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Implementing Strategies to Enhance Public Health Surveillance of Physical Activity in the United States

Committee on Strategies for Implementing Physical Activity Surveillance

Food and Nutrition Board

Health and Medicine Division

A Consensus Study Report of

The National Academies of

SCIENCES • ENGINEERING • MEDICINE

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COMMITTEE ON STRATEGIES FOR IMPLEMENTING PHYSICAL ACTIVITY SURVEILLANCE

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This Consensus Study Report was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise. The purpose of this independent review is to provide candid and critical comments that will assist the National Academies of Sciences, Engineering, and Medicine in making each published report as sound as possible and to ensure that it meets the institutional standards for quality, objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

We thank the following individuals for their review of this report:

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Although the reviewers listed above provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations of this report nor did they see the final draft before its release. The review of this report was overseen by **DIANE F. BIRT,** Iowa State University, and **MAXINE HAYES,** Washington State Department of Health. They were responsible for making certain that an independent examination of this report was carried out in accordance with the standards of the National Academies and that all review comments were carefully considered. Responsibility for the final content rests entirely with the authoring committee and the National Academies.

Preface

Physical activity has long been recognized as a key component of a healthy lifestyle, and promotion of physical activity has been a longstanding priority in some societal sectors including education, health care, and recreation/parks. However, it is only in recent decades that physical activity has become a focus of the public health sector. Because physical activity is a relatively new element in public health, important components of a comprehensive public health strategy for promoting physical activity are still being developed. Surveillance, the systematic, ongoing collection and analysis of health-related data, is a core public health function. The existing public health system in the United States includes some important physical activity surveillance resources. But, many gaps remain to be filled. This report provides a comprehensive set of recommended actions that, when taken, will contribute importantly to filling those gaps and establishing a robust physical activity surveillance system in the United States.

This report builds on the products of two previous projects. In 2014, the Centers for Disease Control and Prevention and the American College of Sports Medicine convened an expert panel that identified priority areas for enhancing physical activity surveillance. This was followed by the work of a group of experts, convened in 2017 by the Physical Activity Innovation Collaborative, an entity affiliated with the Roundtable on Obesity Solutions of the National Academies of Sciences, Engineering, and Medicine. That group identified key strategies for enhancing physical activity surveillance. The work of the committee that produced the current report was informed by the products of the two previous projects. This Consensus

Study Report extends the recommendations of those projects by identifying specific actions that should be taken to implement strategies for enhancement of physical activity surveillance.

The committee has many people to thank for their support in developing the strategies and recommended actions presented in this report. In particular, the committee expresses its gratitude to the experts who were convened to advise the committee on specific actions to enhance physical activity surveillance. That group's thoughtful, thorough, and detailed input was critical to the successful production of this report. In addition, the committee acknowledges the many public health practitioners and researchers whose work has established the foundation of evidence on which the content of this report is based.

The committee also thanks Emily Callahan for copyediting, and the team from Mathematica Policy Research, Kelley Borradaile, Daniel Finkelstein, and Andrew Hurwitz, for their contributions to the committee's work. Finally, the committee could not have done its work without the outstanding guidance and support of Heather Del Valle Cook, Senior Program Officer, and Meredith Young, Research Assistant, with the Health and Medicine Division of the National Academies of Sciences, Engineering, and Medicine. We are deeply appreciative of the skill, energy, and warmth with which they supported the committee's efforts. Lastly, we thank Ann Yaktine, Director of the Food and Nutrition Board, for her wisdom and support.

Russell R. Pate, *Chair*
Committee on Strategies for Implementing
Physical Activity Surveillance

Contents

Summary[1]

Physical activity has far-reaching benefits for physical, mental, emotional, and social health and well-being for all segments of the population. Despite these documented health benefits and previous efforts to promote physical activity in the U.S. population, most Americans do not meet current public health guidelines for physical activity. Surveillance in public health is the ongoing systematic collection, analysis, and interpretation of outcome-specific data, which can then be used for planning, implementation, and evaluation of public health practice. Surveillance of physical activity is a core public health function that is necessary for monitoring population engagement in physical activity, including participation in physical activity initiatives. Surveillance activities are guided by standard protocols and are used to establish baseline data and to track implementation and evaluation of interventions, programs, and policies that aim to increase physical activity.

Physical activity is challenging to assess because it is a complex and multidimensional behavior that varies by type, intensity, setting, motives, and environmental and social influences. The lack of surveillance systems to assess both physical activity behaviors (including walking) and physical activity environments (such as the walkability of communities) is a critical gap that prompted this consensus study.

[1] This Summary does not include references. Citations for the findings presented in the Summary appear in subsequent chapters of the report.

STUDY BACKGROUND AND APPROACH

This committee's work is an extension of previous efforts to address concerns around the need for physical activity surveillance. In 2014, the Centers for Disease Control and Prevention (CDC) collaborated with the American College of Sports Medicine to review the state of physical activity–related surveillance and develop an overarching strategy to establish a national plan for such surveillance, with the goal to enhance coordination and collaboration among sectors. Five strategic priorities to guide future physical activity surveillance in the United States were identified (Fulton et al., 2016). As a result, in 2017, the Physical Activity and Health Innovation Collaborative (PA IC), an ad hoc activity affiliated with the Roundtable on Obesity Solutions of the National Academies of Sciences, Engineering, and Medicine, served as the convener for a meeting of experts brought together to identify specific actions that could improve physical activity surveillance in the United States and to suggest approaches for implementing those actions. Attendees identified 23 recommended actions to advance surveillance of physical activity in specific population subgroups and to enhance monitoring of institutional and community supports that influence physical activity behaviors. A discussion paper was developed that provided the recommended actions that resulted from the convening (Pate et al., 2018).

As a follow-up, based on a request from CDC related to the need for continuing progress toward improving physical activity surveillance, a seven-member ad hoc committee was convened to develop strategies to support the implementation of the recommendations to improve national physical activity surveillance that were identified in the discussion paper (Pate et al., 2018). See Box S-1 for the committee's task. To fulfill its charge, on November 1–2, 2018, as a way of helping the committee gather information, the committee held a public meeting for approximately 30 individuals with expertise in the four areas to discuss strategies for implementing actions to improve physical activity surveillance. As prescribed in the task, information gathered during the meeting of experts was the primary source of input that informed the committee's recommendations. It should be noted that the committee was not charged with conducting a formal search of the relevant scientific/professional literature, and such a search was not undertaken.

Several overarching principles informed the committee's selection of strategies and supporting actions to implement those strategies: physical activity surveillance systems should be as equitable as possible and appropriately representative of the U.S. population and its institutions and communities; physical activity is a complex behavior and it is influenced by factors operating in a variety of settings; and given the complexity of physi-

BOX S-1
Statement of Task

An ad hoc committee will be convened to develop strategies that support the implementation of recommended actions to improve national physical activity surveillance. Specifically the committee will:

- convene a group of experts who will examine and build on existing recommended actions in four topical areas (children and youth, community supports for active transportation, health care, and workplaces) to identify specific strategies for implementing those recommended actions;
- provide guidance and oversight to a consultant who will develop tools to facilitate surveillance within the topical area of community supports for active transportation, that will include developing:
  - two brief sets of prioritized questionnaires to assess: (1) an individual's perceptions of community support for physical activity; and (2) members of a professional organization's design policies and zoning codes supportive of active transportation (the consultant will develop a validation protocol for the questionnaires).
  - two "how-to" protocols to: (1) identify, capture, and store Geographic Information System (GIS) data in a centralized location, and (2) automate the remote collection of audit data.

The committee will prepare a report of its findings and conclusions about strategies for implementing recommended actions to improve national physical activity surveillance. The report will include the questionnaires, and validation protocol and the "how to" protocols developed by the consultant. The committee's consensus report will be subject to standard National Research Council review procedures prior to release. Evaluation, validation, and testing of the questionnaires and protocols will not be carried out under the scope of this study. As part of dissemination, an all-inclusive manuscript (and/or separate manuscripts for each of the four topical areas) may be developed for submission to peer-reviewed publications.

cal activity behavior, a comprehensive surveillance system will be successful only if a diverse set of key partners participate in the design of the system and then act to implement enhancements.

Additionally, the committee employed guidance during the selection process to ensure that the strategies and actions selected should collect information in a manner that is legal, ethical, and properly attendant to personal, institutional, and community confidentiality; expand the availability of physical activity information at the state, tribal, and local levels, as well as at the national level; enhance physical activity surveillance in subpopulations other than children and in other settings, including the home, faith-based

organizations, and educational institutions; leverage new technologies to the extent possible; address surveillance of participation in all those types of physical activity; be feasible for implementation in the near term; and support research on the public health implications of physical activity.

RECOMMENDED STRATEGIES AND ACTIONS TO IMPROVE NATIONAL PHYSICAL ACTIVITY SURVEILLANCE

The committee presents 22 strategies for improving national physical activity surveillance: 6 for children, 6 for health care, 4 for workplaces, and 6 for community supports for physical activity. The committee also recommended specific actions to support implementation of each strategy. A total of 59 implementation actions were identified: 16 for children, 16 for health care, 12 for workplaces, and 15 for community supports for physical activity. The full list of strategies and supporting actions for implementation is provided below.

Children

Strategy 1: Develop and implement state- and national-level systems for monitoring physical activity policies and practices in early child care and early childhood education settings.

Supporting Action 1.1: CDC should implement a system for monitoring existing state-level policies for the promotion of physical activity in child care settings.

Supporting Action 1.2: CDC should incorporate the existing procedures for describing and assessing state regulations pertinent to promotion of children's physical activity in child care settings into a comprehensive surveillance system that monitors both pertinent state regulations and setting-level practices in all the states.

Supporting Action 1.3: CDC should implement a national system for monitoring the implementation of physical activity practices at the child care center level.

Strategy 2: Enhance existing surveillance systems for monitoring elementary through high school–based physical activity policies and programs.

Supporting Action 2.1: CDC should reduce the number and scope of physical activity–related items in the School Health Policies and Practices Study (SHPPS) so that it can be administered every 2 years.

Supporting Action 2.2: CDC, in partnership with the National Cancer Institute (NCI), should modify the Classification of Laws Associated with School Students (CLASS) protocol to codify available information about state-level and school-based physical activity laws and policies. This protocol should be integrated into the SHPPS to form a single, comprehensive surveillance system administered by CDC.

Supporting Action 2.3: CDC should develop an accessible, user-friendly system for connecting SHPPS and CLASS data with individual-level data on physical activity from the Youth Risk Behavior Survey (YRBS). CDC should attempt to create an accessible, user-friendly system for linking these state-, district-, and school-level data.

Strategy 3: Develop a protocol that leverages ongoing administration of physical fitness tests, such as FitnessGram, for the purpose of monitoring fitness levels of children and youth.

Supporting Action 3.1: CDC should incorporate a validated fitness assessment protocol into each National Health and Nutrition Examination Survey (NHANES) cycle and target it to a representative subsample of children ages 10 years and older.

Supporting Action 3.2: CDC should incorporate fitness testing as an add-on module to the YRBS.

Supporting Action 3.3: CDC or The Cooper Institute should develop a nationally representative sampling strategy to collect and analyze FitnessGram data from selected school districts.

Strategy 4: Expand objective monitoring of physical activity in children (ages 3 to 18 years) by incorporating validated wearable technologies into existing surveillance systems.

Supporting Action 4.1: CDC or NCI should convene an expert panel to identify specific procedures for transforming raw accelerometry data from wrist-worn monitors into metrics that indicate adherence with guidelines for children (ages 3 to 18 years).

Supporting Action 4.2: CDC's National Center for Health Statistics (NCHS) should include device-based measurement of physical

activity in children (ages 3 to 18 years) in NHANES, at regular intervals not longer than 10 years.

Strategy 5: Develop a system for monitoring community-level availability of organized sports and other physical activity programs for children.

Supporting Action 5.1: The National Institutes of Health (NIH), CDC, or the National Collaborative on Childhood Obesity Research (NCCOR) should convene an expert panel to develop a survey instrument and sampling protocol to monitor the availability and nature of community-based sport and physical activity programs for children. The panel should include representatives of national organizations that provide such programs, including the National Recreation and Park Association (NRPA), The Y, Boys and Girls Clubs, and sport-specific federations, as well as epidemiologists with expertise in sampling and development of surveillance systems.

Supporting Action 5.2: A nongovernment entity or consortium of nongovernmental organizations, funded by foundations, the participating organizations, or a unit of CDC (e.g., NCHS; Division of Adolescent and School Health; Division of Nutrition, Physical Activity and Obesity), should conduct a comprehensive nationwide survey of the availability of community-based sport and physical activity programs for children, using the survey instrument and sampling protocol recommended above. In the long term, a refined survey protocol should be incorporated into a national surveillance system.

Strategy 6: Identify features of the built environment that are most likely to influence physical activity in children, and embed an assessment of the perceived availability and use of these features into existing surveillance systems.

Supporting Action 6.1: CDC and NCHS should develop a comprehensive list of the perceived built environment features and constructs that are currently measured in surveillance systems such as the National Survey of Children's Health (NSCH) and the National Health Interview Survey (NHIS).

Supporting Action 6.2: NIH, CDC, or NCCOR should convene an expert panel of researchers, practitioners, educators, and urban planners to identify features of the built environment that are most relevant for children's physical activity.

Supporting Action 6.3: NCHS and the U.S. Census Bureau should embed into one or more national surveillance systems a short list of validated items assessing perceived built environment supports for children's physical activity.

Health Care

Strategy 7: Develop surveillance systems to monitor the prevalence of physical activity assessment in adults through expanded integration of a standard physical activity vital sign (PAVS) in health care delivery.

Supporting Action 7.1: An expert panel, including representatives from CDC, other federal and state agencies, academic partners, and/or medical professional organizations (e.g., American Heart Association, Exercise is Medicine), should develop standards for documentation of the PAVS in the electronic health record (EHR). The PAVS should assess both aerobic physical activity (minutes per week) and muscle-strengthening exercise/activities (sessions per week) in accordance with the *Physical Activity Guidelines for Americans, 2nd Edition*.

Supporting Action 7.2: An expert panel, including representatives from CDC, other federal and state agencies, academic partners, and/or medical professional organizations (e.g., American Heart Association, Exercise is Medicine), should develop a survey to monitor health care systems' use and integration of PAVS into EHRs.

Supporting Action 7.3: An expert panel, including representatives from CDC, other federal and state agencies, and academic partners, should develop measurement error correction models (or one model) that would serve to reduce and equalize measurement error incurred from a standardized patient PAVS administered by self-report.

Strategy 8: Develop surveillance systems to monitor the prevalence of physical activity assessment and promotion among children through integration of a standard pediatric physical activity vital sign (PedsPAVS) in health care delivery.

Supporting Action 8.1: An expert panel with representatives from CDC and medical professional organizations (e.g., American Academy of Pediatrics, Exercise is Medicine) should develop an instrument—a PedsPAVS—to assess, document, and support

pediatric physical activity promotion in health care settings. The PedsPAVS should quantify aerobic, muscle-strengthening, and bone-strengthening activities in accordance with the *Physical Activity Guidelines for Americans, 2nd Edition*.

Supporting Action 8.2: An expert panel with representatives from health care organizations, EHR vendors, and medical professional organizations should develop and implement a protocol to assess youth physical activity with a PedsPAVS.

Supporting Action 8.3: Health care systems and EHR vendors should integrate PedsPAVS and documentation of physical activity counseling into the EHR.

Supporting Action 8.4: An expert panel with representatives from CDC, other federal and state agencies, academic partners, and/or medical professional organizations (e.g., American Academy of Pediatrics, Exercise is Medicine) should develop a survey to monitor health care systems' use and integration of PedsPAVS into EHRs.

Strategy 9: Expand the use of data from wearable devices for monitoring physical activity in at-risk patients.

Supporting Action 9.1: An expert panel of stakeholders representing EHR vendors, health care system leaders, CDC, and patients should identify and examine promising scenarios to understand the capabilities and limitations for wearable physical activity devices to help with monitoring/surveillance of physical activity across the health care continuum (i.e., inpatient and outpatient settings).

Supporting Action 9.2: An expert panel of stakeholders representing EHR vendors, health care system leaders, CDC, and patients should determine the patient populations that would benefit the most from the use of wearable physical activity devices to better measure physical activity levels and assess physical activity interventions among higher-risk individuals (e.g., older adults, underserved individuals, or those with specific diseases).

Strategy 10: Conduct surveillance of cardiorespiratory fitness and muscle strength testing among at-risk populations in health care settings.

Supporting Action 10.1: The Centers for Medicare & Medicaid Services (CMS) should partner with health care systems to develop

and implement protocols using grip strength and the 6-minute walking test in primary care settings as part of the Medicare Annual Wellness Visit as a fitness surveillance strategy among adults 65 years of age and older.

Supporting Action 10.2: CDC should develop and implement protocols using grip strength as part of the Diabetes Prevention Program (DPP) in adults 40 to 70 years of age as a fitness surveillance strategy among enrolled adults.

Strategy 11: Ensure that national health care delivery surveys include questions about physical activity assessment and counseling in health care settings.

Supporting Action 11.1: CDC should modify the NHIS to include questions that ask respondents if they (and their child) received assessment, advice, or counseling for physical activity from their primary care physician or health care provider.

Supporting Action 11.2: CDC should modify the National Ambulatory Medical Care Survey (NAMCS) to include questions that ask physician respondents if they provided assessment, advice, or counseling for physical activity (aerobic and muscle strength training) to patients.

Strategy 12: Conduct surveillance of physical activity levels in the health care workforce and related training programs.

Supporting Action 12.1: CDC, in partnership with medical professional organizations (e.g., American College of Physicians, American Medical Association, American Nurses Association, American Physical Therapy Association), should develop and regularly implement a survey to query health care providers (i.e., physicians, advanced practice clinicians, nurses, and physical therapists) about their personal physical activity behaviors, and use the results to inform development of programs aimed at promoting regular physical activity among providers.

Supporting Action 12.2: CDC, in partnership with medical educational organizations (e.g., American College of Graduate Medical Education, American Nurses Association, American Physical Therapy Association, Association of American Medical Colleges), should develop and regularly implement a survey to query medical

students, residents, fellows, advanced practice clinician students, nursing students, and physical therapy students about their personal lifestyle behaviors, and use the results to inform development of programs aimed at promoting regular physical activity among health care providers in training.

Supporting Action 12.3: CDC, in partnership with medical educational organizations (e.g., American College of Graduate Medical Education, American Nurses Association, American Physical Therapy Association, Association of American Medical Colleges), should develop and regularly implement a survey to query medical schools, nursing schools, and graduate programs in physical therapy regarding specific curricula in physical activity assessment and promotion.

Workplaces

Strategy 13: Document existing surveillance efforts that capture physical activity, physical fitness, and sedentary behavior in the workplace and in employees' commutes to and from work, and identify opportunities to expand these efforts.

Supporting Action 13.1: CDC; the American Heart Association; state, tribal, and local public health agencies; or HERO should conduct a comprehensive analysis of existing workplace surveillance efforts, including identifying existing gaps, by 2020.

Supporting Action 13.2: CDC should convene an expert advisory group of researchers, practitioners, and representatives from the Business and Industry Sector of the National Physical Activity Plan Alliance to review the analysis (see Supporting Action 13.1 above) and identify evidence gaps.

Supporting Action 13.3: The expert advisory group should develop questions, based on the gap analysis, that could be inserted in existing surveillance efforts in order to capture additional aspects of workplace physical activity, physical fitness, and active commuting.

Supporting Action 13.4: The expert advisory group, working together with CDC, should assess the processes and costs involved in adding new survey questions and analyzing the data.

Supporting Action 13.5: The expert advisory group should identify potential funders, both public and private, to support the expansion of existing surveillance systems and the analysis of the additional data collected.

Strategy 14: Convene public and private stakeholders to prioritize and implement consensus key measures[2] to assess individual-level physical activity, physical fitness, and sedentary behavior surveillance in the workplace.

Supporting Action 14.1: CDC, HERO, Population Health Alliance, and/or the American Heart Association should convene employers; vendors; health plans; state, tribal, and local public health agencies; and other salient stakeholders to obtain support for disseminating and using the consensus measures to assess physical activity, physical fitness, and sedentary behavior in worksites described in Whitsel et al. (2019).

Supporting Action 14.2: CDC, HERO, the National Physical Activity Plan Alliance, or the American Heart Association, in coordination with vendors and health plans, should develop toolkits and resources and help disseminate and implement these new measures.

Supporting Action 14.3: The Centers for Medicare & Medicaid Services, the National Quality Forum, and the National Committee for Quality Assurance should integrate these metrics into performance and quality measure development to create seamless delivery of care and health surveillance between the health care system and worksite health promotion, including optimal and consistent use of mobile health technologies. There should be purposeful integration between specific health care provider networks and employer-supported programming whenever possible to enhance surveillance applications and contribute to improved service delivery. The implementation impact of this integration should be studied by health services researchers and health care plans within the health care system and employer footprint.

Strategy 15: Develop consistent measures for physical activity in workplace designs and operations, policies, programs, culture, and climate, and use these measures in comprehensive surveillance of physical activity and physical fitness in the workplace.

[2] Described in Whitsel et al., 2019.

Supporting Action 15.1: CDC, HERO, or the American Heart Association should convene an expert advisory group of academics; employers; state, tribal, and public health agencies; and leading organizations to identify existing standards and develop a core set of evidence-based measures that support consistent adoption of healthier building standards (e.g., Fitwel, International Well Building Institute) by employers, architects, and real estate developers as well as other cultural, policy, and environmental support measures that promote active workplaces and active commuting. These measures should also capture the efficacy of outcomes-based incentives and other engagement strategies that employers use to motivate employees to be physically active in the context of program design and the health care plan.

Supporting Action 15.2: NIH, CDC, HERO, and Fitwel should support wide dissemination of the new measures to employers, vendors, health plans, researchers, and practitioners.

Strategy 16: Obtain longitudinal support and funding for the Workplace Health in America survey.

Supporting Action 16.1: Because of their experience implementing the most recent version of the Workplace Health in America survey, the Center for Health Promotion and Disease Prevention at the University of North Carolina at Chapel Hill, CDC, and RTI International should document the necessary resources required for longitudinal support and regular administration (i.e., at least every 5 to 10 years) of the survey.

Supporting Action 16.2: Advocacy organizations, such as the American Cancer Society Cancer Action Network, the American Heart Association, the Population Health Alliance, and Trust for America's Health, should partner with researchers; state, tribal, and local public health agencies; providers; health plans; and employers to communicate the benefits of the Workplace Health in America survey and garner support for future cycles of the survey.

Community Supports for Physical Activity

Strategy 17: Prioritize a set of constructs and corresponding survey items to assess perception of community supports for active transportation and active recreation, incorporate the constructs and survey items into national surveillance systems, and promote their use at the local level.

Supporting Action 17.1: CDC should convene an expert consensus group of multisector practitioners and academic stakeholders to prioritize a list of built and social environment constructs and corresponding survey questions that could be recommended for national, state, and local surveillance.

Supporting Action 17.2: CDC should communicate the prioritized survey items to national, state, and local public health agencies; planning agencies; and other multisector stakeholders that could implement them, so that the data from these levels are as aligned and consistent as possible.

Supporting Action 17.3: CDC should convene a broad intra-agency group to explore providing geographic identifiers at the highest resolution possible for respondents to the BRFSS and the YRBS, ideally at the block group, tract, or zip code level.

Supporting Action 17.4: CDC should recommend changes in Research Data Center (RDC) practices to facilitate wider access to geocoded NHIS survey data.

Strategy 18: Identify and compile GIS-based data sources and methods to facilitate national surveillance of community supports for physical activity.

Supporting Action 18.1: CDC should partner with the U.S. Environmental Protection Agency (EPA) Smart Location Database developers and the National Environmental Database (NED) developers for national surveillance of GIS sources of community supports for physical activity.

Supporting Action 18.2: The Joint Call to Action to Promote Healthy Communities should lead a consensus process to recommend GIS measures relevant to community supports for active transportation and recreation that could be adopted by local, state, and federal agencies.

Supporting Action 18.3: CDC should pursue low-cost opportunities to assemble a national GIS database of community supports data that are already collected at the local or state level but require compilation and harmonization.

Supporting Action 18.4: CDC should collaborate with the Joint Call to Action to Promote Healthy Communities to explore options

for collecting and compiling GIS data for small towns, rural areas, and tribal nations.

Strategy 19: Explore opportunities for partnering with professional organizations to query their membership about physical activity–supportive policies in the communities where they work and to share policy tracking data for surveillance purposes.

