.[20] The next critical step for physicians is to determine, in collaboration with their care teams, the type of information on PA that is feasibly collectible in their clinical settings, how this information is to be recorded, and how it is to be followed up. While using quantitative methods and longitudinal follow-up is ideal, effective capture, collation, and reporting of these data require greater infrastructural, time, and human capital investments, which may make longitudinal quantitative PA assessments problematic in less well-supported clinic settings. Physicians should work with their care team to select the methods for PA assessment that best fit their clinical setting to allow meaningful, longitudinal follow-up (Tables 1 and 2). Regardless of methodology, physicians should commit to the assessment of PA at each office visit and, if quantitative measurements can feasibly be continuously assessed, help create mechanisms for more frequent evaluation.

Role of Physical Therapists

Physical therapists are trained to conduct exercise tests, promote PA, and prescribe exercise to their patients with complex comorbid conditions and range of physical impairments and disabilities.[218] Physical therapists need to be proactive in addressing PA assessment and promotion with their patients or clients during patient care, including educating the public on the role of the physical therapist in the management of CVD and other NCDs through exercise. It has been reported that exercise is "one of the most important and effective interventions physical therapists can incorporate into every patient plan of care to promote health and wellness."[218]

Table 2. Characteristics of Consumer-Oriented WAM Devices for Use in Healthcare Settings

Wearable	Description	Activity Metrics	Validity	Compliance With Aerobic PAG	Patient Feasibility	Healthcare Data Integration Feasibility	Behavior-Change Strategies	Average Score
Fitbit Zip[163,165,219–223]	WAM with visuals on WAM, App, and website; triaxial accelerometer	Calories, steps, distance, total EE, duration by active minutes, activity determined by MET level and manufacturer explains this online, can log activity, activity detected by device, thresholds	3	3	3	2	3	2.8
Fitbit One[165,220,223]	WAM with visuals on WAM, App, and website; triaxial accelerometer	Calories, steps, floors, distance, total EE, duration by active minutes for anything more than walking, activity determined by MET level and manufacturer explains this online, MET, can log activities, can turn on multisport mode, sleep duration, sleep efficiency, thresholds	3	3	2.33	2	3	2.67
Fitbit Flex[163,166,220,223,224,225]	WAM with visuals on WAM, App, and website; triaxial accelerometer	Calories, steps, distance, hourly activity, stationary time, estimated EE, duration by active minutes for anything more than walking, activity determined by MET level and manufacturer explains this online, MET level, can log activities, sleep duration, sleep quality, thresholds	2	3	2.33	2	3	2.47
Piezo Rx[226,227]	Research/consumer WAM; displays on WAM, mobile App/ website via software; uniaxial piezoelectric sensor	Steps, PA duration by active minutes, PA classification levels, bouts of activity measured by levels	3	3	2.33	1	2	2.27
Fitbit Charge HR[223,224,228]	Consumer WAM, App, and website; optical heart rate monitor, triaxial accelerometer, altimeter, vibration motor	Calories, steps, floors, distance, duration by MET and manufacturer explains online, MET, recognizes activity, heart rate, sleep duration, sleep efficiency, thresholds	1	3	2	2	3	2.2
Garmin Vivofit[166,223,229,230]	WAM with alternative heart rate strap and visuals on WAM, App, and website; accelerometer, heart rate monitor, step counter	Calories, steps, distance, heart rate, PA duration by active minutes, can purchase bike speed sensors to go with it, sleep duration	2	1	3	2	3	2.2
Tractivity[231–233]	Consumer WAM; triaxial accelerometer, advanced signal-processing techniques	Calories, steps, distance, PA duration by active minutes	3	2	2	1	3	2.2
Jawbone UP 24[163,166,170,223,225,234,235]	WAM with visuals on App; tridimensional activity tracker	Calories, steps, distance, estimated EE (resting and active separately), PA and sedentary behavior, user can log duration and intensity with stopwatch mode, PA by classification level, sleep duration, sleep efficiency	2.2	1	2.67	2	3	2.17

(*Continued*)