Supporting Action 19.1: CDC should facilitate partnerships with public health and non-health professional organizations to develop and implement surveys of their members about policies relevant to community supports for physical activity.

Supporting Action 19.2: CDC should collect policies and plans from advocacy organizations that already track policies and support those organizations in their data collection efforts.

Strategy 20: Develop and standardize methods for linking policies, self-reported surveillance systems, and environmental geospatial data to identify opportunities to support physical activity.

Supporting Action 20.1: CDC should establish partnerships between public health organizations and non-health organizations to use common geographic identifiers (GEOIDs) to link geospatial policy, self-reported surveillance systems, and environmental data.

Strategy 21: Identify a brief set of prioritized constructs and methods that could be assessed using audits (observations) of streets, parks, and other relevant public spaces.

Supporting Action 21.1: CDC should convene a multisector group of academics and practitioners to agree on constructs and items that should be assessed in nationwide observations of street designs, parks, and other physical activity environments, using standard instruments.

Supporting Action 21.2: CDC should organize a community of practice for investigators working on automated computer vision assessment methods that can be applied to physical activity–related variables. This community of practice should be supported to accelerate work on computer vision methodology that could be used for surveillance of street designs and parks.

Supporting Action 21.3: NIH, CDC, or NCCOR should design and fund a research program to sustain development of user-friendly apps and training/certification methods for use with citizen-science and crowd-sourced methods of collecting observational data. The research program should include strategies for partnerships that would facilitate national-scale data collection.

Strategy 22: Identify methods to assess physical activity events, programs, social environments, and promotion resources.

Supporting Action 22.1: NIH, CDC, or NCCOR should create a research program to develop and evaluate methods to assess high-priority physical activity events, programs, social environments, and promotion resources that could be used for surveillance purposes.

1

Introduction

Physical activity provides important health benefits to all segments of the population. These benefits, which are extensively documented in the 2018 Physical Activity Guidelines Advisory Committee Report (PAGAC, 2018), include reduced risk for development of multiple noncommunicable diseases such as heart disease, type 2 diabetes, breast cancer, and colorectal cancer (also see Box 1-1). Furthermore, physical activity provides numerous near-term benefits, and these include reduced risk for development of overweight and obesity, improved cardiorespiratory and muscular fitness in youth, reduced risk of falls in older persons, and improvements in several elements of brain health in children, adults, and older adults. Despite these documented health benefits and previous efforts to promote physical activity in the U.S. population, most Americans do not meet current public health guidelines for physical activity (CDC, 2014). Accordingly, the Centers for Disease Control and Prevention (CDC) has launched a multicomponent effort to increase population levels of physical activity through initiatives that target changes at the personal, institutional, and community levels (CDC, 2019).

Within public health, surveillance is the ongoing systematic collection, analysis, and interpretation of outcome-specific data, which can then be used for planning, implementation, and evaluation of public health practice (Thacker et al., 1988). Therefore, surveillance of physical activity is a core public health function that is necessary for measuring and analyzing population prevalence of physical activity, including participation in physical activity initiatives. Surveillance activities are guided by standard protocols and are used to establish baseline data and to track implementation and

BOX 1-1
Health Benefits Associated with Regular Physical Activity

Children and Adolescents

- Improved bone health (ages 3 through 17 years)
- Improved weight status (ages 3 through 17 years)
- Improved cardiorespiratory and muscular fitness (ages 6 through 17 years)
- Improved cardiometabolic health (ages 6 through 17 years)
- Improved cognition (ages 6 through 13 years)*
- Reduced risk of depression (ages 6 through 13 years)

Adults and Older Adults

- Lower risk of all-cause mortality
- Lower risk of cardiovascular disease mortality
- Lower risk of cardiovascular disease (including heart disease and stroke)
- Lower risk of hypertension
- Lower risk of type 2 diabetes
- Lower risk of adverse blood lipid profile
- Lower risk of cancers of the bladder, breast, colon, endometrium, esophagus, kidney, lung, and stomach
- Improved cognition*
- Reduced risk of dementia (including Alzheimer's disease)
- Improved quality of life
- Reduced anxiety
- Reduced risk of depression
- Improved sleep
- Slowed or reduced weight gain
- Weight loss, particularly when combined with reduced calorie intake
- Prevention of weight regain following initial weight loss
- Improved bone health
- Improved physical function
- Lower risk of falls (older adults)
- Lower risk of fall-related injuries (older adults)

NOTES: The Advisory Committee rated the evidence of health benefits of physical activity as strong, moderate, limited, or grade not assignable. Only outcomes with strong or moderate evidence of effect are included in this table. * = See Table 2-3 of the *Physical Activity Guidelines for Americans, 2nd Edition*, for additional components of cognition and brain health.
SOURCE: HHS, 2018.

evaluation of interventions, programs, and policies that aim to increase physical activity.

Physical activity is challenging to assess because it is a complex and multidimensional behavior that varies by type, intensity, setting, motives, and environmental and social influences. Accordingly, there is a need to develop and implement surveillance systems that effectively integrate measurement of specific physical activity behaviors (like walking) with assessment of environmental factors that influence physical activity behavior (such as the walkability of communities). This need is addressed in the U.S. National Physical Activity Plan (NPAPA, 2016) and was highlighted in "Step It Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities" (HHS, 2015).

STUDY BACKGROUND AND CONTEXT

To address concerns around the need for physical activity surveillance, in 2014 CDC collaborated with the American College of Sports Medicine (ACSM) to review the state of surveillance related to physical activity behavior, human movement, and community programs and policies that support physical activity initiatives. An outcome of the collaboration was the development of an overarching strategy to establish a national plan for physical activity surveillance, with the goal to enhance coordination and collaboration among sectors. Five strategic priorities to guide future physical activity surveillance in the United States were identified (Fulton et al., 2016) and are included in Box 1-2.

Subsequently, groups involved in the 2014 meeting, including CDC, ACSM, the National Institutes of Health (NIH), the American Heart Asso-

BOX 1-2
Strategic Priorities to Guide Future Physical Activity Surveillance in the United States, as Identified in Fulton et al. (2016)

1. Identify and prioritize physical activity constructs.
2. Assess the psychometric properties of instruments for physical activity surveillance.
3. Provide training and technical assistance for those collecting, analyzing, or interpreting surveillance data.
4. Explore accessing data from alternative sources.
5. Improve communication, translation, and dissemination about estimates of physical activity from surveillance systems.

ciation, and the National Physical Activity Plan Alliance, continued discussions about their shared interest in acting on the priorities identified (see Box 1-2). As a result, in April 2017, the Physical Activity and Health Innovation Collaborative, an ad hoc activity affiliated with the Roundtable on Obesity Solutions of the National Academies of Sciences, Engineering, and Medicine, served as the convener for a meeting of more than 40 experts who were brought together to identify specific actions that could improve physical activity surveillance in the United States and to suggest approaches for implementing those actions. The agenda and participant list can be found in Appendix D. The experts who attended the meeting represented four topical areas in which the needs and opportunities were seen as particularly significant: (1) children, (2) health care, (3) workplaces, and (4) community supports for active transportation. Throughout the 2-day convening, attendees identified a total of 23 recommended actions to advance surveillance of physical activity in specific population subgroups and to enhance monitoring of institutional and community supports that influence physical activity behaviors. A discussion paper was developed that provided the recommended actions that resulted from the convening (Pate et al., 2018 [see Appendix B for the full text of the discussion paper]).

STUDY PURPOSE AND APPROACH

As a follow-up to the April 2017 meeting, based on a request from CDC, a 7-member ad hoc committee was convened to develop strategies to support the implementation of the recommended actions to improve national physical activity surveillance that were identified in the discussion paper (Pate et al., 2018 [see Appendix B]). The committee's statement of task appears in Box 1-3.

As noted in the task, the committee was charged with convening a group of experts to examine and build on the existing recommended actions in the four topical areas (children, health care, workplaces, and community supports for active transportation). On November 1–2, 2018, as a way of helping the committee gather information, the committee held a public meeting for approximately 30 individuals with expertise in the four areas to discuss strategies for implementing actions to improve physical activity surveillance (see Appendix C for the open session agenda and the list of participants organized by the four subgroups). As a way of organizing the discussion based on the time available during the public meeting, the committee prioritized the recommendations in the discussion paper (Pate et al., 2018; Appendix B) in advance based on criteria listed in Box 1-4. As prescribed in the task, information gathered during the meeting of experts was the primary source of input that informed the committee's recommendations. It should be noted that the committee was not charged with

BOX 1-3
Statement of Task

An ad hoc committee will be convened to develop strategies that support the implementation of recommended actions to improve national physical activity surveillance. Specifically the committee will:

- convene a group of experts who will examine and build on existing recommended actions in four topical areas (children and youth, community supports for active transportation, health care, and workplaces) to identify specific strategies for implementing those recommended actions;
- provide guidance and oversight to a consultant who will develop tools to facilitate surveillance within the topical area of community supports for active transportation, that will include developing:
  - two brief sets of prioritized questionnaires to assess: (1) an individual's perceptions of community support for physical activity; and (2) members of a professional organization's design policies and zoning codes supportive of active transportation (the consultant will develop a validation protocol for the questionnaires).
  - two "how-to" protocols to: (1) identify, capture, and store Geographic Information System (GIS) data in a centralized location, and (2) automate the remote collection of audit data.

The committee will prepare a report of its findings and conclusions about strategies for implementing recommended actions to improve national physical activity surveillance. The report will include the questionnaires, and validation protocol and the "how to" protocols developed by the consultant. The committee's consensus report will be subject to standard National Research Council review procedures prior to release. Evaluation, validation, and testing of the questionnaires and protocols will not be carried out under the scope of this study. As part of dissemination, an all-inclusive manuscript (and/or separate manuscripts for each of the four topical areas) may be developed for submission to peer-reviewed publications.

conducting a formal search of the relevant scientific/professional literature, and such a search was not undertaken.

During the meeting, the four subgroups considered five questions regarding implementation of the recommended actions from the discussion paper (Pate et al., 2018; Appendix B), as seen Box 1-5.

Following the meeting, the committee drew on the participants' contributions and the meeting discussions, and used several overarching principles and guidance in its selection of strategies and implementing actions.

BOX 1-4
Criteria for Prioritization of the Recommended Strategies

Feasibility

- Is there a clear action?
- Is it likely that needed resources could be available?
- Is there a likely receptivity to the recommended strategy for those who will act on it?

Impact

- Is there potential for impacting practice (e.g., public health transportation, etc.)?
- Will the recommended strategy address a critical gap (as opposed to fine-tuning something that already exists)?
- Is there potential for information to be effectively communicated?

Overarching Principles

- The committee's work was intended to enhance the current physical activity surveillance system so that it is equitable and appropriately inclusive. Recognizing that there are wide disparities across demographic groups in both compliance with physical activity guidelines and access to physical activity resources, the committee's recommendations support a system that is as equitable as possible. Particular consideration was given to establishing surveillance protocols that include samples that are appropriately representative of the diverse U.S. population and its institutions and communities.
- Physical activity is a complex behavior and it is influenced by factors operating in a variety of settings. This concept is well conveyed by ecological models of behavior that, when applied to physical activity behavior, posits that activity is affected by layers of influence ranging from broad societal factors to those operating within and proximal to the individual person (Sallis et al., 2015). The committee's work, as delineated in the statement of task, was focused on one sub-population (children) and three settings (health care, workplaces, and community support for physical activity). Nonetheless, the committee approached its work recognizing that personal physical activity behavior is performed in the context of a system comprising unique settings that operate interactively. Accordingly, the recommendations for children considered all levels of the social-ecological model, and the recommendations for the

BOX 1-5
Approach for Discussing Recommendations from the Pate et al. (2018) Discussion Paper

In order to implement this strategy:

Is instrument development work required?
- If no, which existing instruments are strong candidates for application here?
- If yes, what is the nature of the instrument development work that is required?
- How should technological advances be reflected in the instruments used to address this strategy?

Could an existing surveillance system be modified?
- If yes, which system or systems are the best candidates?
- If no, what is the nature of the new system that is required?
- How should technological advances be applied in modifying or creating surveillance systems that would be used to address this strategy?

Which organizational actor or actors could implement this strategy?
- Is there a primary organizational candidate?
- Are there other organizations that could implement this strategy?

What financial and human resources are needed to implement this strategy?
- Could this strategy be implemented by redirecting existing resources?
- Are new resources required? If so, what could be the source of these resources?

Will it be necessary to mount an advocacy effort in order to implement this strategy?
- If so, which policy makers should be addressed?
- If so, which organizations could be effective advocates?

three specific settings considered influences on each setting from other settings and levels of the overall system.

- The major focus of this study was the creation of a more robust system for surveillance of physical activity to support public health practice by enhancing what is currently measured. Accordingly, the committee strove to consider the needs and interests of a broad array of stakeholders, collaborators, and professionals whose interests, skills, and needs would ultimately determine the extent to which the committee's recommendations would be acted upon. The committee recognized that, given the complexity of physical

activity behavior, a comprehensive surveillance system can only be successful only if a diverse set of key partners participate in the design of the system, and then act to implement enhancements.

Guidance

- Surveillance often involves collection of sensitive information. The committee's recommendations are intended to be implemented in a manner that is legal, ethical, and properly attendant to personal, institutional, and community confidentiality.
- To enhance the utility of surveillance as a component of public health practice, the committee's recommendations are intended to expand the availability of physical activity information at the state, tribal, and local levels, as well as at the national level.
- Though delimited by the components of physical activity surveillance that were specified by the statement of task, the committee's work was undertaken with the awareness that there are needs and opportunities to enhance physical activity surveillance in other areas. These include population subgroups other than children and settings including the home, faith-based organizations, and educational institutions.
- The committee's work took place during a time of dynamic change and technological advances related to methods of data collection. Important innovations include broad application of biometry in the population and advances in methods for analysis of "big data." The committee's recommendations are intended to be forward looking and to strategically leverage new technology.
- Current physical activity guidelines call for regular participation in multiple types of physical activity including large muscle, whole-body physical activity of moderate-to-vigorous intensity; resistance exercise to enhance muscular strength; bone-loading activity to promote skeletal health; and, in older persons, movements that enhance balance. The committee's recommendations are intended to address surveillance of participation in all those types of physical activity.
- The committee's recommendations are intended to be feasible for implementation in the near term. While financial investments will be required to implement some of the recommendations, the committee's intent was to minimize the need for new investments and optimize use of existing resources. Multiple stakeholders will be asked to share data, make new investments, and reallocate existing resources.
- Although the focus of this study is on creating a more robust physical activity surveillance system to support public health practice,

the committee's recommendations are also intended to support research on the public health implications of physical activity.

Development of the Recommendations

The committee's recommendations were developed in two phases. First, the committee identified four to six key strategies for each of the four topical areas. In addition to the November 2018 public meeting, two additional sources informed the committee's selection of these strategies, including the recommendations from the 2014 CDC-ACSM expert panel (Fulton et al., 2016) and the Pate et al. (2018) discussion paper that resulted from the April 2017 expert convening (see also Appendix B). Ultimately, 22 strategies were selected for inclusion in this report: 6 for children, 6 for health care, 4 for workplaces, and 6 for community supports for physical activity.

Second, drawing on their individual expertise as well as the ideas shared during the November 2018 meeting, the committee identified specific actions to support implementation of each strategy in the four topical areas. In the identification process, committee applied several criteria to the implementation actions. First, each supporting action was intended to be attainable within a 2- to 3-year period. Second, an "actor," typically an organization or agency, was to be specified. Third, each supporting action was intended to make a unique and important contribution to attainment of the strategy. Each supporting action was to be phrased concisely, with additional detail provided for clarification as needed. A total of 59 implementation actions were identified: 16 for children, 16 for health care, 12 for workplaces, and 15 for community supports for physical activity.

The committee's task also included providing guidance and oversight to a consultant hired to develop tools to facilitate surveillance, specifically within the topical area of community supports for active transportation, including prioritized questionnaires and "how-to" protocols. The reports developed by the consultant are in Appendix E. The reports do not necessarily reflect the opinions of the committee and served as additional pieces of evidence that informed the committee in its development of the strategies and supporting actions for implementation.

ORGANIZATION OF THIS REPORT

This report is organized into chapters that present background information followed by the recommended strategies and actions for implementing national physical activity surveillance in the four topical areas: children (Chapter 2), health care (Chapter 3), workplaces (Chapter 4), and community supports for physical activity (Chapter 5). Appendix A is a glossary of acronyms and terms used in the report. Appendix B contains the

agenda, participant list, and discussion paper for the April 2017 convening. Appendix C contains the open session agenda and participant list for the November 2018 public meeting that informed the committee's deliberations. Appendix D provides a table of surveillance systems. Appendix E contains the consultant's reports, and Appendix F includes biographical sketches of the committee members.

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2

Children

INTRODUCTION

The health benefits of physical activity in children are strongly supported by evidence. To illustrate, the 2018 Physical Activity Guidelines Advisory Committee conducted an extensive review of the evidence on the relationship between physical activity and health outcomes in school-age children (ages 6 to 17 years). The committee concluded that higher levels of physical activity are associated with better cardiorespiratory and muscular fitness, lower risk of excessive weight gain, more favorable cardiometabolic risk profiles, and bone health. Furthermore, for preschool-age children (ages 3 to 5 years) the Advisory Committee concluded that higher levels of physical activity are associated with bone health and lower risk of excessive weight gain (PAGAC, 2018). Accordingly, the *Physical Activity Guidelines for Americans, 2nd Edition,* recommends that preschool-age children should be active throughout the day and accumulate at least 3 hours of total physical activity (light, moderate, or vigorous intensity) per day. Furthermore, the guidelines recommend that school-age children should accumulate at least 60 minutes per day of moderate-to-vigorous physical activity and should regularly engage in vigorous intensity, bone-loading, and muscle strengthening activities (HHS, 2018).

Ecological models of behavior suggest that behaviors such as physical activity are influenced by a variety of factors spanning contextual levels of analysis ranging from the individual level to the organizational/environmental level (Sallis et al., 2015). Accordingly, youth physical activity surveillance strategies may assess status, availability, and accessibility of physical activity

behaviors, programs, and environments at the (1) *individual level* such as the volume of physical activity (i.e., intensity duration, frequency), specific forms of physical activity (e.g., walking to and from school, team sports), and objectively measured levels of physical activity (e.g., accelerometer); and (2) *organizational level* such as physical activity policies, programs, and environments in school and non-school contexts, including child care settings and community-based organizations. The strategies and actions for implementing physical activities surveillance in youth outlined below map onto one or both of these levels of analysis.

The needs for high-quality nationally representative physical activity surveillance data on youth are many-fold. One important application of ongoing and current surveillance data is to compare children's activity levels with the levels recommended in the guidelines. A second application is to uncover sociodemographic disparities (e.g., pinpointing subgroups that fall short of physical activity recommendations). A third application is to identify critical areas of policy or programmatic need by highlighting behaviors or environments (e.g., lack of standardized physical activity programming in preschools) that require input from government and organizational bodies. Finally, surveillance data on children's physical activity can be used to as a tool to assess and evaluate the impact of interventions and policies to promote physical activity.

STRATEGIES AND ACTIONS FOR IMPLEMENTATION OF PHYSICAL ACTIVITY SURVEILLANCE IN CHILDREN

Strategy 1

Develop and implement state- and national-level systems for monitoring physical activity policies and practices in early child care and early childhood education settings.

Background

Ensuring that children of preschool age (3 to 5 years of age) attain adequate levels of physical activity is critical for the prevention of chronic diseases (e.g., hypertension, type 2 diabetes) during the child and young adult years (Strong et al., 2005; Timmons et al., 2012; Tammelin et al., 2014). Millions of young American children spend several hours per day in structured child care settings. Their physical activity levels in these settings are influenced by certain physical activity policies and practices (Dowda et al., 2009). Accordingly, multiple entities have recommended that early child care and education programs adopt policies and instructional practices that

are known to promote higher levels of physical activity among children in these settings (American Academy of Pediatrics et al., 2012). For example, it has been recommended that child care providers adopt physically active teaching–learning strategies, provide children with substantial amounts of outdoor play time, and include teacher-led physical activities as standard practice (McWilliams et al., 2009; Larson et al., 2011; Pate et al., 2016). In addition, the Institute of Medicine (IOM) recommended that "Child care regulatory agencies should require child care providers and early childhood educators to provide infants, toddlers, and preschool children with opportunities to be physically active throughout the day" (IOM, 2011).

Findings

Researchers have summarized state regulations pertaining to physical activity policies and practices in child care centers (Duffy et al., 2014; Benjamin-Neelon et al., 2018) and the Centers for Disease Control and Prevention (CDC), in collaboration with the National Resource Center, has summarized these regulations (CDC, 2016). However, these reviews have been conducted irregularly and not as part of an ongoing surveillance process. Furthermore, practices to promote children's physical activity in child care settings have not been monitored in the context of a national surveillance system. However, such a monitoring system is in development at CDC. The agency has produced an instrument for soliciting information from directors of child care settings, and has made preparations for pilot-testing that instrument with representative samples of directors of child care settings in a small number of states. CDC is developing instruments and procedures that may be pilot-tested, refined, and incorporated into a comprehensive national surveillance system for monitoring state regulations and center-level practices in all states.

Supporting Actions for Implementation

The committee proposes the following actions to improve national physical activity surveillance:

> ***Supporting Action 1.1:*** **CDC should implement a system for monitoring existing state-level policies for the promotion of physical activity in child care settings.**

> ***Supporting Action 1.2:*** **CDC should incorporate the existing procedures for describing and assessing state regulations pertinent to promotion of children's physical activity in child care settings into**

a comprehensive surveillance system that monitors both pertinent state regulations and setting-level practices in all the states.

Supporting Action 1.3: **CDC should implement a national system for monitoring the implementation of physical activity practices at the child care center level.**

The goal of this national system would be to track practices implemented by child care centers that ensure children are physically active at levels recommended by federal physical activity guidelines. CDC is developing instruments and procedures that may be pilot-tested, refined, and incorporated into a comprehensive surveillance system for monitoring state regulations and center-level practices in all the states.

Strategy 2

Enhance existing surveillance systems for monitoring elementary through high school–based physical activity policies and programs.

Background

School is a critical context for physical activity promotion as children spend a substantial amount of time in this setting, and it offers the opportunity to deliver comprehensive programming that reaches large numbers of children (Story et al., 2009). The Institute of Medicine's *Educating the Student Body: Taking Physical Activity and Physical Education to School* recommends that school-based policies and practices be implemented to ensure that all K–12 students have the opportunity to participate in at least 60 minutes of physical activity during each school day (IOM, 2013). CDC's *School Health Guidelines to Promote Healthy Eating and Physical Activity* provides empirically supported strategies to achieve physical activity during the school day, such as requiring daily physical education and recess, providing other physical activity breaks, offering students the opportunity to participate in after-school sports, and implementing walk-/bike-to-school programs (CDC, 2011). Implementation of these types of physical activity policies and practices varies drastically across states, districts, schools, and classrooms. Regular surveillance of school-based policies and practices that support physical activity is necessary for policy makers and educators to make informed decisions about where to target efforts.

Findings

Federally supported school-based assessment efforts currently provide a comprehensive assessment of school health policies and practices. The School Health Policies and Practices Study (SHPPS) is a national survey periodically conducted by CDC to assess school health policies and practices at the state, district, school, and classroom levels (CDC, 2012). The Classification of Laws Associated with School Students (CLASS) includes codified data on state-level laws related to physical activity from 2003 to 2015 (NIH, 2018), but it was not designed to be a surveillance system. Furthermore, it was a limited-time project funded by the National Cancer Institute (NCI), and data have not been updated since 2015. Plans for NCI to continue funding CLASS are uncertain.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

> ***Supporting Action 2.1:*** **CDC should reduce the number and scope of physical activity–related items in the SHPPS so that it can be administered every 2 years.**

SHPPS has many survey questions that assess nuanced aspects of school-based physical activity policies and programs. Many of these data are never analyzed nor reported by schools. CDC can streamline the SHPPS survey by prioritizing questions that collect the most critical information, based on what was included in previous CDC reports on SHPPS data. By limiting the length and scope of the SHPPS survey, CDC may be able to refocus resources on administering SHPPS more frequently over the next 5 to 10 years.

> ***Supporting Action 2.2:*** **CDC, in partnership with NCI, should modify CLASS protocol to codify available information about state-level and school-based physical activity laws and policies. This protocol should be integrated into the SHPPS to form a single, comprehensive surveillance system administered by CDC.**

In partnership with NCI, CDC could modify the CLASS protocol into a comprehensive surveillance system that codifies available information about state-level, school-based physical activity laws and policies. This protocol could then be integrated into the

ongoing SHPPS surveillance efforts conducted by CDC to address the gap left by the elimination of the state-level SHPPS survey.

Supporting Action 2.3: **CDC should develop an accessible, user-friendly system for connecting SHPPS and CLASS data with individual-level data on physical activity from the Youth Risk Behavior Survey (YRBS). CDC should attempt to create an accessible, user-friendly system for linking these state-, district-, and school-level data.**

Such a system would link state-, district-, and school-level data on the availability and implementation of school-based physical activity policies and programs with individual-level data (e.g., minutes of moderate-to-vigorous physical activity per day). These linked data could be made available to the public through a central repository to facilitate use by researchers and key stakeholders, which is feasible with existing technology. A system such as this will enable researchers, educators, and decision makers to assess the extent to which, the conditions under which, and the mechanisms through which physical activity policies and programs influence children's physical activity levels. It will also be useful to comprehensively evaluate the effectiveness of school-based physical activity policies and programs. Continuous evaluation is needed to guide program improvements, which increase physical activity levels of children.

Strategy 3

Develop a protocol that leverages ongoing administration of physical fitness tests, such as FitnessGram, for the purpose of monitoring fitness levels of children and youth.

Background

Physical fitness refers to the body's ability to function efficiently and effectively in physically demanding activities. Components of physical fitness include agility, balance, body composition, cardiovascular endurance, coordination, flexibility, muscular endurance, and muscular strength. Higher levels of physical fitness in children are linked to numerous health and developmental benefits, including lower cholesterol, lower blood pressure, lower risk of overweight/obesity, and greater academic achievement (Castelli et al., 2007; Janssen and LeBlanc, 2010). To improve and maintain key components of physical fitness, the *Physical Activity Guidelines for*

Americans, 2nd Edition, recommends that children engage in vigorous-intensity aerobic activity at least 3 days per week, muscle-strengthening activities at least 3 days per week, and bone-strengthening activities at least 3 days per week (HHS, 2018). Monitoring physical fitness data in youth is useful as an assessment tool of individual health, for program evaluation and improvement of school-based physical education and sports, and understanding military preparedness.

Findings

Between the 1950s and 1980s, components of physical fitness were regularly assessed in nationally representative samples of children through programs such as Presidential Physical Fitness Testing and Awards (Pate, 1983). However, since the 1980s, national surveillance of children's physical fitness has been limited. In 2012, the National Health and Nutrition Examination Survey (NHANES) National Youth Fitness Survey (NNYFS) conducted assessments of muscle strength and fitness in a nationally representative sample of children ages 3 to 15 years. However, the NNYFS was a one-time assessment. There is not currently a national surveillance system that routinely assesses physical fitness in children. A coordinated surveillance approach that uses a common set of assessments across a range of populations would enhance the link between research and practice.

In many schools across the United States, the Presidential Physical Fitness Testing program has been replaced by FitnessGram, a health-related fitness assessment and reporting program for children developed by The Cooper Institute. FitnessGram tests are conducted by school physical education teachers to assess cardiovascular fitness, muscle strength, muscular endurance, flexibility, and body composition. Using proprietary FitnessGram software, schools can create personalized fitness reports for each student. Schools may also report FitnessGram data to a national database managed by The Cooper Institute. Although FitnessGram offers a comprehensive and well-validated system for assessing key components of physical fitness, it was not designed to be a national surveillance system. Schools opt in, which creates a patchwork of data that is incomplete and often not representative.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

> ***Supporting Action 3.1:*** **CDC should incorporate a validated fitness assessment protocol into each NHANES cycle and target it to a representative subsample of children ages 10 years and older.**

Assessments of cardiovascular fitness and muscular strength could be conducted through existing community-based sampling procedures using the NHANES Mobile Examination Center (MEC), as was done for the 2012 NNYFS.

Supporting Action 3.2: **CDC should incorporate fitness testing as an add-on module to the YRBS.**

A fitness testing protocol could be incorporated into the YRBS as an add-on module conducted each year by YRBS data collectors or trained physical education teachers. A nationally representative subsample of high schools participating in YRBS could be selected to implement the fitness assessment protocol using low-cost assessment strategies, such as a progressive shuttle-run test or standing long jump.

Supporting Action 3.3: **CDC or The Cooper Institute should develop a nationally representative sampling strategy to collect and analyze FitnessGram data from selected school districts.**

School districts could be selected (from those already conducting FitnessGram assessments) to participate in a nationally representative sample. Selected schools would share FitnessGram data with a national coordinating center, potentially run by CDC or The Cooper Institute, that would apply appropriate sample weights to generate national estimates for physical fitness indicators.

Strategy 4

Expand objective monitoring of physical activity in children (ages 3 to 18 years) by incorporating validated wearable technologies into existing surveillance systems.

Background

The only regularly administered surveillance system that monitors children's compliance with physical activity guidelines is the Youth Risk Behavior Surveillance System (YRBSS), which is limited to self-reported physical activity in high school students (Brenner et al., 2003). NHANES has included device-based measures of physical activity in two survey cycles. The waist-worn monitor was used in the 2003–2004 and 2005–2006 cycles, and the data it collected were used to determine compliance with the *Physical*

Activity Guidelines for Americans in children ages 6 to 17 years (Troiano et al., 2008). The wrist-worn monitor was used in the 2011–2012 and 2013–2014 cycles, but because of limitations in data-reduction procedures, those data have not been used to determine compliance with the guidelines.

Findings

Algorithms that transform raw accelerometry data from wrist-worn monitors into metrics can be used to indicate compliance with guidelines. In addition to developing these algorithms, it would be helpful to incorporate device-based measurement of physical activity in children into an existing national surveillance system. If collected and reported in appropriate terms, these physical activity data would allow assessment of population-level compliance with guidelines for children at each 1-year age increment between 3 and 18 years of age.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 4.1: **CDC or NCI should convene an expert panel to identify specific procedures for transforming raw accelerometry data from wrist-worn monitors into metrics that indicate adherence with guidelines for children (ages 3 to 18 years).**

The purpose of this action is to ensure that wrist-worn accelerometer data can be interpreted for children and converted easily from its raw form. These procedures could include algorithms to derive physical activity intensity levels as well as computational strategies to estimate and adjust for measurement error. For the latter area, measurement error methods and models developed for other health behaviors could be applied to physical activity.

Supporting Action 4.2: **CDC's National Center for Health Statistics (NCHS) should include device-based measurement of physical activity in children (ages 3 to 18 years) in NHANES, at regular intervals not longer than 10 years.**

Although more frequent assessment is preferable, the burden of costs for devices and data processing need to be taken into consideration.

Strategy 5

Develop a system for monitoring community-level availability of organized sports and other physical activity programs for children.

Background

Youth sports and other organized physical activity programs are important opportunities for children to be physically active. Authoritative organizations endorse the participation in high-quality sports programs (Elster and Kuznets, 1994; Committee on Sports Medicine and Fitness and Committee on School Health, 2001; NPAPA, 2016). While the doses of physical activity associated with sports participation vary considerably across types of activity (e.g., soccer versus baseball/softball) (Leek et al., 2011), it has been shown that, in general, children who participate in sports programs tend to be more physically active than their non-participating peers (Pate et al., 2000; Harrison and Narayan, 2003; Walters et al., 2009).

A majority of U.S. children participate in organized sports programs (CDC, 2017; The Aspen Institute: Project Play, 2017); only 15 percent of children in the 3rd to 12th grades report never having participated in a sports program (Sabo and Veliz, 2008). Prevalence of participation in youth sports programs decreases markedly as children transition from childhood to adolescence (Seefeldt et al., 1992; Harris, 2000; Sabo and Veliz, 2008), and drop-out rates are higher in girls than boys (Sabo and Veliz, 2008). These observations suggest that preventing drop-out from sports programs could be expected to lessen age- and gender-related declines in physical activity.

Findings

Previous surveillance efforts have assessed participation in organized sports and physical activity programs, with varying levels of detail and specificity. The National Federation of State High School Associations has monitored high school students' participation in inter-scholastic sports programs for many years (NFHS, 2017). Some surveys of participation in sports programs have been conducted within the context of national surveillance systems (CDC, 2017; HRSA, 2017), and others have been undertaken by nongovernmental education and trade groups (Sabo and Veliz, 2014; Physical Activity Council, 2018; Sports and Fitness Industry Association, 2018). These studies have indicated that participation rates in sports programs differ across demographic and geographic groups (Walters et al., 2009). Moreover, the availability of sports programs may vary markedly

across neighborhoods, municipalities, counties, states, and regions in the United States. No existing surveillance system monitors the availability of organized sports and other physical activity programs for children at these jurisdictional levels. Ongoing assessment of these community-based physical activity opportunities for youth at the local- and county-levels can identify disparities and fluctuations in program availability to stimulate public and private investment.

Supporting Actions for Implementation

The committee proposes the following actions to improve national physical activity surveillance:

Supporting Action 5.1: **The National Institutes of Health (NIH), CDC, or the National Collaborative on Childhood Obesity Research (NCCOR) should convene an expert panel to develop a survey instrument and sampling protocol to monitor the availability and nature of community-based sport and physical activity programs for children. The panel should include representatives of national organizations that provide such programs, including the National Recreation and Park Association (NRPA), The Y, Boys and Girls Clubs, and sport-specific federations, as well as epidemiologists with expertise in sampling and development of surveillance systems.**[1]

NRPA, because it represents publicly supported local agencies that provide children's sport and physical activity programs in communities across the nation, may consider testing a procedure for monitoring the availability and nature of community-level programs in a representative sample of its local affiliates.

Supporting Action 5.2: **A nongovernment entity or consortium of nongovernmental organizations, funded by foundations, the participating organizations, or a unit of CDC (e.g., NCHS; Division of Adolescent and School Health; Division of Nutrition, Physical Activity and Obesity), should conduct a comprehensive nationwide survey of the availability of community-based sport and physical activity programs for children, using the survey instrument and sampling protocol recommended above. In the long term, a refined**

[1] Also see Chapter 5, Supporting Action 22.1.

survey protocol should be incorporated into a national surveillance system.[2]

Strategy 6

Identify features of the built environment that are most likely to influence physical activity in children, and embed an assessment of the perceived availability and use of these features into existing surveillance systems.

Background

The built (i.e., physical) environment and its influence on children's physical activity levels has been the subject of much research in recent years. Several systematic and comprehensive literature reviews have identified key features of built environments that are associated with children's physical activity, such as recreational infrastructure, transport infrastructure, and safety/crime (Davison and Lawson, 2006; Ding et al., 2011; McGrath et al., 2015). Although much of the research has focused on objective assessments of built environment features (using Geographic Information Systems [GISs] and Global Positioning Systems [GPSs]), a growing emphasis has been placed on how individual perceptions (i.e., subjective evaluations) of the built environment may influence physical activity in children (Duncan et al., 2005). It is common for subjective and objective assessments of physical activity environments to differ (Ball et al., 2008), and evidence suggests that perceived availability of physical environment resources (in the home, neighborhood, and school) are associated with physical activity in children (Fein et al., 2004). National-level surveillance of the quantity and quality of built environment features that support children's physical activity can inform environmentally related policies and interventions to promote physical activity in children.

Findings

Assessing individual perceptions of environmental supports for children's physical activity may be a promising approach to nationwide surveillance on this topic. Although research on this topic is limited, one area that has received some attention is parental concerns about neighborhood safety. Such concerns are related to lower physical activity levels in children (Weir et al., 2006; Carver et al., 2010). Currently, national surveil-

[2] Also see Chapter 5, Supporting Action 22.1.

lance systems such as the National Survey of Children's Health (NSCH) assess parental perceptions of neighborhood features that may be related to children's activity levels, including the perceived availability of parks and playgrounds, sidewalks and walking paths, and recreation centers (NSCH, 2018). The NSCH also assesses parental perceptions of neighborhood disorder (e.g., litter, broken windows, and graffiti). However, there is not a coordinated effort to comprehensively assess perceived environmental features related to children's physical activity (either within or across various national surveys), making it difficult to generate national estimates.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 6.1: **CDC and NCHS should develop a comprehensive list of the perceived built environment features and constructs that are currently measured in surveillance systems such as NSCH and the National Health Interview Survey (NHIS).**

This effort will identify any unnecessary overlap (in which cost-saving reductions can be made) and critical gaps (to which relevant items can be added).

Supporting Action 6.2: **NIH, CDC, or NCCOR should convene an expert panel of researchers, practitioners, educators, and planners to identify features of the built environment that are most relevant for children's physical activity.**[3]

Empirical evidence and expert judgment may inform the panel's conclusions. The built environment features that are identified may serve as targets of national surveillance efforts.

Supporting Action 6.3: **NCHS and the U.S. Census Bureau should embed into one or more national surveillance systems a short list of validated items assessing perceived built environment supports for children's physical activity.**[4]

Built environment features related to children's physical activity may be assessed through parental proxy for children ages 2 to 12

[3] Also see Chapter 5, Supporting Action 17.1.
[4] Also see Chapter 5, Supporting Action 17.2.

years old and through self-report for children ages 13 to 18 years old. Examples of national surveillance systems to which such items could be added include NHANES, YRBS, NSCH, and NHIS.

CONCLUSION

The health benefits of physical activity in children are supported by strong and increasing evidence, which paved the way for the recommendations in the *Physical Activity Guidelines for Americans, 2nd Edition,* released in 2018. National surveillance enables a comparison of children's current physical activity levels with recommended levels, and can also reveal sociodemographic disparities and inequities in children's physical activity opportunities. Surveillance data are also vital for evaluating the availability, accessibility, and impact of programs, policies, and environments that promote physical activity among children. These data also help shape new interventions and policies that seek to improve physical activity prevalence. The 6 strategies and 16 implementation actions presented in this chapter will promote high-quality surveillance of physical activity in children and ultimately improve children's physical activity levels so they are more closely aligned with the *Physical Activity Guidelines for Americans*.

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3

Health Care

INTRODUCTION

Promoting physical activity in health care settings is a promising strategy to improve population health. Health care providers are trusted and effective advocates for promoting physical activity as part of their standard practices (Lobelo Garcia de Quevedo, 2016). The average individual in the United States visits a primary care provider 2.8 times per year (CDC/NCHS, 2012). These visits provide valuable opportunities to assess physical activity levels and advise patients to be physically active.

Despite the well-defined health risks of being physically inactive, rates of health care provider assessment and advice for inactivity are low (Blair, 2009). Only 32.4 percent of American adults report having been advised for physical activity by their health care provider in the past year (Barnes and Schoenborn, 2012). Notably, 41 percent of obese American adults report never having been advised for physical activity by their health care provider (Barnes and Schoenborn, 2012).

Challenges to routine physical activity assessment and counseling in primary care medicine include competing demands and time management. Face-to-face time between a physician and patient averages 7.6 minutes per office visit, during which questions, concerns, management of acute and chronic conditions, and preventive care must be addressed (Nathan et al., 2017). Efforts to make it simple for the physician and other members of the health care team to address physical activity are essential. This includes expanded use of a physical activity vital sign (PAVS), assessment of minutes per week of self-reported physical activity, and integration of objectively

measured physical activity through wearable devices into the electronic health record (EHR) and clinical workflow (Lobelo et al., 2018).

Critical gaps remain in our understanding of physical activity promotion in health care settings, including

- What are the key components of a physical activity prescription?
- How do patients implement a physical activity prescription?
- How does prescribed physical activity have an impact on health outcomes?
- What measures are appropriate for performance and quality, and for insurance coverage determinations?

As a health care quality measure, measurement or surveillance of physical activity assessment and counseling by health care providers is ongoing for care provided to children and adolescents, and older adults. However, it remains a measurement gap for care provided to the largest segment of the U.S. population, those aged 18 to 64 years. It is during these years of life that regular physical activity can have a significant impact on risk of chronic disease. Ongoing surveillance of physical activity assessment and counseling by health care providers, and the resultant physical activity performed by patients, provides a lens to better understand the strength of their association, enhancing future efforts in health care.

STRATEGIES AND ACTIONS FOR IMPLEMENTATION OF PHYSICAL ACTIVITY SURVEILLANCE IN HEALTH CARE

Strategy 7

Develop surveillance systems to monitor the prevalence of physical activity assessment in adults through expanded integration of a standard physical activity vital sign (PAVS) in health care delivery.

Background

The PAVS is an important prompt for health care providers to discuss physical activity in the context of a patient's health and health care. The PAVS has been defined as minutes per week of self-reported moderate to vigorous physical activity (MVPA), and has been integrated into commercially available EHRs (Sallis et al., 2016). Additionally, the PAVS has been found to be a valid measure of MVPA (Ball et al., 2016). The PAVS is collected by a clinical assistant and recorded in the EHR, where it can be interpreted by the physician, who can then provide physical activity advice

and a prescription. Similar to other vital signs (e.g., weight, blood pressure), the PAVS is collected at every visit.

The PAVS has been successfully implemented in several health care systems (Golightly et al., 2017). A study of 2.1 million adult patients from Kaiser Permanente in Southern California demonstrated that within the first year of implementation, the health care system was able to capture a PAVS on 85 percent of eligible patients. As a vital sign, physical activity level can be measured and monitored over time, facilitating more comprehensive and personalized counseling initiatives.

Widespread adoption of the PAVS will require multiple stakeholders to come together, including health care organizations, EHR vendors and information technology professionals, and quality assurance organizations (e.g., National Committee for Quality Assurance [NCQA], National Quality Forum [NQF]).

Findings

There is inconsistency in how physical activity is assessed and documented within EHRs, especially in regard to self-reported physical activity intensity. While a matrixed approach assessing minutes of light, moderate, and vigorous activity is likely a more accurate reflection of energy expenditure, it would take more time to administer at the point of care.

The PAVS is a valid measure of adult aerobic physical activity, and has been successfully implemented in a limited number of settings. There are a lack of standards for documentation of the PAVS in EHRs, and there are no standards for assessment and documentation of muscle-strengthening exercise/activities. Broad implementation will require partnership among key stakeholders.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

> ***Supporting Action 7.1:*** **An expert panel, including representatives from the Centers for Disease Control and Prevention (CDC), other federal and state agencies, academic partners, and/or medical professional organizations (e.g., American Heart Association, Exercise is Medicine), should develop standards for documentation of the PAVS in the EHR. The PAVS should assess both aerobic physical activity (minutes per week) and muscle-strengthening exercise/activities (sessions per week) in accordance with the *Physical Activity Guidelines for Americans, 2nd Edition*.**

Supporting Action 7.2: **An expert panel, including representatives from CDC, other federal and state agencies, academic partners, and/or medical professional organizations (e.g., American Heart Association, Exercise is Medicine), should develop a survey to monitor health care systems' use and integration of PAVS into EHRs.**

Such a survey could be deployed by the Office of the National Coordinator (ONC) for Health Information Technology (HIT).

Supporting Action 7.3: **An expert panel, including representatives from CDC, other federal and state agencies, and academic partners, should develop measurement error correction models (or one model) that would serve to reduce and equalize measurement error incurred from a standardized patient PAVS administered by self-report.**

Correcting and standardizing measurement error of a self-report surveillance instrument would allow surveillance of and studies using physical activity in health care to be comparable among systems.

Strategy 8

Develop surveillance systems to monitor the prevalence of physical activity assessment and promotion among children through integration of a standard pediatric physical activity vital sign (PedsPAVS) in health care delivery.

Background

The rapidly increasing prevalence of obesity among children is one of the most challenging dilemmas facing pediatricians. Diet and physical activity play a critical role in energy balance across the lifespan. As children age, their likelihood of achieving recommended levels of physical activity declines (Troiano et al., 2008). A 2008 study found that 42 percent of children 6 to 11 years of age achieved 60 minutes of physical activity per day, dropping to 8 percent among children 12 to 15 years of age, and 7.6 percent among children 16 to 19 years of age (Troiano et al., 2008).

Children see their primary health care provider on a regular basis until adolescence to receive age-appropriate immunizations and assess growth

and development. Visit frequency tends to taper off considerably as children enter adolescence, when they are at even greater risk for developing unhealthy lifestyle habits (Uddin et al., 2011).

The NCQA quality measure, "Weight assessment and counseling for nutrition and physical activity for children/adolescents," assesses the percentage of commercial insurance members 3 to 17 years of age who had an outpatient visit with primary care practitioner (PCP) or obstetrician/gynecologist and who had evidence of body mass index (BMI) percentile documentation, counseling for nutrition, *and* counseling for physical activity during the measurement year (NCQA, 2018). Performance on this measure reveals that the percentage of children enrolled in commercial health plans who received physical activity counseling (47.8 to 60.6 percent) lags behind counseling for nutrition (52.9 to 67.1 percent), and BMI percentile assessment (56.6 to 72.5 percent) (NCQA, 2018). Furthermore, data from the National Ambulatory Medical Care Survey (NAMCS) indicate that provider education and counseling for lifestyle behaviors in children and adolescents were implemented at a low level (Hammig and Jozkowski, 2015). This likely reflects a variety of factors that include physician training and self-efficacy for physical activity counseling, clinical workflow and tools to aid in physical activity assessment, and the inherent challenge of asking a child how many minutes of MVPA he or she engaged in over a given time frame.

Few clinical assessment and documentation tools for child physical activity have been developed (Berlin et al., 2006; Joy and Lobelo, 2017). Objective measurement of physical activity in youth is promising, although its integration is not yet a standard in health care (Berlin et al., 2006).

Findings

Physical activity counseling for children and adolescents is an important health care quality measure. Documented rates of physical activity counseling lag behind rates of both nutrition counseling and documentation of BMI percentile. There is a lack of tools and clinical workflow in support of physical activity counseling, as well as inconsistency in how children's physical activity is assessed and documented within EHRs. While a matrixed approach assessing minutes of aerobic, muscle-strengthening, and bone-strengthening activity is likely a more accurate reflection of energy expenditure, it would take considerably more time to administer at the point of care. Additionally, the ability of a child to accurately self-report physical activity remains a significant question.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 8.1: **An expert panel with representatives from CDC and medical professional organizations (e.g., American Academy of Pediatrics, Exercise is Medicine) should develop an instrument—a PedsPAVS—to assess, document, and support pediatric physical activity promotion in health care settings. The PedsPAVS should quantify aerobic, muscle-strengthening, and bone-strengthening activities in accordance with the *Physical Activity Guidelines for Americans, 2nd Edition*.**

Supporting Action 8.2: **An expert panel with representatives from health care organizations, EHR vendors, and medical professional organizations should develop and implement a protocol to assess youth physical activity with a PedsPAVS.**

Supporting Action 8.3: **Health care systems and EHR vendors should integrate PedsPAVS and documentation of physical activity counseling into the EHR.**

The primary role of the PedsPAVS is to prompt health care providers to discuss the importance of physical activity in child health and wellness. Documentation standards for physical activity assessment and counseling support existing health care quality measures, identify gaps in clinical practice, and can promote improvements in clinical care.

Supporting Action 8.4: **An expert panel with representatives from CDC, other federal and state agencies, academic partners, and/or medical professional organizations (e.g., American Academy of Pediatrics, Exercise is Medicine) should develop a survey to monitor health care systems' use and integration of PedsPAVS into EHRs.**

Such a survey could be deployed by ONC for HIT, whose function is to develop, maintain, and report on measurable outcome goals for health information technology.

Strategy 9

Expand the use of data from wearable devices for monitoring physical activity in at-risk patients.

Background

Wearable physical activity devices present health care organizations with an opportunity to engage and monitor an increasing number of patients who would benefit from personalized advice regarding physical activity in the context of their health. This is especially true for patients with chronic health conditions such as diabetes for which physical activity can have a significant impact on health outcomes (USPSTF, 2016). Other at-risk populations (e.g., aging adults, post-operative patients) could also benefit from surveillance of physical activity levels in an effort to improve health and reduce injury and disease; reduction in the higher health care costs associated with these conditions might be realized as well. Studies have demonstrated acceptance of wearable physical activity devices in at-risk populations (e.g., older adults, adults with chronic illness) (Mercer et al., 2016; Lyons et al., 2017), as well as improvement in physical activity levels when combined with counseling (Lyons et al., 2017).

While wearable physical activity devices have been found to be acceptable, valid, and reliable measures of physical activity (especially number of steps taken), notable differences among devices make direct comparisons of data challenging (Case et al., 2015; Kooiman et al., 2015). Integration of wearable physical activity devices into health care, and specifically clinical workflow, is in its infancy. Key to its successful integration is understanding data reduction, analysis, and integration into both the EHR and into clinical workflow.