Table 2. Continued

Wearable	Description	Activity Metrics	Validity	Compliance With Aerobic PAG	Patient Feasibility	Healthcare Data Integration Feasibility	Behavior-Change Strategies	Average Score
Basis Peak[228,236]	WAM with visuals on WAM, App, and website; optical heart rate engine, triaxial accelerometer, skin temperature, galvanic skin response	Calories, steps, distance, heart rate, PA duration by active minutes, describes how it tracks: uses sensors and needs at least 3 METs to track (trouble tracking yoga/Pilates, weights, stationary bike, walking with stroller, and lap swimming), detects when walking/running/biking outside, sleep duration, sleep efficiency	3	3	1.67	1	2	2.13
Withings Pulse Ox[163,166,170,223,237–239]	WAM with visuals on WAM and App; accelerometer, heart rate, blood oxygen monitor	Calories, steps, distance, elevation, run analyzer, heart rate monitor, blood oxygen monitor, PA, resting heart rate, sleep duration, sleep efficiency	2.33	1	2.33	2	3	2.13
Samsung Gear S[240–242]	Consumer WAM, displays on WAM and App; accelerometer, gyroscope, heart rate, ambient light, barometer	Calories, steps, distance, speed, heart rate, PA duration by active minutes, PA classification by level	1	3	1.33	2	2	2.07
Misfit Shine[163,166,223,225,228,243,244]	WAM with visuals on WAM and App; triaxial accelerometer	Calories, steps, distance, estimated EE, duration by active minutes, earn points for activity, can set for swimming/cycling/running/walking, sleep duration, sleep quality (can swim with this device)	1.33	2	2.67	1	3	2.0
Omron HJ-203[163,170,245]	WAM with visuals on WAM, App, and website; 2-dimensional smart sensor technology, advanced acceleration	Calories, steps, distance, duration by active minutes, user presses timer for active minutes, user can enter activity	1.5	2	3	1	2	1.9
Adidas MiCoach[223,245–247]	WAM with visuals on WAM and App; Fit Smart technology for heart rate, accelerometer	Calories, distance, speed, heart rate, stride rate for walking/jogging/running, PA duration by active minutes, PA level, explains how minutes are calculated but unsure if it was only for field sports	1	3	1.67	2	2	1.93
TANITA AM-160[166,248]	WAM with visuals on WAM and App; triaxial accelerometer	Calories, steps, distance, total energy, activity energy, resting calories, fat burned, total activity time, uses Calorism Engine PRO to classify into resting/daily activity/walking/running, movement analysis every 6 s	3	3	1.67	1	1	1.93
Metria IH1[249,250]	Consumer, disposable WAM that sticks to upper arm	Unclear; calories, classification levels, sleep	3	3	1.33	1	1	1.87
Omron CaloriScan HJA-403C[166,170,223]	WAM with visuals on WAM, App, and website; 3-dimensional accelerometer	Calories, steps, fat burned	3	1	1.67	1	2	1.73

(*Continued*)

Table 2. Continued

Wearable	Description	Activity Metrics	Validity	Compliance With Aerobic PAG	Patient Feasibility	Healthcare Data Integration Feasibility	Behavior-Change Strategies	Average Score
Moves[163,223,251,252]	Smartphone App with visuals on App; acceleration sensors from smartphone, GPS	Calories, steps, distance, duration by activity, user can input activity, can detect running/walking/cycling/transport, will map route	1	2	2.33	2	1	1.67
DirectLife[165,247,253]	WAM with visuals on WAM and website; triaxial accelerometer	Calories, activity EE, user can label activities on website, website explains how calories are calculated	2	1	1.67	1	2	1.53
Apple Watch[228,254,255]	Consumer WAM, display on WAM and App; photoplethysmography for heart and accelerometer	Calories, steps, distance, speed, heart rate, PA duration by active minutes; defines anything above brisk	1	2	1.33	1	2	1.47
Yamax Digiwalker SW-200[163,256–258]	WAM with visuals on WAM; pendulum, 2-dimensional pedometer	Steps	1.5	1	2.33	1	1	1.37
Mio Alpha[259]	Consumer WAM, displays on WAM and App; optical heart rate and triaxial accelerometer	Calories, steps, distance, heart rate, pace	1	1	1.67	1	1	1.13

Each column represents a scoring domain ranked from 1 (worst) to 3 (best) according to prespecified criteria detailed in Data Supplement 2. App indicates application; EE, energy expenditure; GPS, global positioning system; MET, metabolic equivalent; PA, physical activity; PAG, physical activity guidelines; and WAM, wearable activity monitor.

Fitbit Zip and Garmin Vivofit additional reference: E. Sprouse and A. Swelin, oral communication, September 2016.

Role of Nurses

Nurses and nurse practitioners have an important role in primary and secondary healthcare settings.[260] Nurses and nurse practitioners are on the front line for addressing the increasing burden of NCD through education. One study demonstrated that a team approach to lifestyle management improved outcomes related to chronic CVD management and PA behaviors compared with a program delivered with the current healthcare model (ie, usual care).

Role of Fitness Professionals

Community-based providers of exercise services constitute a potentially powerful component of a comprehensive healthcare system that is geared to the promotion of PA among clinical populations. Most communities include commercial health clubs and nonprofit organizations (eg, the YMCA/YWCA, Jewish Community Centers) that employ fitness professionals who are trained to design and supervise individualized, effective exercise programs. In addition, in most communities, many such professionals work as personal trainers providing one-on-one exercise services to individual clients. Despite the wide availability of these fitness professionals, they are rarely included in the healthcare delivery system.

An important step in establishing the fitness professional as an integral component of the healthcare system is to institutionalize physician referral of patients to qualified community-based providers of exercise services. Through such a system, patients, having been screened in the clinical setting and provided with an exercise prescription, would be referred to fitness professionals for translation and supervision of the recommended exercise regimen. The referrals would be made to preidentified organizations (either nonprofit or for profit) or to individual providers. A key element of this system would be the provision of compensation by the patient's health insurance entity to the providing organization or individual fitness professional.