Additional challenges to integrating data from wearable physical activity devices into health care include device cost and resultant disparities in access to the devices, as well as privacy and security concerns about the data collected and their potential integration into EHRs. Finally, wearable physical activity devices typically do not report physical activity in such a way to assess patient compliance with *Physical Activity Guidelines for Americans* (i.e., minutes per week of moderate to vigorous physical activity) (Knight et al., 2015).

The U.S. Food and Drug Administration (FDA) considers wearable physical activity devices to be "general wellness product," and not "regulated medical devices"; as such, these devices are not subject to FDA approval (FDA, 2016).

Findings

Wearable physical activity devices are promising tools to assess patient physical activity levels, and data from these devices have already been integrated into EHRs and health care delivery (Munro, 2014; Pennic, 2015). The benefits of collecting and analyzing data from wearable physical activity devices may be most apparent in populations for which achievement of recommended physical activity has a significant impact on health and cost outcomes, such as patients at risk for cardiovascular disease and patients at risk for falls (USPSTF, 2016). To achieve the potential of these devices to improve both health care delivery and patient health outcomes, it will be important to determine how to integrate actionable wearable data into the EHR, and to develop clinical best practices (e.g., clinical workflow, data management, and reporting) for the use of such data. Integrated wearable devices data must be structured data amenable to clinical decision support tools within the EHR, consistent with public health guidelines (e.g., minutes of physical activity in contrast to number of steps), and broadly understandable and translatable to diverse members of the health care team and to patients themselves.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 9.1: **An expert panel of stakeholders representing EHR vendors, health care system leaders, CDC, and patients should identify and examine promising scenarios to understand the capabilities and limitations for wearable physical activity devices to help with monitoring/surveillance of physical activity across the health care continuum (i.e., inpatient and outpatient settings).**

These scenarios, or use cases, can help evaluate the technology requirements to download, analyze, and integrate wearable physical activity device data into EHRs and clinical workflow. Such scenarios can also evaluate patient acceptance and experience with objective physical activity assessment in health care settings, and learning on the use of these data for surveillance purposes.

Supporting Action 9.2: **An expert panel of stakeholders representing EHR vendors, health care system leaders, CDC, and patients should determine the patient populations that would benefit the most from the use of wearable physical activity devices to better**

measure physical activity levels and assess physical activity interventions among higher-risk individuals (e.g., older adults, underserved individuals, or those with specific diseases).

Strategy 10

Conduct surveillance of cardiorespiratory fitness and muscle strength testing among at-risk populations in health care settings.

Background

Cardiorespiratory fitness and muscular strength are independent, but additive measures of health and longevity (HHS, 2008). Among older adults, grip strength is a better predictor of premature mortality—independent of age, nutritional status, number of prescribed drugs, number of chronic diseases, and level of physical activity—than blood pressure (Leong et al., 2015; Arvandi et al., 2016). Grip strength has been linked to longevity in several prospective studies (Rantanen et al., 2012; Leong et al., 2015; Syddall et al., 2017). Grip strength is assessed using a handheld dynamometer, taking only minutes to perform; and there are reference values for grip strength for adults of all ages (Perna et al., 2016). Given the small percentage of 18- to 80-year-old adults (~30 percent) and 65- to 74-year-old adults (~24 percent) in the United States who engage in regular strength training, grip strength testing could be a useful "nudge" to encourage older adults to engage in health-promoting muscle strength training (Bennie et al., 2018).

Cardiorespiratory fitness is tested through mechanisms including graded exercise stress tests, step tests, and walking tests (Guazzi et al., 2012; Lobelo et al., 2018; Whitsel et al., 2019). The 6-minute walk test (6MWT) measures the distance that a patient can quickly walk on a flat, hard surface in a period of 6 minutes. The 6MWT has been found to be highly predictive of cardiorespiratory fitness (Sperandio, 2016).

Emerging research has demonstrated that grip strength and the 6MWT combined are highly predictive of frailty, and can be successfully implemented in primary care settings (Lee et al., 2017). Recognition of frailty is important because there is evidence that the degree of frailty can be improved with interventions including high-intensity exercise training (Lee et al., 2017).

Findings

Fitness assessment in older adults is highly predictive of premature mortality. Limited studies have demonstrated the utility of such testing in

ambulatory care settings. The growth in the population older than age 65, combined with higher rates of obesity and lower rates of physical activity, make fitness assessment an even higher priority in the pursuit to lower chronic disease prevalence, high-cost health care utilization, and associated costs.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 10.1: **The Centers for Medicare & Medicaid Services (CMS) should partner with health care systems to develop and implement protocols using grip strength and the 6MWT in primary care settings as part of the Medicare Annual Wellness Visit as a fitness surveillance strategy among adults 65 years of age and older.**

Health care systems and providers, as well as payers, are financially incentivized to provide high-quality care to older adults in the Medicare program. As 60 percent of an individual's lifetime health care costs are attributed to the last 10 years of life, efforts to improve lifestyle behaviors and associated fitness and health are prioritized (Alemayehu and Warner, 2004). This is especially true for interventions that directly impact conditions associated with higher health care utilization and cost. Identification of low cardiorespiratory fitness and/or weak grip strength for age and gender provides an opportunity for referral to evidence-based medical and community fitness programs. Ultimately, the recommended pilot testing can help determine if assessing measures of fitness improves adherence to physical activity recommendations, improves health, and reduces costs.

Supporting Action 10.2: **CDC should develop and implement protocols using grip strength as part of the Diabetes Prevention Program (DPP) in adults 40 to 70 years of age as a fitness surveillance strategy among enrolled adults.**

A population health approach to increasing the percentage of middle-aged adults who regularly participate in muscle strength training is a promising strategy. Studies have shown that muscle strength training in addition to aerobic training reduces the risk of developing type 2 diabetes among individuals with prediabetes

(Aguiar et al., 2014). The incorporation of grip strength testing in the DPP may increase participation in muscle strength training, especially among individuals identified as having weak grip for age and gender.

Strategy 11

Ensure that national health care delivery surveys include questions about physical activity assessment and counseling in health care settings.

Background

National health care delivery surveys provide data on the proportion of patients or patient visits where counseling for exercise is provided. The NAMCS is designed to provide objective, reliable information about ambulatory medical care services in the United States, and it is administered annually to a national sample of outpatient providers who are asked to provide information regarding patients seen over a 1-week reporting period (CDC/NCHS, 2012). The survey does not ask about patient self-reported physical activity levels, but it does ask if the physician provided health education or counseling for exercise (CDC, 2018). The Medicare Health Outcomes Survey (HOS) is administered to a random sample of Medicare Advantage members and asks if members were asked about their physical activity level, and if so, were they counseled to start, increase, or maintain their physical activity level (CMS, 2018). Finally, the National Health Interview Survey (NHIS) has been used by the National Center for Health Statistics (NCHS) to assess trends in adults and children receiving advice from a health care provider regarding physical activity (Barnes and Schoenborn, 2012). However, the redesigned NHIS for 2019 does not include specific questions addressing physician assessment, advice, or prescription of physical activity or exercise.

Findings

Surveys such as the NAMCS and the Medicare HOS can provide valuable information regarding counseling for physical activity/exercise in health care settings, which in turn can be used to identify gaps in care and opportunities for health care improvement. Current data collected by the NAMCS on health education/counseling for exercise is both insufficient and inconsistent with the *Physical Activity Guidelines for Americans*. Changes to the NHIS have eliminated specific questions regarding physician assessment, advice, and counseling for physical activity. Understanding health

care delivery practices and trends for the promotion of physical activity in youth and adults could inform interventions and partnerships aimed at improving physical activity counseling in clinical settings.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 11.1: **CDC should modify the NHIS to include questions that ask respondents if they (and their child) received assessment, advice, or counseling for physical activity from their primary care physician or health care provider.**

Supporting Action 11.2: **CDC should modify the NAMCS to include questions that ask physician respondents if they provided assessment, advice, or counseling for physical activity (aerobic and muscle strength training) to patients.**

Strategy 12

Conduct surveillance of physical activity levels in the health care workforce and related training programs.

Background

A strong predictor of lifestyle counseling is a health care provider's personal engagement in health promotion activities. Medical students and practicing physicians who are more physically active are also more likely to counsel their patients regarding physical activity (Oberg and Frank, 2009). Rates of health promotion counseling among physicians can be increased through provider-centered health promotion. In a 4-year controlled trial that addressed lifestyle behaviors over the course of medical school, medical students made improvements in their personal health practices, and their self-reported counseling on those topics improved as well (Oberg and Frank, 2009).

Other health professionals also play an important role in promoting physical activity with patients. A study of physical therapists and physical therapy students found that physical therapy professionals should be role models for healthy lifestyle behaviors such as physical activity (Black et al., 2012). Similar to observations among physicians and medical students, nurses who regularly exercise are more likely to encourage physical activ-

ity as a treatment for patients (McDowell et al., 1997). Given that nurses represent the largest health care workforce, with more than 3 million registered nurses in the United States, further engagement of nurses in regular physical activity, and in turn, physical activity promotion is a key strategy to improving physical activity levels in patients (HHS and HRSA, 2010). Given the trend toward team-based health care delivery, it is important that all members of the health care team engage in health-promoting physical activity and promote physical activity with patients.

Health care professional organizations regularly survey their members to better understand professionals' experiences and challenges in the current health care environment, and the results are used to inform the development of programs that support providers in professional practice. Likewise, medical education organizations regularly survey learners regarding their educational experiences, and results are used to inform the development of programs that support learners in professional development. However, systematic assessment of U.S. medical students, physicians, nurses, and other health care professionals regarding personal physical activity habits is nonexistent. Research has indicated that physical activity levels decline throughout medical school, and even more so into residency training (Stanford et al., 2014). A study of internal medicine residents found that higher levels of personal physical activity translated into greater physical activity counseling self-efficacy (Rogers et al., 2006).

Physical activity assessment and promotion by health care professionals is also enhanced by educational interventions at all levels of training. A survey of U.S. medical schools found that 78.4 percent reported having physical activity training in their curriculum; however an average of only 8 hours of training over 4 years was offered (Stoutenberg et al., 2015). A systematic review of physical activity counseling in medical school education found evidence that educational programs positively impact students' attitudes toward physical activity, improve their physical activity counseling knowledge and skills, and their self-efficacy to conduct physical activity counseling (Dacey et al., 2014). An examination of physical activity counseling training programs in family medicine residency training found improvements in knowledge, but inconsistent improvements in self-efficacy to perform physical activity counseling (Wattanapisit et al., 2018).

Findings

Personal physician physical activity behaviors are highly predictive of physician counseling behaviors; and similar findings are observed among nurses, nurse practitioners, and physical therapists. Educational programs likewise are key to advancing knowledge, attitudes, self-efficacy, and physical activity counseling skills. Efforts to improve the personal physical

activity habits of physicians also translate into improved physical activity counseling behaviors. Given the evidence that a physically active workforce is more likely to promote physical activity with patients, both the activity levels of health care providers and the interventions aimed at promoting physical activity among health care providers and their patients should be regularly assessed and reported to ensure ongoing efforts to promote a physically active lifestyle.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 12.1: **CDC, in partnership with medical professional organizations (e.g., American College of Physicians, American Medical Association, American Nurses Association, American Physical Therapy Association), should develop and regularly implement a survey to query health care providers (i.e., physicians, advanced practice clinicians, nurses, and physical therapists) about their personal physical activity behaviors, and use the results to inform development of programs aimed at promoting regular physical activity among providers.**

Supporting Action 12.2: **CDC, in partnership with medical educational organizations (e.g., American College of Graduate Medical Education, American Nurses Association, American Physical Therapy Association, Association of American Medical Colleges), should develop and regularly implement a survey to query medical students, residents, fellows, advanced practice clinician students, nursing students, and physical therapy students about their personal lifestyle behaviors, and use the results to inform development of programs aimed at promoting regular physical activity among health care providers in training.**

Supporting Action 12.3: **CDC, in partnership with medical educational organizations (e.g., American College of Graduate Medical Education, American Nurses Association, American Physical Therapy Association, Association of American Medical Colleges), should develop and regularly implement a survey to query medical schools, nursing schools, and graduate programs in physical therapy regarding specific curricula in physical activity assessment and promotion.**

CONCLUSION

Health care settings should be a natural environment for promoting physical activity. As trusted and effective health advocates, health care providers are uniquely positioned to assess and advise patients regarding physical activity behaviors. Furthermore, patients may be particularly motivated to adopt or increase physical activity behaviors to help manage a health condition and/or to prevent adverse health outcomes for which they may be at risk. The 6 strategies and 16 implementation actions recommended in this chapter can help improve the low rates of health care provider physical activity assessment and advice by providing relatively simple solutions that are integrated with existing EHRs and clinical workflows.

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4

Workplaces

INTRODUCTION

On average, adults in the United States who are employed fulltime spend a majority of their waking hours working and doing work-related activities, whether at a traditional worksite or office environment, at home or another location for telework situations, or at an offsite location for non-office jobs (e.g., truck driver or construction worker) (DOL, 2018). Thus, the workplace is an important environment to conduct physical activity surveillance. Workplace physical activity surveillance can capture the amount of time an individual engages in physical activity or sedentary behaviors throughout the day, job-specific physical activity or sedentary behavior, an employee's level of physical fitness, physical activity or sedentary time during commuting, availability and use of workplace programs that support physical activity, and the types of policies that encourage physical activity such as paid time off to be active or promotion of active commuting to and from work.

Physical activity surveillance in the workplace is not straightforward to implement. First, there are questions about the level at which physical activity surveillance should occur—organizationally (including worksite design and culture, leadership role modeling, and programs that promote physical activity) or individually (an employee's physical activity or fitness level). Second, because physical activity is only one component of health assessment within the broad scope of worksite health promotion, it is rare that employers consider physical activity surveillance independent of other health metrics such as body weight, blood pressure, cholesterol, or tobacco use (Bailey et al., 2018). Third, goals for surveillance raise questions about

which employers and employees are included in the surveillance system and which are not. Inclusion can vary based on employer prioritization of workplace health promotion, labor union contracts, or resource limitations, and has implications for equitable implementation of surveillance efforts. These questions are particularly important in light of the changing U.S. workforce, which increasingly includes teleworking opportunities and independent employment as part of the fast growing "gig economy," which refers to workers who are loosely connected to organizations as independent contractors or selling directly to the market place (Petriglieri et al., 2019). For example, how are workers captured by surveillance systems when they are not at a physical workplace each day? Moreover, understanding which employers and employees are captured in surveillance systems is important for future analysis of disparities in rates of physical activity or sedentary behavior, as well as underlying inequities in workplace practices. Fourth, several factors are considered crucial to supporting a culture of health and well-being at work, including workplace policies, benefit design, work conditions, and the built and psychosocial environments within the walls of the workplace, in the case of a brick-and-mortar building, as well as while traveling to and from a workplace. If these factors influence physical activity, how are they captured in surveillance efforts?

The geography, size, industry, and demographics of workplaces are also important to consider, as it is preferred for surveillance systems to include a diverse sample of workplaces and employees. Related to the changing nature of the workplace are the changing demographics of the workforce. The U.S. workforce is aging and becoming more racially and ethnically diverse, which raises questions about how surveillance systems capture different employee groups.

In addition to these questions about which employers and employees are included in the surveillance system, there is a fundamental belief that a robust workplace physical activity surveillance system can occur only with buy-in from employers and employees. Any effort to implement physical activity surveillance should consider how surveillance outcomes are tied to value on investment, so that they are relevant for employers and employees and clearly described as such. It is also important to secure appropriate consumer protections for employees to ensure data privacy and adequate engagement.

The following strategies and actions for implementation of physical activity surveillance in workplaces were informed by a discussion paper, Pate et al. (2018), and with input from a group of experts representing government, academia, not-for-profit organizations, and the private sector. These individuals were engaged in discussions to prioritize implementation strategies, and an in-person meeting that occurred in November 2018 (as described in Chapter 1).

STRATEGIES AND ACTIONS FOR IMPLEMENTATION OF PHYSICAL ACTIVITY SURVEILLANCE IN WORKPLACES

Strategy 13

Document existing surveillance efforts that capture physical activity, physical fitness, and sedentary behavior in the workplace and in employees' commutes to and from work,[1] and identify opportunities to expand these efforts.

Background

Several workplace surveillance initiatives exist, including the Workplace Health in America Survey; the Bureau of Labor Statistics' data collection efforts (e.g., American Time Use Survey [ATUS]), which measures the amount of time people spend doing various activities such as paid work; the Occupational Requirements Survey, which assess the physical demands of different occupations (DOL, 2019); organizational scorecards (e.g., Centers for Disease Control and Prevention [CDC] Worksite Health ScoreCard, the Health Enhancement Research Organization [HERO] Scorecard, the American Heart Association Workplace Health Achievement Index); employer-based surveys/tools; and other measures of the built environment and building design standards (e.g., Fitwel, a certification system that optimizes buildings to support health).

In addition to these workplace surveillance initiatives, there are other well-known national surveillance systems, such as the Behavioral Risk Factor Surveillance System, as well as many other lesser-known state and local surveillance systems, that capture valuable data about physical activity in the workplace and active commuting to and from work.

Findings

It would be beneficial to create a compendium of current workplace surveillance efforts, which would help identify gaps. A comprehensive analysis of existing efforts could serve as the foundation for future programmatic, policy, systems, and environmental change work and advocacy efforts.

The process for adding new questions to existing surveillance systems is unclear. Moreover, there is a lack of information on the exact costs

[1] Chapter 5, Community Supports for Physical Activity, provides guidance on potential opportunities to capture physical activity during travel to and from work.

to modify existing surveillance questions and analyze data pertaining to workplace physical activity. The cost for adding new surveillance measures and/or questions will be influenced by the surveillance system into which they are inserted, the timetable for their addition, and whether they are included longitudinally or at only one point in time. Securing information on these administrative and financial implications is important for the federal appropriations process and fundraising efforts related to expanding surveillance efforts.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 13.1: **CDC; the American Heart Association; state, tribal, and local public health agencies; or HERO should conduct a comprehensive analysis of existing workplace surveillance efforts, including identifying existing gaps, by 2020.**

Supporting Action 13.2: **CDC should convene an expert advisory group of researchers, practitioners, and representatives from the Business and Industry Sector of the National Physical Activity Plan Alliance to review the analysis (see Supporting Action 13.1 above) and identify evidence gaps.**

Supporting Action 13.3: **The expert advisory group should develop questions, based on the gap analysis, that could be inserted in existing surveillance efforts in order to capture additional aspects of workplace physical activity, physical fitness, and active commuting.**

Supporting Action 13.4: **The expert advisory group, working together with CDC, should assess the processes and costs involved in adding new survey questions and analyzing the data.**

Supporting Action 13.5: **The expert advisory group should identify potential funders, both public and private, to support the expansion of existing surveillance systems and the analysis of the additional data collected.**

Strategy 14

Convene public and private stakeholders to prioritize and implement consensus key measures[2] to assess individual-level physical activity, physical fitness, and sedentary behavior surveillance in the workplace.

Background

The workplace sector has identified the need to develop consistent, reliable, and validated criteria for physical activity, physical fitness, and sedentary behavior assessment in worksite health promotion (Pate et al., 2018). An expert group was convened to identify such criteria, and published its consensus recommendations in early 2019 (Whitsel et al., 2019).

Findings

The current measures that stakeholders use in the field to assess workplace physical activity, physical fitness, and sedentary behavior are inconsistent. Standardizing the measures would support consistency in the physical activity surveillance that informs outcome evaluation, benchmarking, and individually tailored, evidence-based programming across the worksite health promotion field.

Supporting Actions for Implementation:

The committee recommends the following actions to support this strategy:

Supporting Action 14.1: **CDC, HERO, Population Health Alliance, and/or the American Heart Association should convene employers; vendors; health plans; state, tribal, and local public health agencies; and other salient stakeholders to obtain support for disseminating and using the consensus measures to assess physical activity, physical fitness, and sedentary behavior in worksites described in Whitsel et al. (2019).**

Example organizations to include in this convening are existing CEO Roundtables, employers, HERO, the American College of

[2] Described in Whitsel et al., 2019.

Occupational and Environmental Medicine, workplace health promotion vendors, and health plans.

Supporting Action 14.2: **CDC, HERO, the National Physical Activity Plan Alliance, or the American Heart Association, in coordination with vendors and health plans, should develop toolkits and resources and help disseminate and implement these new measures.**

Supporting Action 14.3: **The Centers for Medicare & Medicaid Services, the National Quality Forum, and the National Committee for Quality Assurance should integrate these metrics into performance and quality measure development to create seamless delivery of care and health surveillance between the health care system and worksite health promotion, including optimal and consistent use of mobile health technologies. There should be purposeful integration between specific health care provider networks and employer-supported programming whenever possible to enhance surveillance applications and contribute to improved service delivery. The implementation impact of this integration should be studied by health services researchers and health care plans within the health care system and employer footprint.**

The health care sector is a key collaborator on efforts to create and expand physical activity surveillance at work, especially in light of employer-sponsored health insurance. The health care sector could include the new consensus measures in its ongoing surveillance efforts, which could then be included in patients' electronic health records (EHRs). This effort should proceed in close collaboration with the National Committee for Quality Assurance, the National Quality Forum, and the Centers for Medicare & Medicaid Services.

Strategy 15

Develop consistent measures for physical activity in workplace designs and operations, policies, programs, culture, and climate, and use these measures in comprehensive surveillance of physical activity and physical fitness in the workplace.

Background

The measures of workplace designs and operations, policies, programs, culture, and climate that foster physical activity promotion are not

standardized nor developed for different types of workplaces. It is well documented that organizational culture is strongly associated with health outcomes, with research showing that organizations with cultural support, such as the presence of worksite policies or statements supporting healthy behaviors or policies that support physical activity breaks, reported greater improvements in health behaviors compared to organizations with little or no cultural support (Allen, 2017). There is also evidence regarding the role of supportive leadership in creating and promoting opportunities for physical activity (Bailey et al., 2018).

Findings

Achieving consensus on measures that can be consistently used and applied to different types of workplaces would generate critical data on workplace supports for physical activity.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

> ***Supporting Action 15.1:*** **CDC, HERO, or the American Heart Association should convene an expert advisory group of academics, employers, state and public health agencies, and leading organizations to identify existing standards and develop a core set of evidence-based measures that support consistent adoption of healthier building standards (e.g., Fitwel, International Well Building Institute) by employers, architects, and real estate developers as well as other cultural, policy, and environmental support measures that promote active workplaces and active commuting. These measures should also capture the efficacy of outcomes-based incentives and other engagement strategies that employers use to motivate employees to be physically active in the context of program design and the health care plan.**
>
> These evidence-based measures could document organizational readiness, availability of resources, or training needs of staff to implement cultural, social, environmental, and policy support measures along with healthier building standards and work spaces.
>
> ***Supporting Action 15.2:*** **The National Institutes of Health, CDC, HERO, and Fitwel should support wide dissemination of the new**

measures to employers, vendors, health plans, researchers, and practitioners.

Dissemination efforts could include presentations, webinars, and toolkits. The new measures will inform future research, policy, and practice.

Strategy 16

Obtain longitudinal support and funding for the Workplace Health in America survey.

Background

The federally funded Workplace Health in America (WHA) survey, conducted in 2016–2017, is the most comprehensive national survey of employers' workplace health promotion offerings (CDC, 2017). The WHA is also the first national survey to capture the status of workplace health and safety programming, the implementation of evidence-based strategies, and the description of key components of a comprehensive workplace health promotion program (Linnan et al., 2019). The last nationally representative, federally funded survey of employers' workplace health promotion offerings was conducted in 2004 and indicated that 19.6 percent of employers offered physical activity–related programming (Linnan et al., 2008). The latest WHA survey compared some of its findings with the 2004 results, presenting a wider array of data on evidence-based physical activity programs and policies, and documenting existing worksite health programs, benefits, policies, and supports (Linnan et al., 2019). Ideally, surveillance measures identified in the previous supporting actions would be integrated into the WHA survey working in close partnership with CDC.

Findings

Data for the WHA were collected from November 2016–December 2017, after a 12-year gap, due to budget limitations. Securing funding to support regular administration of this survey is important for national physical surveillance efforts in workplaces.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 16.1: **Because of their experience implementing the most recent version of the WHA survey, the Center for Health Promotion and Disease Prevention at the University of North Carolina at Chapel Hill, CDC, and RTI International should document the necessary resources required for longitudinal support and regular administration (i.e., at least every 5 to 10 years) of the survey.**

Supporting Action 16.2: **Advocacy organizations, such as the American Cancer Society Cancer Action Network, the American Heart Association, the Population Health Alliance, and Trust for America's Health, should partner with researchers; state, tribal, and local public health agencies; providers; health plans; and employers to communicate the benefits of the WHA survey and garner support for future cycles of the survey.**

CONCLUSION

Employed adults spend many of their waking hours on the job, which makes workplaces an important environment for promoting physical activity and conducting physical activity surveillance. The heterogeneity of U.S. workplaces calls for a variety of approaches to implementing surveillance, and there are a variety of corresponding challenges as well. Buy-in from employers and employees can help overcome some of the challenges, and this buy-in can be achieved in part by clarifying the value and return on investment of surveillance outcomes. The 4 strategies and 12 implementation actions described in this chapter will help coordinate longitudinal data collection and data analysis to promote more comprehensive physical activity surveillance across workplaces and create opportunities to examine inequities in physical activity and physical fitness outcomes across work settings and employee populations.

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5

Community Supports for Physical Activity

INTRODUCTION

Although physical activity is an individual behavior, it occurs in built and social environmental contexts that affect individuals' decisions about being active. There are different community attributes that can be supportive of active recreation (e.g., leisure time physical activities) and active forms of transportation (Bauman et al., 2012). Active recreation includes sports, recreational walking, and exercise, and they are discretionary and not associated with tasks required for daily functioning. By contrast, active transportation encompasses all human-powered means of travel to reach a destination, such as walking, bicycling, or wheelchair rolling. Public buses and rail systems may be frequently overlooked as forms of active transportation, but they contribute to physical activity because they often involve walking at the beginning and end of trips (Giles-Corti et al., 2016). This committee expanded its initial focus on the outcome of active transportation to include active recreation because there are significant gaps in surveillance of community supports for both categories of physical activity; therefore this chapter's recommended strategies and actions consider community attributes that are relevant for both outcomes.

Community supports for physical activity take numerous forms, from physical infrastructure such as parks, trails, sidewalks, and bicycle facilities, to neighborhood design features such as accessibility to destinations, compactness or density, and the availability and cost of automobile parking. Policies and standards influence when and where these supports are implemented. Policies may heavily favor vehicular travel over active modes

of travel, or they may compel or incent decision makers and developers to design neighborhoods and environments that support physical activity (Giles-Corti et al., 2016). For example, policies that open school recreational facilities for community use have proven to be promising for enhancing access to recreational areas and increasing physical activity (Labarthe et al., 2016).

Topics related to community supports for physical activity overlap with topics discussed in this report's other chapters. For example, although many community supports are relevant for all community members and visitors, such as sidewalks and parks, other supports are specific to subpopulations in the community. Schools and early childhood education facilities are particularly influential for children; whereas the built environment around workplaces and health care facilities, as well as the design of the buildings and grounds, influences the physical activity behaviors of people using those facilities. Some physical activity programs and promotions are available to communities through schools, workplaces, and health care facilities.

Evidence on the importance of community supports for physical activity has accumulated over the past two decades. For example, data indicate that street design can encourage pedestrian and bicyclist activity by increasing the connectivity of destinations, improving safety by creating safe crossings, separating bicyclists from cars, lowering vehicular speeds with traffic calming measures, and enhancing the attractiveness of the environment (Smith et al., 2017; Stappers et al., 2018). Zoning ordinances, complete streets policies, and urban design codes can influence the proximity and accessibility of land uses, which in turn help determine walking and bicycling for transportation (Choi et al., 2017). Although access is important, the design aesthetics and the visual appeal of public and private spaces also influence walking and biking activity. For example, both the availability of parks and the presence of amenities and activity facilities in parks are positively associated with park use and physical activity (Karmeniemi et al., 2018).

Extensive evidence about the importance of community supports for physical activity has led to recommendations by authoritative groups. The Surgeon General's Call to Action to Promote Walking and Walkable Communities, the Community Preventive Services Task Force recommendation for combined built environment approaches to increase physical activity, and the World Health Organization Global Action Plan on Physical Activity 2018–2030 recognize the importance of community supports for physical activity (HHS, 2015; Barnett et al., 2017; CDC, 2017; WHO, 2018).

Social environments and community programs can enhance the usefulness and impact of the built environment. There is preliminary evidence of the interactive effects between built and social environments and physical activity (Sawyer et al., 2017). Programs such as Open Streets, which

temporarily prohibit vehicles and make city streets open only to walkers, bicyclists, roller skaters, and the like, can support physical activity by increasing awareness of opportunities, changing attitudes, and creating incentives for active leisure and transportation (Eyler et al., 2015).

Community supports for physical activity are important across the lifespan, and their relevance for active transportation and overall walking is similar across age groups. Among older adults, the presence of recreational facilities, the quality of sidewalks, and safety features are emerging as important community attributes (Barnett et al., 2017; Cerin et al., 2017). For adolescents and children, evidence suggests that improvements in the walking environment, traffic safety, transportation infrastructure, and access to sports and recreational facilities are important community supports (Bauman et al., 2012; HHS, 2012). Encouraging active travel to school through a mix of infrastructure, policy, and programs is an important support to increase physical activity and reduce pedestrian- and bicycle-related injury among children and adolescents (HHS, 2018; NPAPA, 2018).

Decisions about community supports lie primarily outside the public health sector. Thus, a multisector approach that includes decision makers and practitioners in education, parks and recreation, urban planning, transportation, and other sectors of civil society is important (Giles-Corti et al., 2016; Reis et al., 2016). Representation of these disciplines at different geographic levels is also necessary, because decisions about physical and social environments cut across neighborhood, local, county, regional, state, and national governments. Likewise, multiple sectors and government agencies have relevant expertise and data that are essential for understanding opportunities for, and influences on, physical activity. Therefore, surveillance of policies and practices regarding community supports at local, regional, state, and national levels is important.

The multisector nature of community supports offers opportunities for broader benefits of a robust surveillance system. Implementing many of the recommendations that follow will require collaboration among public health and stakeholders in diverse fields. There is the possibility that such collaboration could lead to greater integration of health goals into what are considered "non-health" sectors. To facilitate such a shift, care should be taken to make the community supports surveillance data as accessible as possible to a wide range of partners, including data access, data linkage, and data visualization. Implementation of new surveillance systems should also seek to increase the value of the data within public health. Because there is evidence that several types of community supports are inequitably distributed across communities (Taylor and Lou, 2011), improved surveillance is needed to document such inequities and use the information to plan public health actions to achieve equity goals. Improved community

supports surveillance could also be integrated within widely used public health resources, such as County Health Rankings.[1]

To develop recommended strategies for surveillance of community supports for physical activity, along with specific actions to support implementation of those strategies, the committee consulted a list of 20 relevant community support constructs. The list was compiled in a 2018 discussion paper (Pate et al., 2018) and includes community design; street design; safety; policy and planning; transportation systems and infrastructure; events, resources, and programming; and public attitudes toward policies and environments (see Box 5-1). Although all 20 community support constructs are relevant to physical activity, and it would be desirable to monitor as many of them as feasible, the discussion paper, Pate et al. (2018), used a systematic process to prioritize seven constructs for surveillance systems. The eight experts on the community supports workgroup ranked all 20 constructs on three criteria: (1) level of evidence that construct relates to higher levels of physical activity, (2) relevance to active transportation as a form of physical activity, and (3) potential for change or improvement over time and change can be sustained. Those results were used to select seven constructs for further consideration. Prioritization was based on the logic that it is not feasible for surveillance systems to assess all relevant variables.

As noted in the study statement of task (see Chapter 1, Box 1-3), to meet the priority needs of the sponsor, a surveillance document was commissioned as a component of the larger study to serve as part of the range of available evidence on tools to facilitate surveillance in the area of community supports for active transportation. The sponsor requested that the surveillance document include (1) a population survey about community supports for active transportation; (2) a survey of practitioners and professionals about the presence of relevant policies in the communities where they work; (3) guidance for creating relevant measures of community supports for active transportation using geographic information systems; and (4) a guide for conducting streetscape audits using an automated system.

The commissioned document was developed in tandem with the committee's work, and in its evaluation of the final commissioned document, the committee determined that the reports included can be considered as resources for developing more comprehensive survey materials and guidelines for surveillance purposes, particularly within the area of community supports for active transportation. The final commissioned document consists of three components, which can be found in Appendix E. Part I includes the brief questionnaires on individual perceptions of community supports for active transportation and for members of a professional organization, and an accompanying validation protocol; Part II includes the geographic

[1] See http://www.countyhealthrankings.org (accessed April 15, 2019).

BOX 5-1
Major Constructs Identified as Priorities for Surveillance of Community Supports for Active Transportation

A. Community Design (Macro level)
1. Land use mix*
2. Residential density
3. Street connectivity*
4. Parks (walk-to [proximity] and walk-through)
5. Walkability (summative)

B. Street Design (Micro level)
1. Multimodal transport infrastructure (e.g., sidewalks, bike facilities, traffic-calming features, street-crossing design)*
2. Amenities to promote use (e.g., signage, aesthetically pleasing elements, rest opportunities, lighting)
3. Social disorder (e.g., graffiti, vacant lots, abandoned or boarded-up buildings)

C. Safety
1. Crime- and violence-related safety (e.g., perceptions, documented crime, street harassment)
2. Traffic-related safety (e.g., perceptions, pedestrian injuries)*

D. Policies and Planning Documents
1. Zoning and related policies (e.g., Complete Streets policies, form-based and new urbanist zoning)*
2. Planning documents (e.g., comprehensive, master, land use, bike and pedestrian plans)

E. Transportation Systems
1. Public transit (e.g., access, proximity, schedule)*
2. Bicycle infrastructure (e.g., bike networks, protected bike systems)

F. Events, Programs, and Resources
1. Events (e.g., Bike to Work Day, Open Streets initiatives)
2. Programs (e.g., Safe Routes to School, employer-supported programs, bike share program, pedestrian education)*
3. Resources (e.g., staff, initial investments, maintenance budget)

G. Public Attitude toward Policies and Environments
1. Perceptions related to value of active transport and related facilities (e.g., health benefits, economic benefits)
2. Public support for active transport policies and environments (e.g., family, community, employer, or school support for active transportation)
3. Political will, support, and culture

NOTE: Top seven constructs are denoted with an asterisk.
SOURCE: Pate et al., 2018.

information systems (GISs) protocol; and Part III pertains to the protocol of remote collection of audit data.

For the development of the strategies and supporting actions for implementation, the committee expanded the focus from community supports for active transportation to physical activity in general, with the main additional focus being on leisure or recreational physical activity. This expansion was based on the idea that many supports for recreational physical activity such as parks, events, and programs can also increase utilitarian physical activity and can affect entire communities. Evidence and existing measures also make these types of supports promising prospects for physical activity surveillance systems. Because this expansion made a complex set of constructs even more complex, we decided not to further expand into other domains of occupational physical activity (which could be considered by the workplace group) or household activities. The following strategies and actions for implementation of surveillance of community supports for physical activity attempt to cover as many community support constructs as possible while being feasible.

STRATEGIES AND ACTIONS FOR IMPLEMENTATION OF SURVEILLANCE OF COMMUNITY SUPPORTS FOR PHYSICAL ACTIVITY

Strategy 17

Prioritize a set of constructs and corresponding survey items to assess perception of community supports for active transportation and active recreation, incorporate the constructs and survey items into national surveillance systems, and promote their use at the local level.

Background

Self-reported surveys of population health are frequently used in public health surveillance. They can complement other measurement methods, such as GIS, direct observation of environments, and coding of policy documents. Surveys can measure constructs, such as perceived safety and public attitudes toward environments and policies, that cannot be assessed through other methods. Surveys can also provide built environment data for locations that lack GIS data.

Findings

Numerous surveys of the built and social environment constructs (e.g., perceived safety) listed in Box 5-1 have been developed and evaluated (Brownson et al., 2009). These surveys usually ask the respondent to evaluate the "neighborhood" around the home or workplace. Though other scales of assessment are possible, such as cities, smaller geographic scales are preferable because they provide more detailed, and probably more accurate, assessment. Evidence indicates that survey measures are related to physical activity outcomes in age groups ranging from children through older adults, though there are inconsistencies in the evidence (Bauman et al., 2012). Some brief measures have been developed (Brownson et al., 2009), and a few have already been used in national samples of the U.S. population (Sallis et al., 2009; Whitfield et al., 2018). Thus, it is feasible to include a small number of survey items regarding the built and social environments in existing national surveys, such as the National Health Interview Survey (NHIS) conducted by the Centers for Disease Control and Prevention's (CDC's) National Center for Health Statistics (NCHS), and possibly the National Household Transportation Survey conducted by the Federal Highway Administration.

By contrast, measures of events, programs, and resources, as well as measures of public attitudes toward policies and environments, are much less developed. Further development will help prepare these constructs for inclusion in national surveillance systems.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 17.1: **CDC should convene an expert consensus group of multisector practitioners and academic stakeholders to prioritize a list of built and social environment constructs and corresponding survey questions that could be recommended for national, state, and local surveillance.**

The brief questionnaires on individual perceptions of community supports for active transportation commissioned (see Appendix E, Part I) details promising questions on land use, street connectivity, multimodal transportation, safety from traffic, and access to parks. Other survey items for potential inclusion are the availability of private recreation facilities, senior centers, schools, and sources of food such as grocery stores, convenience stores, and restaurants.

The expert group may also consider including social environment items related to crime. Though most built and social environment measures ask about environments in the home neighborhood, it would be valuable to include similar questions about workplace and/or school neighborhoods. Items that are particularly relevant to important subgroups such as children, older adults, and historically disadvantaged communities may also be considered. Chapter 2, which focuses on children, recommends identifying survey items especially relevant to youth, and it is recommended that such items be incorporated into national surveillance surveys, as appropriate. When new survey items are proposed, they need to be deemed adequately valid and reliable for inclusion consideration in existing surveillance systems.

Supporting Action 17.2: **CDC should communicate the prioritized survey items to national, state, and local public health agencies; planning agencies; and other multisector stakeholders that could implement them, so that the data from these levels are as aligned and consistent as possible.**

There is a great opportunity to use recommended items in existing surveillance systems such as NHIS, conducted by CDC's NCHS and possibly the National Household Transportation Survey, conducted by the U.S. Federal Highway System, both of which are in planning stages for their next round of nationally representative surveys. Recognizing that national data may not provide the level of granularity that is needed to guide decisions within a state or community, state and local public health agencies, local planning agencies, and Metropolitan Planning Organizations, should be encouraged to use the same measures to collect local data. Use of common measures across all levels of government will allow local leaders to compare community supports across different local neighborhoods while using national data as a benchmark.

Supporting Action 17.3: **CDC should convene a broad intra-agency group to explore providing geographic identifiers at the highest resolution possible for respondents to the Behavioral Risk Factor Surveillance System (BRFSS) and the Youth Risk Behavior Survey (YRBS), ideally at the block group, tract, or zip code level.**

Current surveillance survey data lack geographic identifiers below a state or county level due to respondent privacy and confidentiality reasons. Geocodes at higher geographic resolution will enable link-

ages of the survey data with other GIS, audit, and policy data. Such linkage would be particularly helpful in examining geographic and demographic inequities in community supports for physical activity. They can also be important in enabling analyses to better support decisions around physical activity supports. Changing current CDC practices would likely require policy change, given privacy concerns, and would be complex, given the multiple stakeholders involved. However, providing more specific geographic identifiers would substantially expand the value of surveillance data and benefit users of many components of these data.

Supporting Action 17.4: **CDC should recommend changes in Research Data Center (RDC) practices to facilitate wider access to geocoded NHIS survey data.**

Current RDC procedures present barriers to use of block group level data in NHIS. When linkages between datasets have been made for one user, those linked data will be more useful if approval is extended to other qualified users, with simplified application procedures. For example, NHIS data have been linked to the U.S. Environmental Protection Agency's (EPA's) Smart Location Database[2] at the block group level, and these linked data could be made available to others. Broader access to linked data through the RDC would benefit public health surveillance and research.

Strategy 18

Identify and compile GIS-based data sources and methods to facilitate national surveillance of community supports for physical activity.

Background

Objective measurement of community supports using GIS is an important component of a surveillance system for physical activity. The depth and availability of GIS data on community supports varies by sector. For instance, transportation system characteristics such as the presence of public streets and number of street lanes are collected, distributed, and regularly updated by the U.S. Census Bureau (U.S. Census Bureau, 2018). Other data

[2] Available at https://www.epa.gov/smartgrowth/smart-location-mapping (accessed March 25, 2019).

such as the presence and quality of sidewalks, bicycle facilities, and parks are not collected nationally, but some municipalities and regional agencies collect, maintain, and disseminate these data. Availability of GIS data on land uses and places people visit (e.g., libraries, health care clinics, stores), building footprints, and building intensity varies considerably across cities, and no single national source exists. Some private firms commercialize GIS-related information based on administrative records, such as employment reporting and county and municipal permits, that can be used to infer land uses and destinations (e.g., National Employment Time Series, InfoUSA/ReferenceUSA). Others have recently used image processing to develop a national inventory of buildings (Microsoft, 2018), but this technique has not been applied to examine community supports relevant to physical activity. Finally, indices (e.g., WalkScore®, BikeScore®, ParkScore®) that attempt to encapsulate in a single score the degree of community support for a specific physical activity behavior have been developed and commercialized recently and are also being increasingly used in research (Hirsch et al., 2014; Braun et al., 2016).

Findings

There is no centralized repository of up-to-date and consistent GIS data on community supports. Given the large number of potential GIS measures of local community supports, it would be beneficial to identify which are key measures (starting with the constructs in Box 5-1). It is desirable that data on community supports are available at small geographic units, which helps support local decision making and enables linkage to other data such as the U.S. Census block groups, tracts, and zip codes.

EPA's Smart Location Database makes available more than 90 indicators associated with the built environment at the Census block group level nationwide, as well as publicly available walkability and public transportation access indices. The current version of the database (2.0) has data from 2010 to 2013, but it is undergoing an update, providing continuity and opportunity for improvement. Similarly, the National Environmental Database (NED)[3] provides data at the block group level for metropolitan areas. The NED has overlap with EPA's database, but adds important new measures and constructs such as employment mixing, pedestrian fatality rates, and the presence of open space and tree canopy. Appendix E provides an introduction to GIS methods and illustrates the creation of a physical activity–related environmental indicator.

[3] Available at http://ned.ud4htools.com (accessed March 11, 2019).

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 18.1: **CDC should partner with the EPA Smart Location Database developers and the NED developers for national surveillance of GIS sources of community supports for physical activity.**

Together these databases can serve a variety of users, ranging from individuals with little GIS experience to sophisticated users. When feasible and appropriate, it is beneficial for the updated database to retain the base year data, enabling longitudinal analyses of change in community supports. Enhancements to the user interface of EPA's Smart Location Database could facilitate more practical and research use. Similarly, it would be helpful to make the GIS data available online in multiple formats to enable downloading data to conduct offline analyses or make linkages with other data. Many private firms, such as Esri, Google, and Here, also host a wide range of data, so it would be worthwhile exploring a public–private partnership to further extend the range of available GIS variables.

Supporting Action 18.2: **The Joint Call to Action to Promote Healthy Communities should lead a consensus process to recommend GIS measures relevant to community supports for active transportation and recreation that could be adopted by local, state, and federal agencies.**

The Joint Call to Action to Promote Healthy Communities is a multidisciplinary collaborative effort among eight[4] national organizations to create healthier, more equitable communities. Additional representation from the transportation sector may be beneficial, such as the Institute of Transportation Engineers, the American Association of State Highway and Transportation Officials, or the National Association of City Transportation Officials. The process of recommending GIS measures can start with the prioritized measures identified in Box 5-1. Multilevel adoption of consis-

[4] American Institute of Architects, American Planning Association, American Public Health Association, American Society of Civil Engineers, American Society of Landscape Architects, National Recreation and Park Association, Urban Land Institute, and U.S. Green Building Council.

tent measures would foster comparability of data across levels of government.

Supporting Action 18.3: **CDC should pursue low-cost opportunities to assemble a national GIS database of community supports data that are already collected at the local or state level but require compilation and harmonization.**

One promising possibility is to assess features of the streetscape that are not captured in a centralized database, such as the presence and quality of facilities that support walking, bicycling, running, and other physical activities. For example, most large metropolitan areas already post public databases for bicycle facilities (Braun, 2019) and parks, but they are not harmonized nor integrated into a single database. The focus on parks is particularly important given the various types of physical activities and individuals they serve and the various ecosystem services they provide. Inclusion of green space measures in the NED is encouraging, but the measures are not specific to parks. An open-source approach to building a database could be considered. Making methods transparent and accessible for improvement could facilitate adoption of the national methods by local stakeholders, but attention would have to be paid to data consistency and quality when incorporating data from local sources.

Another possibility is to encourage state departments of transportation to make location-specific, transportation-related injury data available online, separately for pedestrian and bicycle users. The committee recognizes the availability of national fatality data, but non-fatal crashes for pedestrians and bicyclists could also be used as a marker of community supports. Data on both non-fatal and fatal crashes can identify "hot spots" or locations of concern for safety.

Supporting Action 18.4: **CDC should collaborate with the Joint Call to Action to Promote Healthy Communities to explore options for collecting and compiling GIS data for small towns, rural areas, and tribal nations.**

It appears that relevant GIS data for small towns, rural areas, and tribal nations are particularly rare, and it is expected that community supports also will be less available in these areas. These expected inequities are of increasing interest due to worsening health conditions of populations living in such areas. Thus, it would be useful to convene diverse partners to investigate whether relevant

GIS data might be available and consider options for expanding data collection in small towns, rural areas, and tribal nations.

Strategy 19

Explore opportunities for partnering with professional organizations to query their membership about physical activity–supportive policies in the communities where they work and to share policy tracking data for surveillance purposes.

Background

Most (if not all) of the community support constructs are influenced by policies, either directly (e.g., community design, streetscapes, programs) or indirectly (e.g., perceptions of safety) (Giles-Corti et al., 2016). Policies can be generated in different ways, such as by legislation, by agency regulation, by professional association guidelines and standards, and by companies. Policies are made at local, state, and national levels, sometimes with relevant policies at all three levels, such as with transportation. However, few policies that affect community supports for physical activity are under the jurisdiction of public health. The professionals most knowledgeable about community support policies are in fields such as urban planning, transportation, parks and recreation, landscape architecture, education (for schools), and employers (for workplaces).

Findings

It is not feasible for one centralized group to conduct national surveillance of community support policies, given the number of sectors, involvement of multiple levels of government, and complexity of content. Multisector collaboration is imperative for developing surveillance systems for community support policies.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 19.1: **CDC should facilitate partnerships with public health and non-health professional organizations to develop and implement surveys of their members about policies relevant to community supports for physical activity.**

Most professional organizations conduct periodic surveys of their membership. These professionals are likely to be the most knowledgeable sources about policies in the communities where they work. Organization-specific survey questions and methods can help assess policies within each professional organization's sphere of practice. The partnership with professional organizations could develop a consensus list of constructs to include in their periodic member surveys. The commissioned report and survey of members of a professional organization (see Appendix E, Part I) can be considered as an initial resource for creating final surveys. Different constructs may apply to different groups of professionals given that their scopes of practice (e.g., parks, transportation, land use, public health) also differ. Documentation of reliability and validity for proposed survey items is needed.

Because organizations have members in every state and in many towns and cities, surveying a sample of members could provide national estimates about a wide variety of policies. The American Planning Association, the National Association of City Transportation Officials, and the Institute for Transportation Engineers are relevant for community design, street design, and transportation system policies. The National Recreation and Park Association is relevant for parks policies. The International City and County Managers Association surveys its members about sustainability policy, and some of these topics could be related to community supports for physical activity. The American Public Health Association, Association of State and Territorial Health Officials, and National Association of County & City Health Officials could collect data about relevant public health policies. The Joint Call to Action for Healthy Communities has compatible goals and may be another potential partner. Ideally, partnerships would meet each party's goals and be maintained over years so that trends in policy change can be monitored. Such partnerships are likely to require some level of funding to support the professional organizations.