A model for this system is the Diabetes Prevention Program, which is currently being implemented through collaboration among the YMCA, selected health insurance entities, and HCPs.[261] This program is currently being applied across the United States by linking physicians and health insurance providers to community-based health promotion specialists, including fitness professionals. The Silver Sneakers program for Medicare-eligible individuals is another model in which health plans already include a fitness benefit at very reduced or no extra cost, including access to a personal trainer, fitness center, or exercise classes,[120–122] showing that the potential for integrated PA-related care exists. Finally, the Centers for Medicare & Medicaid Services has recently announced support for national coverage of supervised exercise therapy for patients with symptomatic peripheral artery disease delivered by qualified exercise professionals.[262] These efforts demonstrate the great potential associated with including fitness professionals and programs in the healthcare delivery system.

Suggestions for Clinicians Integrating PA Assessment and Promotion in Practice

- Make PA assessment a priority in all visits, in particular when the focus is CVD E&M or preventive care, using a simple, standardized tool such as the PAVS:
  - "On average, how many days per week do you engage in moderate or greater intensity physical activity (like a brisk walk)?"
  - "On average, how many minutes do you engage in this physical activity on those days?"
- If the product of those responses (MVPA in minutes per week) indicates a lack of compliance with the aerobic component of the US PA guideline recommendation of 150 min/wk, individuals should be advised of the health benefits of regular PA and encouraged to gradually increase either their frequency or duration of activity.
- Consumer-oriented wearable devices or smartphones are feasible tools for objectively assessing PA levels. Self-tracking can help some individuals increase their PA levels in the short term, but a more robust PA promotion/referral/behavior change plan is needed for the maintenance of effects.
- The PA guidelines may be perceived by some inactive individuals as too difficult to achieve. Explaining that accumulating at least 60 to 100 min/wk of PA (ideally in 10-minute bouts of at least moderate-intensity PA) largely contributes to improved physical and mental health and CVD reduction.
- As recommended by the PA guidelines for Americans, a comprehensive assessment of PA should include engaging in muscle-strengthening, resistance, and flexibility exercises for major muscle groups at least twice a week. The following question can be used:
  - "How many days a week do you perform muscle-strengthening exercises such as body weight exercises or resistance training?"
- Behavior is a dynamic phenomenon, and individuals attempting to change their behaviors often go through a series of stages. Identifying behavioral readiness with the transtheoretical model of behavior change can help tailor the PA counseling.
  - For individuals in precontemplation (no intention to become more physically active), discussing the health benefits of regular PA; exploring doubts, misconceptions, and myths about PA; and addressing barriers and facilitators for increased PA will be more appropriate than providing a specific PA prescription at this point.
  - For individuals in contemplation and preparation (thinking about becoming physically active and have made small changes but not sustained yet to meet guidelines), a written PA prescription using the FITT principle (recommended frequency, intensity, time, and type of PA) with or without a referral to a trusted exercise professional/program constitutes an appropriate step.
- In addition to behavioral readiness, assessment of physical readiness for exercise constitutes an important step for PA promotion. Although the deleterious health effects of inactivity far outweigh the risks of an adverse CVD event trigged by exercise, following a pre-exercise screening protocol can reduce these risks and build trust between the provider and the patient.[194]
- To make PA promotion efforts more credible and motivating, physicians should ensure that they "walk the talk" themselves. Personal experience makes a difference in PA promotion.

CONCLUSIONS

There are now ample evidence and widespread recognition of the pivotal role that PA plays in the prevention and management of CVD and other NCDs. Several clinical recommendations and policy statements support the integration of PA assessment and promotion in healthcare settings. Substantial evidence, including from large healthcare systems and country-level implementation experience, emphasizes that multifaceted PA assessment, counseling, and referral strategies are scalable and cost-effective. Those linking health care to community-based PA resources may be particularly so. These strategies should be part of CVD and NCD management and control programs. Given their benefit, large-scale implementation of these strategies could significantly contribute to the AHA 2020 Impact Goals and the US National Prevention Strategy and to global NCD control goals, which call for a 10% reduction in the global prevalence of physical inactivity.[13] However, despite some innovative implementation examples, policies and recommendations are not being sufficiently translated into pragmatic implementation and sustained programs in real-life healthcare settings.

For PA assessment and promotion to be embraced by health systems, clinical and community care providers, patients, payers, and technology and community care stakeholders, it needs to be incorporated into the modern fabric of healthcare delivery in a sustainable fashion. A "systems change" approach is necessary to spark the vital institutional and personal impetus for healthcare systems and providers, respectively, to break the barriers that impede integration of clinical-community links for PA promotion. Resource allocation for executing clinical, community, and data integration components is critical. Experience in other countries shows that this can be done and should yield positive results. Finally, this scientific statement strongly supports the importance of cross-national learning, knowledge transfer, and adaptation of successful models to make PA promotion a standard in health care and to contribute to meeting global CVD and NCD control targets.

ARTICLE INFORMATION

The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

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Disclosures

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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

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