Supporting Action 19.2: **CDC should collect policies and plans from advocacy organizations that already track policies and support those organizations in their data collection efforts.**

Several advocacy organizations routinely track policies in their sphere of interest, and some have longitudinal data about policies. These groups could partner with CDC to use their data for surveil-

lance purposes. Examples of relevant groups and their spheres of interest are:

- Complete Streets Coalition, which tracks adoption of policies consistent with active transportation.
- Form-Based Code Institute, which tracks adoption of zoning codes that are compatible with walkability.
- Safe Routes to School National Partnership, which tracks adoption and implementation of policies and programs.
- Vision Zero Network and the Road to Zero Coalition, which track adoption of policies that set transportation safety goals that are consistent with physical activity promotion.
- National Association of City Transportation Officials, which tracks adoption of street design standards that are consistent with active transportation.

Strategy 20

Develop and standardize methods for linking policies, self-reported surveillance systems, and environmental geospatial data to identify opportunities to support physical activity.

Background

Existing policies can provide valuable information about the regulatory and institutional requirements and incentives for, and possible barriers to, community supports for physical activity. Self-reported data also provide information about the perceived presence and quality of these supports. Linking these data sources with other geospatial data is critical to understanding possible underlying causes for the presence or absence of supports, examining inequities in the distribution of supports across sociodemographic groups, and identifying opportunities for further improvements.

Findings

There is variation in the relevance of spatial information as is relates to assessing policies that influence community supports. In some cases, policies cover entire jurisdictions and may not vary from one location to the next. For example, minimum sidewalk widths or design standards for curb cuts may apply uniformly in a given jurisdiction (National Association of City Transportation Officials, 2013). In other cases, policies can vary considerably across space. Zoning and maximum speed limits are policies that may

vary based on the characteristics of the neighborhood under consideration (Chriqui et al., 2016).

Linkages at smaller geographic units (e.g., tract, block group, zip code) are preferable to aggregate linkages (e.g., county) as long as confidentiality and privacy of respondents can be preserved. The U.S. Census Bureau and other U.S. federal agencies have developed a system for assigning unique numerical codes called geographic identifiers (GEOIDs) to geographic entities.[5] These identifiers are key to organizing, presenting, and linking policies, self-reported data, and other environmental data within and across geographies. GEOIDs can be included in policies and self-reported data when geographic linkages are desired.

Supporting Action for Implementation

The committee recommends the following action to support this strategy:

> ***Supporting Action 20.1:*** **CDC should establish partnerships between public health organizations and non-health organizations to use common GEOIDs to link geospatial policy, self-reported surveillance systems, and environmental data.**
>
> GEOIDs simplify the linkage of geospatial data. Whether spatial relationships are hierarchical (with blocks nested within block groups, which are nested within tracts, which are nested within counties and states) or not (e.g., zip code tabulation areas and state legislative districts are nested only within states), the identifiers enable quick linkage of data at the most disaggregated level possible.

Strategy 21

Identify a brief set of prioritized constructs and methods that could be assessed using audits (observations) of streets, parks, and other relevant public spaces.

Background

Community design, street design, and park environment features can be assessed through direct observation, often called audits (Brownson, 2009).

[5] Available at https://www.census.gov/geo/reference/geoidentifiers.html (accessed March 4, 2019).

Audits generally involve a trained observer using a systematic coding protocol to identify features of streets, intersections, and parks. Observational measures of schools and buildings are less developed. Audits are often conducted in person, but comprehensive photographic records of all streets in most U.S. cities, such as Google StreetView™, allow online assessments.

An advantage of the observation method is that more detailed local data can be collected than are available through other measurement modes. Community design variables, especially land uses and macro-level street features like street connectivity, can also be quantified with GIS, but observational methods may provide more detail. Observational methods are particularly useful for assessing street design details that are rarely available in GIS databases and measured only crudely through self-reports. Most street observational measures assess key street design variables including presence and quality of sidewalks, quality of street crossings, presence of traffic controls at intersections, presence of aesthetic features like trees and well-maintained buildings, and signs of social disorder such as graffiti and boarded-up buildings. Park observations usually assess presence and quality of physical activity and sport facilities, aesthetics, and amenities such as water fountains, restrooms, benches, and parking.

Observations of streets and parks are indicators of the quality of the built environment, and they have been shown to be related to physical activity in multiple age groups even after adjusting for walkability (Cain et al., 2014). Park observation scores have also been related to number of people and overall physical activity in parks (Geremia et al., 2018). Observational data have demonstrated sensitivity to socioeconomic and race/ethnicity group inequities that exist in the quality of these community supports (Engelberg et al., 2016; Thornton et al., 2016).

Findings

There is no centralized repository to store nationwide observational data on street designs and parks. Numerous measures for observing street designs and parks have been published, with documented inter-observer reliability (Brownson, 2009). However, most observational instruments are lengthy to complete, many measures lack clear scoring guidelines, and data collection is labor-intensive and may involve travel. As a result, observational measures appear to be used infrequently for either research or practice. Conducting observations online using images such as Google StreetView™ still requires trained data collectors, but cost savings are realized by eliminating travel to the location being observed (Rzotkiewicz et al., 2018). Diverse technologies such as artificial intelligence could be leveraged to collect observational data on a broad scale within the next 5 to 10 years.

Supporting Actions for Implementation

The committee recommends the following actions to support this strategy:

Supporting Action 21.1: **CDC should convene a multisector group of academics and practitioners to agree on constructs and items that should be assessed in nationwide observations of street designs, parks, and other physical activity environments, using standard instruments.**

There are many existing measures to draw from, but the consensus group may need to develop new items or even new instruments for specific settings. For example, observational measures specific to school and workplace environments could complement other surveillance strategies for these settings.[6]

Supporting Action 21.2: **CDC should organize a community of practice[7] for investigators working on automated computer vision assessment methods that can be applied to physical activity–related variables. This community of practice should be supported to accelerate work on computer vision methodology that could be used for surveillance of street designs and parks.**

Computer vision and machine learning are active areas of study in engineering and computer science. The technology is progressing rapidly because it is central to the operation of autonomous vehicles and is thus attracting substantial investment. The technology is already being used to measure details of roadways, so it appears feasible to integrate computer vision and artificial intelligence to assess attributes of street designs and parks that would be useful for physical activity surveillance. Images could be supplied from the fleets of vehicles currently assessing roadways as input to support vehicular automation, from vehicles systematically driving around streets (e.g., collecting street images for Google StreetView™), or from vehicles conducting their regular business (e.g., waste collection). The technology can also be used with overhead imagery from

[6] Also see Chapter 2 on children and Chapter 4 on workplaces.

[7] A community of practice refers to the group of researchers and practitioners who use computer vision and machine learning to identify supports for physical activity from digital images. These individuals and organizations come together, physically or digitally, under the umbrella of a community of practice to discuss applications, analytical approaches, data sources, and results, among others.

drones and high-resolution satellites or from oblique photographs that provide a sense of perspective. High-resolution aerial imagery seems particularly helpful to code park attributes. Care should be taken in ensuring that disadvantaged groups and their communities are not underrepresented in these data and further disadvantaged. Appendix E contains more information on this topic.

Supporting Action 21.3: **NIH, CDC, or the National Collaborative on Childhood Obesity Research (NCCOR) should design and fund a research program to sustain development of user-friendly apps and training/certification methods for use with citizen-science and crowd-sourced methods of collecting observational data. The research program should include strategies for partnerships that would facilitate national-scale data collection.**

Even if technology advances to the point when automated national surveillance of street design and park attributes is possible, there may still be advantages of developing methods of personal observation that can be scaled up. The reliability of data collected by humans relative to machines is likely to vary based on the characteristics of the data being collected as well as the training and background of data collectors. Examples of community supports that can be crowd-sourced include incivilities such as graffiti and litter, the presence of benches and trash bins, aesthetic qualities like trees and landscaping, and quality of sidewalks, bicycle facilities, and street crossings. In the event that technological approaches do not meet the needs of surveillance systems, personal observation could become a more important method. Personal observations could provide additional benefits in terms of educating observers about how environments can influence health and promoting informed engagement in decision making about their community.

The following actions and goals are likely to lead to a system of personal observation that could be used for national surveillance.

- Investigators attend conferences and trainings to explore best practices in citizen science and crowd-sourcing.
- Investigators develop and evaluate promising methods of recruiting, training, certifying, and retaining observers, ideally those residing in the communities where data are being collected. National membership organizations could be engaged

as partners in creating a national network for implementing this strategy.
- In a national system, trained observers are deployed to specific locations to achieve sufficient coverage of streets and parks. Methods for assigning locations for observations are developed and evaluated.
- Technology is developed to support citizen-science and crowd sourced observations, including apps for data collection and automatic geocoding of observations within GIS.
- Investigators develop and validate sampling strategies for personal observational methods to adequately characterize a neighborhood. Sampling strategies reduce the time and effort needed to characterize environments for neighborhoods. It will be important to ensure equitable inclusion of lower socioeconomic status areas, communities of color, and tribal nations in sampling strategies.

Strategy 22

Identify methods to assess physical activity events, programs, social environments, and promotion resources.

Background

The underlying concept is that the diverse community supports covered in this strategy enhance the likelihood of community residents being active. It is expected that the more events, programs, social environments, and promotions, the better for physical activity, though evidence is variable. There are concerns about inequities in all these resources within and across communities. Physical activity events and programs encourage use of facilities such as parks, trails, and other public spaces. There is growing interest in the potential of physical activity programs in public settings to produce health benefits, such as exercise classes in parks and Open Streets events (Giles-Corti et al., 2017). Physical activity programs often serve specific age, sex, or race/ethnic groups, adding to the complexity of their assessment.[8]

Various aspects of the social environment are relevant for physical activity, such as social norms about being active, positive and negative responses to people being active, fear of crime, depictions of physical activity and sedentary behavior in the media, and advertising for products and

[8] Programs based in schools and early childhood facilities are covered in Chapter 2, and workplace programs are covered in Chapter 4.

programs that promote being active or sitting. Physical activity promotion resources refer to personnel, budgets, training programs, and advocacy efforts that enable proportionate responses to the epidemic of physical inactivity, especially by public health departments (Yancey et al., 2007).

Findings

No systematic approaches exist for monitoring physical activity events, programs, social environments, or promotion resources as they relate to community supports. Each category is complex, dynamic, and difficult to assess. Residents would likely have limited information about these resources in their community, unless they had direct contact through participation. There is likely no single person or professional group that would be informed about all aspects of any one category of supports. There are widely used measures of most of the social environment constructs, but it is unclear how suitable these would be for surveillance purposes. In the Healthy Community Study, a resource-intensive method of identifying and interviewing multiple key informants in each community was used to quantify physical activity events and programs (Collie-Akers et al., 2018), but this method does not seem feasible for national surveillance. There can be substantial difficulties in assessing physical activity promotion resources even in public health departments, because physical activity resources may not be separable from resources devoted to chronic disease control more broadly.

Although it is questionable whether methods could be developed to obtain a subset of these components of community supports in a systematic, reliable, and cost-effective way, these supports play an important role, are modifiable in the short term, and can be inequitably distributed. Thus, it is critical to attempt to develop methods that could be used for surveillance purposes.

Supporting Action for Implementation

The committee recommends the following action to support this strategy:

> ***Supporting Action 22.1:*** **NIH, CDC, or NCCOR should create a research program to develop and evaluate methods to assess high-priority physical activity events, programs, social environments, and promotion resources that could be used for surveillance purposes.**

These community supports are relevant for all age groups, but many physical activity programs in particular are targeted to chil-

dren and adolescents.[9] The diversity of community support categories named in this strategy warrant a variety of approaches, each with its own evaluation. Because there are likely to be inequities in access to some of these community supports, it will be important for methods to be sensitive to these inequities, especially by sex, income, and race/ethnicity groups. For events and programs, it would be useful to collect data on frequency, duration, and cost. Engaging national partners in efforts to create and evaluate data collection strategies could enhance chances of success by building existing capacity and local knowledge. Examples of partner organizations include

- Partner with the National Recreation and Park Association and the National Park Service to survey members about physical activity events and programs.
- Partner with YMCAs to survey local Ys about physical activity events and programs.
- Partner with the American Public Health Association, Association of State and Territorial Health Officials, and National Association of County & City Health Officials to survey health departments about physical activity promotion resources.
- Partner with the United Way to assess locations and characteristics of physical activity programs in its 211 system, which helps people find local resources.
- Partner with the County Extension system to develop monitoring systems for physical activity events and programs, particularly in rural areas.
- Partner with the Indian Health Service and national organizations of American Indians to develop methods for assessing resources on tribal lands.
- Partner with affinity groups such as Outdoor Afro, Girl Trek, and Girls on the Run, which are associated with individuals who are less covered through mainstream programming.

CONCLUSION

Many aspects of built and social environments influence individuals' decisions to be active, and evidence on the effects of these community supports is mounting. Because multiple non-health sectors and government agencies have expertise and data that are integral to assessing a

[9] See Chapter 2 for additional recommendations about assessing physical activity programs targeting children.

community's influences on physical activity, a multisector approach is an imperative element of surveillance of community supports. The 6 strategies and 15 implementation actions described in this chapter are expected to promote the multisector collaboration that can help achieve such surveillance, and ultimately achieve more widespread community supports for physical activity.

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Appendix A

Acronyms and Abbreviations

6MWT	6-minute walk test
ACSM	American College of Sports Medicine
ATUS	American Time Use Survey
BMI	body mass index
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CLASS	Classification of Laws Associated with School Students
CMS	Centers for Medicare & Medicaid Services
DPP	Diabetes Prevention Program
EHR	electronic health record
EPA	U.S. Environmental Protection Agency
FDA	U.S. Food and Drug Administration
GEOID	geographic identifier
GIS	geographic information system
GPS	global positioning system
HERO	Health Enhancement Research Organization
HHS	Department of Health and Human Services

HIT	Health Information Technology
HOS	Medicare Health Outcomes Survey
IOM	Institute of Medicine
MEC	NHANES Mobile Examination Center
MVPA	moderate to vigorous physical activity
NAMCS	National Ambulatory Medical Care Survey
NCCOR	National Collaborative on Childhood Obesity Research
NCHS	National Center for Health Statistics
NCI	National Cancer Institute
NCQA	National Committee for Quality Assurance
NED	National Environmental Database
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey
NIH	National Institutes of Health
NNYFS	NHANES National Youth Fitness Survey
NQF	National Quality Forum
NRPA	National Recreation and Park Association
NSCH	National Survey of Children's Health
ONC	Office of the National Coordinator
PAVS	physical activity vital sign
PCP	primary care practitioner
PedsPAVS	pediatric physical activity vital sign
RDC	Research Data Center
SHPPS	School Health Policies and Practices Study
WHA	Workplace Health in America survey
YRBS	Youth Risk Behavior Survey
YRBSS	Youth Risk Behavior Surveillance System

Appendix B

April 2017 Convening Agenda, Participant List, and Discussion Paper

CONVENING AGENDA

Actions to Improve Physical Activity Surveillance in the United States

Physical Activity and Health Innovation Collaborative of the Roundtable on Obesity Solutions

April 25–26, 2017

Lecture Room
National Academy of Sciences Building
2101 Constitution Avenue, NW, Washington, DC

Purpose of meeting: Identify specific solutions to improve physical activity surveillance in the United States, including recommended actions for implementing the solutions. Areas of focus include

- compliance of physical activity recommendations for children;
- practice change of health care providers and referrals to community resources;
- supportive workplace environments; and
- community-level supports for active transport.

DAY 1 – APRIL 25

8:30 am **Light Breakfast**

9:00 am **Welcome, Introductions, Defining the Problem, and Goals of the Meeting**—Lecture Room
Russ Pate

9:30 am **Subgroup Discussions**—Proceed to Respective Breakout Rooms
Board Room—Children—*Russ Pate*
Room 227—Health Care—*David Buchner*
Room 114—Workplace—*Laurie Whitsel*
Room 250—Community Supports for Active Transportation—*Susan Carlson, Janet Fulton*

[Break(s) at the discretion of subgroup leads.]

12:00 pm **Lunch and Networking**

1:00 pm **Continue Subgroup Discussions**—Return to Respective Breakout Rooms

2:00 pm **Report Out from Subgroups**—Return to Lecture Room **(~10 min. each)**
Children—*Russ Pate*
Health Care—*David Buchner*
Workplace—*Laurie Whitsel*
Community Supports for Active Transportation—*Susan Carlson, Janet Fulton*

Report Out on Cross-Cutting Issues (~5 min. each)
Eduardo Sanchez
Jim Whitehead

3:00 pm **Subgroup Collaboration Round 1**
Board Room—Health Care and Children
Room 250—Community Supports and Workplace

3:45 pm **Subgroup Collaboration Round 2**
Board Room—Health Care and Workplace
Room 250—Community Supports and Children

4:30 pm **Full Group Discussion**—All Subgroups Return to Lecture Room

5:00 pm **Adjourn**

DAY 2 – APRIL 26

8:30 am **Light Breakfast**

9:00 am **Continue Subgroup Discussion**—Proceed to Respective Breakout Rooms
Board Room—Children—*Russ Pate*
Room 227—Health Care—*David Buchner*
Room 114—Workplace—*Laurie Whitsel*
Room 250—Community Supports for Active Transportation—*Susan Carlson, Janet Fulton*

[Break(s) at the discretion of subgroup leads.]

12:00 pm **Lunch and Networking**

1:00 pm **Final Report Out from Subgroups**—Return to Lecture Room
Children—*Russ Pate*
Health Care—*David Buchner*
Workplace—*Laurie Whitsel*
Community Supports for Active Transportation—*Susan Carlson, Janet Fulton*

Report Out on Cross-Cutting Issues (~5 min. each)
Eduardo Sanchez
Jim Whitehead

[Break(s) at the discretion of meeting coordinators.]

2:30 pm **Summary and Next Steps**

2:45 pm **Group Photo**
(Proceed to the front of the building [facing Constitution Avenue].)

3:00 pm **Adjourn**

PARTICIPANT LIST

Children Subgroup

Russell Pate, Subgroup Lead, Chair, Physical Activity and Health Innovation Collaborative
David Berrigan, Planning Group Member, National Institutes of Health (NIH)
Charlene Burgeson, Partnership for a Healthier America
Genevieve Dunton, Planning Group Member, National Physical Activity Plan Alliance (NPAPA)
Peter Katzmarzyk, Pennington Biomedical Research Center
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Margo Pedroso, Safe Routes to School National Partnership
Karin Pfeiffer, Michigan State University
Debbie Rohm-Young, Kaiser Permanente
Sandy Slater, University of Illinois at Chicago

Health Care Subgroup

David Buchner, Subgroup Lead, NPAPA
Cedric Bryant, American Council on Exercise
Liz Joy, American College of Sports Medicine (ACSM) President and Intermountain Healthcare/University of Utah School of Medicine
Felipe Lobelo, Emory University
Natalie Muth, Rady Children's Hospital
Kevin Patrick, University of California, San Diego
Rick Troiano, Planning Group Member, NIH

Workplace Subgroup

Laurie Whitsel, Subgroup Lead, American Heart Association
Chris Calitz, American Heart Association
Joanna Frank, Center for Active Design
Jessica Grossmeier, Health Enhancement Research Organization
Kristen Monaco, Bureau of Labor Statistics
Heather Patrick, Carrot Sense, Inc.
Keshia Pollack Porter, Johns Hopkins University
Nico Pronk, HealthPartners
Jim Pshock, Bravo Wellness
Giselle Sebag, Center for Active Design
Kathy Watson, CDC

Community Supports Subgroup

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Sara Zimmerman, Safe Routes to School National Partnership

Cross-Cutting Issues

Eduardo Sanchez, Planning Group Member, American Heart Association
Jim Whitehead, Planning Group Member, ACSM

Attendees

Rachel Banner, National Recreation and Park Association
Paul Branks, ACSM
Stacey Burr, Adidas
Bill Dietz, The George Washington University
Erikka Moreno, Build Our Kids' Success (BOKS)

Discussion Paper: Actions to Improve Physical Activity Surveillance in the United States

Russell R. Pate, PhD, University of South Carolina; **David Berrigan, PhD, MPH,** National Institutes of Health; **David M. Buchner, MD, MPH,** University of Illinois at Urbana-Champaign; **Susan A. Carlson, PhD,** Centers for Disease Control and Prevention; **Genevieve Dunton, PhD, MPH,** University of Southern California; **Janet E. Fulton, PhD,** Centers for Disease Control and Prevention; **Eduardo Sanchez, MD, MPH, MS,** American Heart Association; **Richard P. Troiano, PhD,** National Institutes of Health; **James Whitehead,** American College of Sports Medicine; **Laurie P. Whitsel, PhD, FAHA,** American Heart Association

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Disclaimers
The convening and the proposed actions described were developed by meeting participants. The convening entity was the Physical Activity and Health Innovation Collaborative, an ad hoc activity associated with the Roundtable on Obesity Solutions at the National Academies of Sciences, Engineering, and Medicine. The responsibility for the content rests with participants and not with the National Academies.

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September 24, 2018

DISCUSSION PAPER

Actions to Improve Physical Activity Surveillance in the United States

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September 24, 2018

Background

Physical activity, which has been defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" [1], provides important health benefits across the lifespan. However, a large percentage of Americans fail to meet current physical activity guidelines, and this deficiency accounts for a sizeable population health burden.

A core function of public health, "surveillance" refers to "ongoing, systematic collection, analysis, and interpretation of outcome-specific data for use in the planning, implementation, and evaluation of public health practice" [2,3]. There are many different forms of physical activity, and physical activity is performed at varying intensities, in numerous settings, and for multiple reasons. Physical activity behavior is known to be influenced by personal, social, physical, environmental, institutional, community, and societal factors. Because physical activity is a complex behavior, physical activity surveillance is a complex, multicomponent process.

In the U.S., the existing system for surveillance of physical activity includes some important resources, but it also includes many gaps, catalyzing the need to develop a more robust physical activity surveillance system in the United States—a priority identified in the 2016 National Physical Activity Plan [4].

Introduction

The Physical Activity and Health Innovation Collaborative (PA IC) is an ad hoc activity affiliated with the Roundtable on Obesity Solutions at the National Academies of Sciences, Engineering, and Medicine. The PA IC brings together individuals from various disciplines and sectors—such as academia, government, nonprofit organizations, foundations, health care, and the private sector—to discuss strategies to promote active lifestyles among Americans. Consistent with this goal, the PA IC convened a panel of experts in April, 2017 to catalyze development of a more robust physical activity surveillance system in the U.S. Representatives from key organizations—including the American College of Sports Medicine, American Heart Association (AHA), Centers for Disease Control and Prevention (CDC), National Institutes of Health, and National Physical Activity Plan Alliance—formed a planning group and organized the meeting, which brought together 42 experts April 25-26, 2017, in Washington, DC.

The purpose of the meeting was to identify specific actions that could improve physical activity surveillance in the United States and to suggest approaches for moving forward on those actions. The experts attending the meeting represented four priority areas: 1) children and youth, 2) health care, 3) workplaces, and 4) community supports for active transportation. The experts used the 2014 meeting's overarching strategies and priorities identified to guide the future of

DISCUSSION PAPER

physical activity surveillance as a framework for the initial planning [3]. Prior to the in-person meeting, participants engaged in advance work to decide on organizational schemes to guide the in-person discussions and identify current and existing surveillance systems related to relevant policies and programs for each priority area. On the first day of the meeting, the subgroups met to identify critical gaps and opportunities for action to fill those gaps. In a full group session, the experts separated into subgroups focused on each priority area to share and discuss critical gaps and opportunities within each priority area. The full group also identified issues that cut across the priority areas. During the second day, the subgroups identified specific recommended actions within the four priority areas to improve physical activity surveillance in the United States, focusing on those actions that could be undertaken within one to three years. The critical gaps and specific actions identified for the four priority areas are described in the sections below. Expert panelists, working in sub-groups for each of these four areas, identified critical gaps and specified high priority actions for improving surveillance of physical activity. A total of 23 recommended actions were selected to advance surveillance of physical activity in specified population sub-groups and to enhance monitoring of institutional and community supports that influence physical activity behavior.

Children and Youth

The health effects of physical activity in children and youth are well documented. These include more favorable cardiometabolic risk factors, better weight status and body composition, and enhanced cardiorespiratory and muscular fitness. In addition, higher levels of physical fitness are associated with multiple positive indicators of health in youth, and both physical activity and physical fitness are positively associated with academic achievement in children and youth [5,6]. Further, there is growing concern that high levels of sedentary behavior may be associated with negative health outcomes in young people.

Because physical activity and physical fitness are linked to children's health status, efforts to monitor these characteristics in US youth have a long history. Physical fitness was routinely assessed in representative samples of children and youth between the 1950s and the 1980s, and it was assessed in the National Health and Nutrition Examination Survey (NHANES) National Youth Fitness Survey in 2012 [7]. Monitoring of self-reported physical activity in high-school students has occurred regularly since 1991 through the Youth Risk Behavior Survey (YRBS) [8], and accelerometer-measured physical activity was assessed in representative samples of US children and youth in the 2012 NHANES National Youth Fitness Survey. In addition, selected sedentary behaviors have been assessed in YRBS and the NHANES surveys [9]. The status of school physical education and other school-based physical activity policies and programs was assessed regularly at the national level from 1994 to 2016 through the School Health Policies and Practices Study [10]. School Health Profiles (Profiles), an ongoing system of surveys, assesses school health policies and practices in states, large urban school districts, and territories [11]. Profiles monitors the status of school-based physical education, classroom physical activity breaks, intramural sports, interscholastic sports, and access to physical activity facilities.

Gaps

As noted above, the physical activity surveillance system in the United States has included some important resources for assessing physical activity in children and youth. However, the system is also lacking in some areas. The subgroup on surveillance of physical activity in children and youth identified two critical gaps.

First, existing physical activity surveillance systems provide ongoing monitoring of physical activity levels only for self-reported physical activity in high school students. Because YRBS reports on students in grades 9-12, large gaps exist in our knowledge of physical activity behavior in younger children (ages 2-14). Of note, while limited as an overall measure of physical activity, data on self-reported physical activity is essential for other purposes, such as social context, physical context, and specific forms of physical activity. In addition, despite important advances in wearable devices that measure physical activity, current physical activity surveillance systems are not regularly using the data produced by these devices. Existing systems are limited in the extent to which they monitor children's participation in specific forms of physical activity or their engagement in specific types of physical activity programs (e.g., community-based youth sports programs, school-sponsored sports, dance lessons).

Second, physical activity in children and youth is influenced by a wide variety of factors, including en-

vironmental factors and institutional policies and practices. However, comprehensive national surveillance of those environmental factors and policies and practices is currently not performed. No surveillance system monitors physical activity policies and practices in child-focused settings other than schools, including child care centers and community-based organizations.

Recommended Actions

Establish and administer a protocol that monitors, at regular intervals, physical activity, sedentary behavior, and physical fitness in nationally representative samples of children and youth ages 2-18. Examples of key strategies could include:

- Incorporate into future cycles of NHANES physical activity and sedentary behavior measured by wearable devices, and measures of physical fitness in children and youth ages 2-18.
- Modify or expand the existing YRBS to provide state-of-the-art information on participation in specific forms of physical activity and sedentary behavior, and expand the middle school YRBS to be representative of the United States.

Monitor participation of children and youth ages 2-18 in specific forms of physical activity and monitor their sedentary behavior (e.g., television watching, studying) by incorporating state-of-the-art self-reporting instruments into existing programs and surveillance systems. Some examples of systems that could be modified to address this include NHANES, YRBS, National Health Interview Survey (NHIS) [12], and National Survey of Children's Health [13].

Monitor prevalence of physical activity assessment, counseling, and referral of children by health care providers to community-based providers of physical activity services to youth (also see the "Health Care Settings" section). Potentially relevant systems include National Ambulatory Medical Care Survey [14], Medical Expenditure Panel Survey [15], NHIS, and the Healthcare Effectiveness Data and Information Set (HEDIS) [16].

Enhance surveillance systems that monitor school-based physical activity policies and programs, such as the School Health Profiles. For example, additional information consistent with the Comprehensive School Physical Activity Program model [17] could be collected.

Develop and, where feasible, implement new protocols for monitoring physical activity behavior and factors influencing physical activity behavior. Examples of key strategies could include:

- Develop a protocol that leverages ongoing school-based administration of physical fitness tests, such as FitnessGram [18], to monitor fitness levels of children and youth in the US population.
- Explore development of a physical activity surveillance protocol that would leverage device-based (e.g., fitness trackers, smart watches) or self-reported indicators of physical activity provided by convenience samples of children and youth.
- Develop and implement a system for monitoring physical activity policies and practices in child care centers and preschools.
- Develop and implement a system for monitoring community-level availability of sports and other physical activity programs for children and youth.
- Identify elements of the built environment that influence physical activity in children and youth, and embed assessment of the perceived availability and utilization of those resources in existing surveillance systems. Relevant systems include NHANES, YRBS, NHIS, and National Survey of Children's Health.

Health Care Settings

Strong scientific evidence demonstrates that physical activity both reduces the risk of many chronic medical conditions and provides effective treatment for many diseases. Hence, strong consensus exists that health care providers and health care systems should promote physical activity to patients. For example, Healthy People 2020 includes objective PA-11: "Increase the proportion of physician office visits that include counseling or education related to physical activity" [19]. The National Committee for Quality Assurance's (NCQA's) HEDIS includes quality-of-care measures for assessing physical activity in children and older adults and counseling on such activity [16].

DISCUSSION PAPER

Monitoring in the health care setting involves two activities: 1) assessing a patient's current level of physical activity and 2) providing advice and/or education about physical activity. The vast majority of health care providers now use electronic health records (EHRs) to document the assessments and services they provide. Thus, assessments of physical activity levels and documentation of advice are included in the EHR with increasing frequency. While EHR data on physical activity are not yet part of national surveillance systems, major precedents exist for using EHR data in surveillance. Data on notifiable diseases collected in health care settings already contribute to national surveillance as part of the National Notifiable Diseases Surveillance System [20]. In addition, the CDC has demonstrated the feasibility of extracting and sharing EHR data for surveillance via its Biosense Platform—an integrated surveillance system for the rapid assessment of bioterrorism-related events [21].

It is appropriate, then, to identify possible ways in which health care data systems can contribute to national surveillance of physical activity in US children and adults. This effort will require identifying gaps in current surveillance data and ways to improve data collection. Whereas other national physical activity data sources provide cross-sectional data, notably, EHRs can provide longitudinal data. Further, using EHR data is efficient, as it provides useful information at three levels: personal (for patient care), local (for population management of diseases and risk factors by health care systems), and national (for surveillance).

Gaps

The subgroup on surveillance of physical activity in health care settings identified four important gaps in existing surveillance systems in this area.

First, current surveillance systems have limited specificity and capacity to characterize physical activity levels in population subgroups of interest, including people with specific diagnoses, specific high-risk groups, and rising-risk groups (such as those with an increasing risk of fall injuries). EHR data could potentially address this limitation. However, data on physical activity levels of patients are not yet widely documented in EHRs, and initiatives proposing that physical activity be added as a "vital sign" in the EHR have not yet achieved widespread success.

Second, there is no standardized and widely used quality-of-care measure for monitoring the quality of counseling on and promotion of physical activity in adults in health care settings (although, as noted above, NCQA HEDIS measures do exist for children and older adults).

Third, health care providers do not typically collect data on cardiorespiratory fitness and muscle strength, despite the importance of fitness to health and mortality risk and the fact that feasible clinical measurements exist (e.g., grip strength as a screening test for sarcopenia in older adults).

The fourth gap is commented on in other sections of this report: current surveillance systems are not measuring physical activity with wearable devices on a large-scale, ongoing basis. Wearable device technology for measuring physical activity is becoming inexpensive and relatively accurate, and many consumers use it widely. Part of the gap in the use of wearable device data is due to the underdevelopment of information technology for 1) storing and retrieving health care system data, 2) analyzing and interpreting data, and 3) harmonizing data from multiple sources to the national level is not yet well-developed.

For example, most health care systems currently cannot evaluate their efforts to promote physical activity over time, cannot assess prevention of chronic diseases, and cannot calculate return on investment. Health care system assessments of physical activity and the metrics used to score those assessments are not standardized, which complicates data aggregation. An opportunity exists to explore the feasibility of including data from wearable devices in health care system data by launching pilot projects that measure physical activity in high-priority subgroups, where the return on investment is potentially high. There is a longer-term opportunity in the use of device-assisted measures of gait and balance, given that gait and balance are strong predictors of health and mortality risk as people age. For example, the Timed Up and Go (TUG) performance test is useful in assessing risk of falls. Recent studies suggest data from an accelerometer, worn during the TUG test, have the potential to improve the ability of this performance test to measure physical function and estimate risk of falls [22,23].

Recommended Actions

Expand the use of physical activity "vital sign" and "counseling" indicators in health care systems conducting population health management. Methods to measure these indicators already exist, and a dem-

onstration project could leverage existing networks and data-sharing agreements to demonstrate the feasibility of using EHR data for surveillance.

Consider how national health surveys that include questions dealing with physical activity could address both measures of physical activity levels and counseling for physical activity. Currently, some surveys with physical activity content—such as the National Ambulatory Medical Care Survey—do not measure both physical activity levels and counseling.

Design and implement pilot and demonstration projects on the validity and feasibility of routine measurement of grip strength (or grip power) among older people. These measures could be piloted or added to "Welcome to Medicare" visits to systematically monitor muscle strength in older adults.

Design and implement pilot and demonstration projects that assess the use of low-cost, clinic-based, or self-administered walking tests as indicators of cardiorespiratory fitness for older adults.

- For example, the 400 meter walk test can provide a valid estimate of aerobic capacity (peak VO2) in older adults [24]. Potentially, data from a wearable device worn during the walk test could improve the test's ability to estimate aerobic fitness.
- Priority groups for these projects include people at risk or rising risk for cardiovascular disease and/or type 2 diabetes.

Consider how, or if, age-appropriate, self-reported measures of physical activity could be incorporated into existing routine Medicaid assessment questionnaires that deal with preventive health behaviors in children and adults.

- For example, the Staying Healthy Assessment Questionnaire [25] used in California includes questions on physical activity.
- Expanding surveillance in less advantaged populations helps track the effects of public health initiatives to reduce health disparities.

After identifying existing projects and/or implementing new projects, conduct use cases involving monitoring of patients with wearable devices.

- In these projects, select patient target populations based on factors such as morbidity status, utilization, cost, and potential for return on investments in monitoring (e.g., device costs and data analysis costs).
- Although it will take time to scale up surveillance with wearable devices, it is important to "break the ice" with projects that provide a learning laboratory for the use of wearable devices in physical activity surveillance.

Facilitate collaborations between health care systems and public and private partners to increase the capacity of health care systems to store, retrieve, analyze, and interpret physical activity indicators. Examples of key strategies could include:

- Envision a public-private partnership with resources from multiple sources that 1) build capacity to launch and evaluate initiatives to promote physical activity in patient groups, 2) use EHR data to monitor and manage adverse events due to physical activity, and 3) monitor physical activity levels among priority patient subgroups (e.g., physical activity levels in people with prediabetes as an indicator of effectiveness in preventing type 2 diabetes).
- Offer health care systems incentives to use similar data analysis methods and share data to create national-level estimates of physical activity indicators.

Workplaces

Employed adults in the United States spend a majority of their time at work each day. Accordingly, the workplace setting provides an important opportunity to improve physical activity surveillance of adults across the population. Increasingly, employers are integrating physical activity and physical fitness assessment into incentive design and programming. They are also using, and even purchasing, mobile health technologies for more accurate assessment. Surveillance opportunities in the workplace can capture physical activity levels for a significant part of the day and help to evaluate workplace culture, program design, and policies that promote physical activity and active transportation to and from work.

Vendors and health plans are collecting aggregate data from employers across a wide range of industry sectors, employer sizes, job locations, occupations, and types of employees. Some current surveillance systems capture information on workplace physical

DISCUSSION PAPER

activity (e.g., the Occupational Requirements Survey [26], NHANES) and workplace supports for physical activity and physical fitness assessment (e.g., Workplace Health in America [27]). Data systems that may be modified for surveillance include Fitwel [28] and other similar efforts that assess workplace building design and operations; numerous organizational health scorecards [29,30,31] that evaluate the degree to which workplace policies, programs, and environmental supports improve employee health and well-being; health risk assessments and biometric screening; and tracking device data repositories managed by health promotion vendors and suppliers.

Despite a substantial amount of existing data, current surveillance and data collection systems do not capture several key factors. In addition, connecting data from existing systems may provide a broader picture of how the workplace (and transportation to and from work) contributes to overall physical activity and physical fitness across the US population and to identifying disparities.

Gaps

The subgroup on surveillance of physical activity in the workplace identified several important gaps relevant to the adequacy of surveillance in this sector.

Currently, primary constructs for physical activity, physical fitness, and sedentary time are not standardized or integrated across workplace surveillance systems. Additionally, the metrics used to measure physical activity and physical fitness in health risk assessments are not standardized across workplaces and employers. It is important to have the ability to analyze consistent, aggregated data to correlate physical activity and physical fitness with employer size, industry type, health equity attributes, and other demographic variables. Ideally, public and private sources could share data to foster surveillance opportunities on physical activity and physical fitness in the workplace.

Employee-level data can be aggregated, de-identified, and linked to national surveillance or clinical-level databases with appropriate consumer protections. Data privacy issues are paramount with individual-level information. Optimally, personalized health information about physical activity and physical fitness, captured in a health risk assessment or biometric screening, can be linked to the employee's EHR to create linkages to the health care system. The first step is to develop, disseminate, and adopt common metrics for best practice measurement of individual-level physical activity, physical fitness, and sedentary behavior that could be used consistently in data collection efforts through health risk assessments, biometric screening, and/or wearable devices. It will be important that these best practice workplace physical activity and physical fitness metrics are congruent with the Americans with Disabilities Act, Occupational Safety and Health Administration regulations, and state or other regulations that address physical requirements in the workplace.

It is also important to have clear and consistent metrics to evaluate workplace culture, building design, leadership role modeling, and employer support for physical activity and physical fitness. With this information, business leaders, architects, vendors, program designers and human resources personnel will be able to understand the main facilitators of and barriers to successful physical activity– and physical fitness–promoting policies and programs. Current resources do not exist to support comprehensive, longitudinal surveillance efforts, which would coordinate existing systems and fill gaps in datasets.

Recommended Actions

Identify steps to develop a public-private collaborative to convene vendors, employers, and health plans to prioritize constructs and harmonize data collection for the surveillance of workplace physical activity and fitness. Examples of key strategies could include:

- Convene public and private stakeholders to develop and prioritize key indices for workplace physical activity and fitness.
- Coordinate existing surveillance systems for monitoring workplace physical activity and physical fitness in the United States, and include the assessment of the costs of conducting data analysis and the process for adding new questions.

Convene an expert advisory group and writing group to prioritize and harmonize measures for physical activity, physical fitness, and sedentary time used in workplace health risk assessments. Examples of key strategies could include:

- Develop and identify consistent measures for workplace designs and operations, policies, programs, and culture, and employee percep-

tion of support for physical activity that could be included in comprehensive surveillance of physical activity and physical fitness in the workplace.
- Ensure these measures are consistent with the second edition of the Physical Activity Guidelines for Americans [32].

Standardize the measures of physical activity and physical fitness in health risk assessments in the marketplace. An example of a key strategy could include:
- Publish, promote, and disseminate the measures for implementation. Key implementers could include the AHA, Health Enhancement Research Organization (HERO), CDC, NCQA HEDIS, Health Care Systems Research Network (HCSRN) [33], and health promotion vendors and suppliers.

Enhance surveillance systems and improve capacity for monitoring workplace health programs and practices, including the Workplace Health in America study [27]. An example of a key strategy could include:
- Promote longitudinal data collection and conduct additional research.

Explore the feasibility of establishing a repository for workplace data that is publicly available and accessible for research and surveillance purposes. Key exemplars to inform and participate in this effort would be the Employer Measures of Productivity, Absence and Quality [34], National Quality Forum [35], HCSRN, and Integrated Benefits Institute [36].

Investigate the opportunity to include organizational health scorecards (e.g., Fitwel, HERO, AHA, CDC) in workplace surveillance.

Community Supports for Active Transportation

Community supports for physical activity can help to adjust behavior, including the increased use of active forms of transportation. These supports can take numerous forms, including built environment design, policies, social environments, and programs. Active transportation is any human-powered means of travel, such as walking, biking, or wheelchair rolling. Public transport is also a form of active transportation, because it involves walking at the beginning and end of most trips.

Community design can support active transportation in various ways, including by locating residences within short walking distance of stores, workplaces, public transportation, and schools. Street design can enhance pedestrian and bicyclist safety by providing sidewalks or paths between destinations that are well connected, safe, and attractive; improving street crossings; and reducing traffic speed. Communities can plan, design, construct, retrofit, and maintain streets and public spaces in ways that make physical activity easier to incorporate into daily life. Zoning codes and policies, such as form-based codes and Complete Streets policies, can act as levers to encourage and support these active design changes.

Programs such as Safe Routes to School and other initiatives can promote active transportation by increasing awareness of opportunities, changing attitudes, and creating incentives for walking and bicycling. Several recent efforts—such as Step It Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities [37] and the Community Preventive Services Task Force [38] recommendation for combined built environment approaches to increase physical activity—have called for promoting community supports for active transportation. Though the evidence for these environmental, policy, and program strategies is widely accepted in public health, much work is needed to improve the surveillance of these initiatives. The goal of improved surveillance is to provide evidence of progress and guide further efforts to enhance the quality, reach, and equity of community supports for active transportation.

An initial step of the group of experts that authored this paper was to identify and prioritize constructs for the surveillance of community supports for active transportation. The workgroup created an initial list of 20 major constructs and identified seven constructs as the highest priorities to consider for surveillance actions (see *Box 1*). Priority status was based on the level of evidence that the construct relates to higher physical activity, its relevance to active transportation, and the potential for change over time. In addition, the group considered the potential overlap between constructs and the breadth of constructs covered.

DISCUSSION PAPER

Box 1 | Major Constructs Identified as Priorities for Surveillance of Community Supports for Active Transportation

A. Community Design (Macro-level)
1. Land use mix*
2. Residential density
3. Street connectivity*
4. Parks (walk-to [proximity] and walk-through)
5. Walkability (summative)

B. Street Design (Micro-level)
1. Multimodal transport infrastructure (e.g., sidewalks, bike facilities, traffic-calming features, street-crossing design)*
2. Amenities to promote use (e.g., signage, aesthetically pleasing elements, rest opportunities, lighting)
3. Social disorder (e.g., graffiti, vacant lots, abandoned or boarded up buildings)

C. Safety
1. Crime- and violence-related safety (e.g., perceptions, documented crime, street harassment)
2. Traffic-related safety (e.g., perceptions, pedestrian injuries)*

D. Policies and Planning Documents
1. Zoning and related policies (e.g., Complete Streets policies, form-based and new urbanist zoning)*
2. Planning documents (e.g., comprehensive, master, land use, bike and pedestrian plans)

E. Transportation Systems
1. Public transit (e.g., access, proximity, schedule)*
2. Bicycle infrastructure (e.g., bike networks, protected bike systems)

F. Events, Programs, and Resources
1. Events (e.g., Bike to Work Day, Open Streets initiative)
2. Programs (e.g., Safe Routes to School, employer-supported programs, bike share program, pedestrian education)*
3. Resources (e.g., staff, initial investments, maintenance budgets)

G. Public Attitude toward Policies and Environments
1. Perceptions related to value of active transport and related facilities (e.g., health benefits, economic benefits)
2. Public support for active transport policies and environments (e.g., family, community, employer, or school support for active transportation)
3. Political will, support, and culture

SOURCE: Pate et. al. 2018. Actions to Improve Physical Activity Surveillance in the United States. *NAM Perspectives.* Discussion Paper, National Academy of Medicine, Washington, DC.
NOTE: Top seven constructs are denoted with an asterisk.

Gaps

No surveillance system routinely and comprehensively monitors individual perceptions of community supports for active transportation at the national, state, and local levels. National surveys, such as the NHIS, have asked individuals about the presence of a support or barrier at one point in time. Several validated self-reporting questionnaires that assess individual perceptions of community supports exist, and these could be incorporated into existing survey-based surveillance systems. However, the length of these questionnaires can be a barrier to use.

Public datasets from national surveillance systems lack geospatial information, which limits their use for examining estimates below the state level and for linking survey data with other data sources, such as policy or geographic information system (GIS) data tied to specific geographic areas (e.g., municipal jurisdiction or census block group). In some cases, restricted datasets available at a research data center allow access to geospatial information that can facilitate linking data; however, in most cases, local-level estimates are not possible given small sample sizes. Local data are particularly important because land-use and many transport decisions are made at the local level, and the presence of community supports varies widely within and between communities.

Centralized, consistent, and easy-to-use GIS datasets that offer information on a comprehensive set of community support measures are lacking. Some relevant measures of community supports are available as part of spatial data within existing national GIS datasets (e.g., the Environmental Protection Agency [EPA] Smart Location Database [39], Fatality Analysis Reporting System [FARS] [40], Esri Business Analyst [41]). However, these data are often complicated to use, especially for local practitioners who may not have the resources to conduct spatial analysis. Quality, completeness, and date of collection are often unknown for GIS data. GIS measures can vary in the scale at which they provide data, which may not match the user's level of interest (e.g., individual residences, at the census block group). The underlying data and schema used for collection and derivation of measures are not standardized across jurisdictions. This can make it unclear how or if data from different sources are comparable. Finally, GIS measures are not centrally stored, making it challenging to find and combine measures into a common scale or unit.

Methods for active transportation–related policy surveillance are complex. All levels of government adopt active transportation–related policies to some degree, but these policies are most often sustainably deployed at the county and municipal levels. Examples of active transportation–related zoning and policies include form-based and new urbanist zoning codes, which, by design, are pedestrian-oriented; Complete Streets policies; and Safe Routes to School policies. Collecting and abstracting information about such policies can be resource intensive. Compiling such policies nationally is feasible, because most jurisdictions have this information posted digitally; however, such policy collection may take substantial time and effort, depending on the scope of the surveillance and what information is included in the system. Abstraction and evaluation of the content of these policies for inclusion in a surveillance system are more resource intensive activities than simply collecting the policies. There is a need to find the right balance between simplicity and abstraction for surveillance of active transportation–related policies.

Feasible methods to incorporate alternative approaches for assessing community supports for active transportation into surveillance are lacking. Audit (systematic observation) tools for assessing community supports for active transportation are available. However, these assessments are also resource intensive, and tools differ in scale (e.g., whole neighborhood versus street segment) and breadth of information collected. In the medium term, audit data could be collected by working with organizations that could use a citizen science approach to collect data. If national organizations could engage local affiliates, it may be possible to accumulate a nationwide database of audits. A longer-term approach would include conducting audits remotely by abstracting information from available aerial photos or images (e.g., Google Street View) using computer-based algorithms. However, wide-scale remote audits would require developing a valid method to automate abstraction of the relevant constructs from the images and would require documenting the reliability and validity of using photos or images for the measure. An alternative would be to have community members (i.e., citizen science) collect data on the presence and quality of community supports. Reliability and comparability of these data across auditors would need to be established, and using tools such as Open Street Map may help improve data quality and consistency.

Surveillance data related to programmatic and social environment constructs are not routinely col-

lected. There is some data collection of programmatic supports in schools (e.g., Safe Routes to School) and employer-sponsored programs (e.g., incentives to promote participation). To develop questionnaires for assessing the presence of programmatic and environmental supports across a variety of settings, the first step is to identify key measures to capture these constructs. Using information related to local-, state-, and national-level programmatic funding and budgeting may be a viable method for collecting information on resources provided to programmatic and social environment supports. The challenges in collecting such information include the lack of consistency in compiling and reporting this information as well as the lack of identified groups and resources to support data collection.

Recommended Actions

Regularly include measures of community supports for active transportation in national, state, and local surveillance systems. Examples of key strategies could include:

- Create a brief set of prioritized constructs and corresponding survey items to assess perceptions of community supports for active transportation. Assess their inclusion on national surveillance systems (e.g., NHIS, NHANES, Behavioral Risk Factor Surveillance System [42], YRBS, National Household Travel Survey [43] on an appropriately recurring interval) whenever possible. Promote their use with local practitioners to build local and state databases.
- Develop methods to link data from surveillance systems with policy, systems, and environmental data using smaller geographic units (e.g., municipal jurisdiction or census block group) while protecting privacy.

Develop a plan to make local-level GIS data concerning community supports for transportation publicly available, user friendly, and linked across measures. Examples of key strategies could include:

- Identify, compile, and make available GIS sources of community supports for active transportation support constructs (e.g., EPA Smart Location Database, FARS, Esri Business Analyst data, National Transit Map data [44], Reference USA [45]).
- Institute a multisector consensus process to develop recommended GIS measures relevant to community supports for active transportation that could be adopted by local, state, and federal agencies.
- Develop and standardize methods for documenting and collecting geospatial policy, systems, and environmental data.

Develop simple methods to assess the presence of active transportation–related policies. Examples of key strategies could include:

- Explore opportunities for partnering with professional organizations(e.g., American Planning Association) to query their membership about the presence of supportive policies in the communities where they work.
- Consider how to balance the simplicity and scientific rigor of existing active transportation–related policy collection systems, such as those developed by the National Complete Streets Coalition, the Form-Based Codes Institute, and the Vision Zero Network.

Develop a plan for collecting audit data on a national level to measure community supports for active transportation. Examples of key strategies could include:

- Identify a brief set of prioritized constructs that could be assessed using audits.
- Develop and validate computer-based algorithms for automating remote audits using online images.
- Explore methods for capturing local-level constructs using automated remote sensing or citizen science.

Develop better measures for capturing programmatic and social environment constructs (e.g., walk-to-school programs, social cohesion, crime). Examples of key strategies could include:

- Identify the key measures to capture programmatic and social environment constructs.
- Create validated survey questions to assess key programmatic and social environment constructs related to active transportation to or from specific settings (e.g., school, workplace, community).
- Explore the use of alternative data sources (e.g., information on programmatic funding, local record collection) for measuring these key constructs.

Summary and Conclusions

The group of experts that authored this paper has identified numerous important gaps in the current US physical activity surveillance system. The group recommended 23 actions that, if executed, would produce a much more robust system for monitoring physical activity behavior in the US population and for assessing the status of policies, programs, and elements of physical infrastructure that influence participation in physical activity. Many of the recommended actions call for the enhancement of existing surveillance systems. Some of the recommended actions highlight the value of developing new or modified methodologies, and many of these methodologies would take advantage of emerging technologies for observing human behavior or professional practice.

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Dr. Sanchez reports that he is employed by the American Heart Association, which publishes guidelines on such matters as physical activity and health surveillance.

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DISCUSSION PAPER

Disclaimer

The convening and the proposed actions described were developed by meeting participants. The convening entity was the Physical Activity and Health Innovation Collaborative, an ad hoc activity associated with the Roundtable on Obesity Solutions at the National Academies of Sciences, Engineering, and Medicine. The responsibility for the content rests with participants and not with the National Academies.

The views expressed in this paper are those of the authors and not necessarily of the authors' organizations, the National Academy of Medicine (NAM), or the National Academies of Sciences, Engineering, and Medicine (the National Academies). Additionally, the findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention. The paper is intended to help inform and stimulate discussion. It is not a report of the NAM or the National Academies.

Appendix C

November 2018 Open Session Agenda and Participant List

AGENDA

November 1–2, 2018

National Academy of Sciences Building
2101 Constitution Avenue, NW, Washington, DC

DAY 1 – NOVEMBER 1

9:00 am Light Breakfast Available—Room 125

[Closed Committee Meeting Begins (Committee members only)—Board Room]

10:00 am **Convene Open Session: Welcome, Introductions, and Goals of the Meeting**—Room 125
Russ Pate, Committee Chair

10:30 am **Subgroup Discussions**—Proceed to Respective Breakout Rooms
Board Room—Children—*Russ Pate (for Genevieve Dunton, Committee Member, Subgroup Lead)*
Room 118—Health Care—*Liz Joy, Committee Member, Subgroup Lead*

Room 114—Workplace—*Keshia Pollack Porter and Laurie Whitsel, Committee Members, Subgroup Leads*
Room 125—Community Supports for Active Transportation—*Daniel Rodriguez and Jim Sallis, Committee Members, Subgroup Leads*

[Break(s) at the discretion of subgroup leads.]

12:30 pm **Lunch**—Room 125

1:30 pm **Continue Subgroup Discussions**—Return to Respective Breakout Rooms

3:00 pm **Report Out from Subgroups**—Return to Room 125
Children—*Russ Pate (for Genevieve Dunton)*
Health Care—*Liz Joy*
Workplace—*Keshia Pollack Porter and Laurie Whitsel*
Community Supports for Active Transportation—*Daniel Rodriguez and Jim Sallis*

3:45 pm **Subgroup Collaboration Round 1**
Board Room—Health Care and Children
Room 125—Community Supports and Workplace

4:30 pm **Subgroup Collaboration Round 2**
Board Room—Health Care and Workplace
Room 125—Community Supports and Children

5:15 pm **Full Group Discussion**—All Subgroups Return to Room 125

5:45 pm **Adjourn Open Session**

DAY 2 – NOVEMBER 2

7:30 am **Breakfast Available**—Room 125

8:30 am **Continue Subgroup Discussion**—Proceed to Respective Breakout Rooms
Board Room—Children—*Genevieve Dunton, Committee Member, Subgroup Lead*
Room 118—Health Care—*Liz Joy, Committee Member, Subgroup Lead*

Room 114—Workplace—*Laurie Whitsel, Committee Members, Subgroup Lead*
Room 125—Community Supports for Active Transportation—*Daniel Rodriguez and Jim Sallis, Committee Members, Subgroup Leads*

[Break(s) at the discretion of subgroup leads.]

12:00 pm **Lunch**—Room 125

1:00 pm **Final Report Out from Subgroups**—Return to Room 125
Children—*Genevieve Dunton*
Health Care—*Liz Joy*
Workplace—*Laurie Whitsel*
Community Supports for Active Transportation—*Daniel Rodriguez and Jim Sallis*

2:00 pm **Adjourn Open Session**

2:00 pm **Closed Committee Meeting Begins (Committee members only)**—Board Room

3:00 pm **Closed Committee Meeting Adjourns**

PARTICIPANT LIST

Committee Chair

Russell Pate

Children Subgroup

Committee Member, Subgroup Lead: Genevieve Dunton
Katie Adamson, YMCA
David Berrigan, National Institutes of Health (NIH)
Amy Eyler, Washington University in St. Louis
Sarah Lee, Centers for Disease Control and Prevention (CDC)
Kellie May, National Recreation and Park Association
Greg Welk, Iowa State University
Ben Zablotsky, CDC

Health Care Subgroup

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David Buchner, University of Illinois at Urbana-Champaign
Felipe Lobelo, Emory University
John Omura, CDC
Kevin Patrick, University of California, San Diego
Mary Rosenberger, Stanford University
Rick Troiano, NIH
Janet Wright, CDC

Workplace Subgroup

Committee Member, Subgroup Lead: Keshia Pollack Porter
Committee Member, Subgroup Lead: Laurie Whitsel
Ron Goetzel, IBM
Laura Linnan, University of North Carolina
Karen Moseley, HERO Health
Bonnie Sechrist, Willis Towers Watson
Kathy Watson, CDC

Community Supports Subgroup

Committee Member and Subgroup Lead: Daniel Rodriguez
Committee Member and Subgroup Lead: Jim Sallis
Jason Broehm, Department of Transportation

Susan Carlson, CDC
Jamie Chriqui, University of Illinois at Chicago
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Janet Fulton, CDC
Aaron Hipp, North Carolina State University
Sagar Shah, American Planning Association
John Thomas, U.S. Environmental Protection Agency
Carla Zelaya, CDC

Attendees

Matt Dalbey, U.S. Environmental Protection Agency
Deborah Galuska, CDC

Appendix D

Table of Surveillance Systems

This appendix provides a tabulated overview of surveys and systems that currently contribute to or, in the future, could contribute to physical activity surveillance in the United States. This table provides a compilation of key resources and, for each resource, a concise description is provided.

Surveillance Survey, System, or Partnership	Measures	Frequency of Data Collection
American Time Use Survey (ATUS) https://www.bls.gov/tus	Provides nationally representative estimates of how, where, and with whom Americans spend their time	Annually
Behavioral Risk Factor Surveillance System (BRFSS) https://www.cdc.gov/brfss/index.html	Measures non-occupational physical activity that is self-reported as exercise	Annually
Classification of Laws Associated with School Students (CLASS) https://class.cancer.gov/download.aspx	State-level codified laws for physical education and nutrition in schools	Two sets of data compiled from 2003–2015 and 2008–2015 data
Employer Measures of Productivity, Absence and Quality (EMPAQ®) http://www.empaq.org	Measures employer health, productivity, and absence programs; four distinct categories: overall absence, non-occupational absence, occupational absence and health, employee assistance programs	Tool collects 1 year of data
Environmental Protection Agency Smart Location Database https://www.epa.gov/smartgrowth/smart-location-mapping#SLD	Measures location efficiency (e.g., housing density, diversity of land use, transit service)	Two versions have been released, Smart Location Database in 2011 and version 2.0 in 2013
Form-Based Code Institute https://formbasedcodes.org	Library of form-based codes from U.S. and international communities	Not applicable
Health Care Systems Research Network (HCSRN) http://www.hcsrn.org/en	Network of health care system research departments; houses a Virtual Data Warehouse (VDW) of electronic health record (EHR) data used to facilitate research	Infrequent collection dependent on approved research

Integrated Benefits Institute (IBI) https://www.ibiweb.org	Measures employer benefits programs, including workplace health and productivity; publishes original research using benchmarking and analysis	Not applicable
National Association of City Transportation Officials (NACTO) https://nacto.org	North American association of cities and transit agencies that facilitates the exchange of transportation practices (e.g., publishes design guides)	Not applicable
National Complete Streets Coalition https://smartgrowthamerica.org/program/national-complete-streets-coalition	Repository of resources supporting the development and implementation of Complete Streets policies and practices	Not applicable
National Environmental Database (NED) http://ned.ud4htools.com/about	Repository of built, natural, and social environmental indicators at the Census block group level related to physical activity and health	Not applicable
National Health and Nutrition Examination Survey (NHANES) https://www.cdc.gov/nchs/nhanes/index.htm	Measures health and nutritional status of U.S. adults and children	Annually
National Health and Nutrition Examination Survey National Youth Fitness Survey (NNYFS) https://www.cdc.gov/nchs/nnyfs/about_nnyfs.htm	National survey that collected data in 2012 on U.S. children and adolescent physical activity and fitness levels	Data collected in 2012
National Health Interview Survey (NHIS) https://www.cdc.gov/nchs/nhis/index.htm	National in-person household health survey with special topics including adult physical activity data	Annually

continued

Surveillance Survey, System, or Partnership	Measures	Frequency of Data Collection
National Household Travel Survey https://nhts.ornl.gov	Measures national travel behavior, including characteristics of people traveling, their household, and daily non-commercial travel by all modes	Data collected in 1983, 1990, 1995, 2001, 2009, 2017
National Quality Forum (NQF) https://www.qualityforum.org/home.aspx	Not-for-profit consensus-standard setting organization, endorses and maintains rigorously set health care measures	Not applicable
National Survey of Children's Health (NSCH) http://www.childhealthdata.org/learn-about-the-nsch/NSCH	Measures children's physical and mental health, access to health care, and family, neighborhood, school, and social context	Data collected in 2016, 2017, 2018
School Health Policies and Practices Study (SHPPS) https://www.cdc.gov/healthyyouth/data/shpps/index.htm	Periodically conducted national survey assessing school health policies and practices at the state, district, school, and classroom levels	Data collected in 2012, 2014, 2016
U.S. Bureau of Labor Statistics – Occupational Requirements Survey https://www.bls.gov/ors	Provides summary of the working, standing, and sitting time across different occupations	Annually
U.S. Census Bureau https://www.census.gov/data.html	Federal agency responsible for collecting data on the American people, including health, fatality, and demographic information	Annually
Vision Zero Network https://visionzeronetwork.org	National campaign focused on eliminating traffic fatalities and severe injuries	Not applicable

Workplace Health in America survey https://www.cdc.gov/workplacehealthpromotion/data-surveillance/index.html	National survey of U.S. employers' workplace health programs and practices	Collected in 2016, 2017
Youth Risk Behavior Survey (YRBS) https://www.cdc.gov/healthyyouth/data/yrbs/index.htm	National survey of U.S. 9th–12th grade students, measures include adequacy of physical activity behaviors	Collected in 1991, 1993, 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017

Appendix E

Consultant Reports

The reports included in this appendix were prepared by Mathematica Policy Research in response to requests made by the study sponsor. As noted in the study statement of task (see Chapter 1, Box 1-2), as a consultant, Mathematica Policy Research was asked to develop tools to facilitate surveillance within the topical area of community supports for active transportation, including:

- two brief sets of prioritized questionnaires to assess: (1) an individual's perceptions of community support for physical activity; and (2) members of a professional organization's design policies and zoning codes supportive of active transportation (the consultant will develop a validation protocol for the questionnaires).
- two "how-to" protocols to: (1) identify, capture, and store Geographic Information System (GIS) data in a centralized location, and (2) automate the remote collection of audit data.

The appendix is organized as follows: Part I includes the brief questionnaires on individual perceptions of community supports for active transportation and for members of a professional organization, and an accompanying validation protocol; Part II includes the GIS protocol; and Part III pertains to the protocol of remote collection of audit data.

Evaluation, validation, and testing of the questionnaires and protocols were not carried out under the scope of this study. The reports do not necessarily reflect the opinions of the committee and served as additional pieces of evidence that informed the committee in its development of the strategies and supporting actions for implementation.

PART I

TWO BRIEF QUESTIONNAIRES TO ASSESS COMMUNITY SUPPORTS FOR ACTIVE TRANSPORTATION AND VALIDATION PROTOCOL

MATHEMATICA
Policy Research

Background

Per the statement of task, Mathematica provided several potential questions for each questionnaire. Above each item, we also provide the relevant construct from the seven top priorities for surveillance of community supports for active transportation identified in Pate et al. 2018.[1]

Brief Questionnaire #1: Perceptions of Community Supports for Active Transportation

The first questionnaire is intended to be administered to a census sample of the general population. In this first questionnaire, we provide recommendations for item consideration based on our review of existing instruments assessing similar constructs as those identified in Pate et al. (2018). Because of publisher permission rules and regulations, we cannot reproduce the item in its original form, so we instead describe the intended item, and we link to its source or sources (if multiple exist). In addition, we provide published data on a selected item's reliability coefficient, and the source of the reliability information.[2] In one instance, we were unable to identify a relevant item, so we proposed a novel item and briefly explained the item's intent. This novel item should be considered tentative since it has not undergone any validation exercise. In an effort to keep scaling consistent, we applied the same scale used for the existing items to this novel item. We identify which items are existing and which are novel.

Construct:	**Land Use, Item #1—Existing Item**
Item 1:	We recommend including an item which asks about the opportunities for individuals to walk to multiple destinations from their home.
Source:	PANES, Item 2, test-retest reliability .63
Similar sources:	
Source #1	NEWS_CFA, Item C3, test-retest reliability .71
Source #2	Twin Cities Walking Survey, Item G4, test-retest reliability .79
Source #3:	PANES Item 17, test-retest reliability .74
Note:	Item 2 from the PANES study has been prioritized here because it has been used extensively in research. This item asks specifically about proximity to destinations

[1] The construct "parks" was not identified as part of these seven constructs but was included as a construct per request from the expert committee.
[2] For the PANES and NEWS instruments, test-retest reliability was generated as one-way random effect model single measure intra-class correlations. For the Twin Cities instrument, test-retest reliability was generated as Pearson correlation coefficients for the scale (not the individual item).

where things can be bought. The items under the similar sources ask about destinations more generally. Item G4 from Source #2 and Item 17 from Source #3 are identical, but these items and Item C3 from Source #1 have one small difference. Item C3 does not ask about "ease of access," whereas items G4 and 17 do ask respondents to consider this concept.

The recommended items here aim to understand opportunities to walk to destinations, defined broadly. If the committee seeks to expand the number of items, these instruments also ask about proximity to specific destinations such as stores, shopping, and transit, and they include items that ask respondents to specify how long it would take to walk to a number of specific destinations.

Construct:	**Street Connectivity, Item #2—Existing Item**
Item 2:	We recommend including an item which asks about opportunities for choice in terms of selecting different routes when traveling to destinations.
Source #1:	NEWS_CFA Item D3, test-retest reliability .57
Source #2:	Twin Cities Walking Survey Item H5, test-retest reliability .67
Construct:	**Multimodal Transportation, Item #3—Existing Item**
Item 3a:	We recommend including an item which asks about the accessibility of sidewalks.
Source #1:	NEWS_CFA Item E1, test-retest reliability .17
Source #2:	PANES Item 4, test-retest reliability .76
Item 3b:	We recommend including an item which asks about the accessibility of bicycle facilities.
Source:	PANES Item 5, test-retest reliability .63
Note:	The items we recommend for 3a and 3b ask about infrastructure. These instruments also include items that ask about safety and traffic hazards as they pertain to walking or biking.
Item 3c:	We recommend including an item which asks about access to public transit.
Source:	PANES Item 3, test-retest reliability .62
Construct:	**Traffic-related safety, Item #4—Existing Item**
Item 4:	We recommend including an item which asks whether the amount of traffic is a barrier to walking.
Source #1:	NEWS_CFA, Item G2, test-retest reliability .62
Source #2:	Twin Cities Walking Survey, Item K2, test-retest reliability .71

Source #3:	PANES Item 8, test-retest reliability .65
Note:	The recommended items here aim to understand traffic safety broadly as it pertains to walking. These surveys include a number of additional items that assess specific aspects of traffic safety as well as cycling.

Construct: **Parks, Item #6—Proposed Novel Item**

Item 5: Public parks are easily accessible in my community.

Strongly disagree (1) **Somewhat disagree (2)** **Somewhat agree (3)** **Strongly agree (4)**

Source: Developed from NEWS_CFA Item B21, test-retest reliability .67

Brief Questionnaire #2: Professionals' Understanding of Community Supports for Active Transportation in the Communities where they Work

Brief questionnaire 2 aims to survey working people in relevant professional organizations (for example, a local planner who is a member of the American Planning Association) about where these people work and whether the communities they work in have policies, practices, or guidelines in service of community supports for active transportation. Few relevant questionnaires exist for this population, and the ones available generally do not align with the type of information relevant to this task. As a result, we developed new items for consideration. These novel items should be considered tentative since they have not undergone any validation exercise. We identified steps for validating these new items in a validation protocol that accompanies this questionnaire. We also identified two questionnaires, the National Survey of Land-Use Regulations and the National Survey on Local Residential Development Regulation, both of which collect survey data from similar respondent types as this questionnaire. When we identified similar items in the existing surveys, we included those items below each of our developed items.

It is worth noting that the types of working professionals targeted for this survey represent a diverse group of professions including planners and transportation officials. Not all items presented in the survey below are relevant to all professional groups intended to participate in the survey, for example, some items may only be relevant for transportation officials.

Our draft items are based on the seven constructs identified in Pate et al. (2018). To appropriately frame our newly developed items for surveillance, we use the indicator metrics described in Table 2 of Giles-Corti et al. (2016) as examples. These indicators serve as a potential metric to understand how well communities plan and design best practices for promoting health and increasing physical activity. We identify the construct and appropriate indicator for each of our items. We also include a Likert scale commonly used in many general population surveys on this topic.

One complexity to consider is the number of work locations respondents should draw upon when answering these questions. For example, respondents might work in multiple locations, and it might not be feasible or appropriate for them to provide a single response across multiple locations. Asking respondents to consider the community where they work most frequently is one possible strategy. In the items below, we employ this strategy of asking respondents to consider the community where they work most often when providing answers.

Instructions for Respondents: The questions below ask you to consider the community where you work when providing answers to the survey questions. If you work in multiple communities, we ask that you consider the single community where you work most often. Please provide the main jurisdiction associated with this community (for example, town, city, county, state, etc.).

Construct: **Land Use, Item #1— Proposed Novel Item**

Indicator: Density

*Item 1a: The community I work in has specified a target for minimum density development around activity centers or transportation hubs (for example, dwellings or areas which contain at least 4 units per acre).

Strongly disagree (1) **Somewhat disagree (2)** **Somewhat agree (3)** **Strongly agree (4)**

Sources for similar items:

Source #1: National Survey of Local Land Use Regulations, Item 18 (page 115). This item asks about requirements posed for maximum buildable density of dwellings. The unit of measurement is net acres.

Source #2: The National Survey on Local Residential Development Regulation, Item 3 (page 2) provides a similar item to the one suggested from source #1.

Indicator: Diversity

Item 1b: The community I work in has specified policies or requirements which aim to encourage mixed-use development (for example, different housing types and local destinations).

Strongly disagree (1) **Somewhat disagree (2)** **Somewhat agree (3)** **Strongly agree (4)**

As mentioned earlier all novel items proposed in this survey should be considered tentative. We wish to highlight that these items that measure the construct "land use" should especially be considered tentative. There is disagreement among experts over the best way to measure this construct. Other potential ways of measuring this construct include: asking about the presence of zoning overlays which increase density, the use of density bonuses, and the reduction of minimum parking requirements to stimulate denser development.

Construct: **Street Connectivity, Item #2—Proposed Novel Item**

Indicator: Design

Item 2a: The community I work in has targets for street connectivity (for example, sidewalk completion programs, back alley improvement programs).

Strongly disagree (1) **Somewhat disagree (2)** **Somewhat agree (3)** **Strongly agree (4)**

Item 2b: The community I work in has policies, programs, or requirements for encouraging pedestrian-friendly environments (for example, infrastructure provisions which enhance street connectivity for pedestrians, like sidewalk completion programs).

Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Item 2c The community I work in has policies, programs, or requirements for encouraging cycling-friendly environments (for example, infrastructure provisions which enhance street connectivity for cyclists, like complete bicycle networks).

Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Construct: Multimodal Transportation, Item #3—Proposed Novel Item

Indicator: Air pollution

*Item 3: The community I work in has policies or requirements that reduce emissions of exhaust fumes caused by public transportation.

Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Construct: Public Transit, Item #4—Proposed Novel Item

Indicator: Public transport access

*Item 4: The community I work in has policies or requirements that a specified percentage of the population live in close proximity to high-frequency public transit (for example, 0.25 to 0.5 miles).

Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Sources for similar items:

Source #1: National Survey of Local Land Use Regulations, Item 23 (page 116). This item asks about requirements posed on residential builders to set aside funds in support of community infrastructure (for example, public transportation).

Source #2: The National Survey on Local Residential Development Regulation, Item 14 (page 5) provides a similar item to the one suggested from source #1.

Construct: Traffic Safety, Item #5—Proposed Novel Item

Indicator: Road trauma

*Item 5a: The community I work in has policies or requirements which aim to reduce pedestrian and cyclist injuries and death (for example, complete streets, traffic calming measures, safe street crossings, and safe routes to schools).

Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Indicator: Demand management

*Item 5b: The community I work in has policies or restrictions that limit car parking (for example, pricing parking appropriately for the context).

Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Construct: Parks, Item #5—Proposed Novel Item

Indicator: Open or green space

Item 6: The community I work in has policies or requirements that a defined percentage of residents live within a specified proximity to a park.

Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

VALIDATION PROTOCOL FOR BRIEF QUESTIONNAIRES #1 AND #2

I. Overview

This protocol describes two important next steps in refining the items and brief questionnaires that Mathematica developed in response to the statement of task. The brief questionnaires are entitled Perceptions of Community Supports for Active Transportation (questionnaire #1) and Professionals' Understanding of Community Supports for Active Transportation in the Communities Where They Work (questionnaire #2). The first step is establishing content validity, and the second step is conducting cognitive interviews.[3] These two steps, described below, build on our earlier work in establishing face validity through literature reviews, in reviewing existing instruments and items, and in engaging in an iterative review process with the expert committee.

II. Content Validity

Content validity refers to the extent to which an item is measuring a given construct. A researcher demonstrates content validity by establishing rules that reflect the construct and then assessing the items against those rules to ensure that the content of each item matches the defined content of the construct (Trochim 2006). The step-by-step process for establishing content validity is described below.

1. Defining Constructs

The first step in establishing content validity is to define each construct. Mathematica developed the two brief questionnaires with items intended to measure the seven constructs identified by Pate et al., 2018 as priorities for measuring community supports for active transportation[4]. Pate and his colleagues defined these constructs through examples. For instance, the construct "multimodal transport infrastructure" is defined through examples such as sidewalks, bike facilities, traffic-calming features, and street-crossing design. These examples provide a good foundation for defining the constructs represented by the two questionnaires.

After the constructs are defined, the next step is to both solicit feedback from stakeholders on whether the items in the questionnaire are aligned with the defined criteria for the construct and determine whether the items are meaningful, whether they cover the intended constructs, and whether anything is missing. An efficient way to do this is through focus groups, although it also possible to obtain this information through one-on-one interviews.

2. Identifying Focus Group Participants

In order to obtain useful feedback about the items, it is important to consider who should participate in the focus groups. Since the questionnaires are oriented toward community and policy domains, the most appropriate participants are professionals in the public health, planning, and

[3] The expert committee recommended that the protocol concentrate on these two methods for validation because a large feasibility study may not be attainable until the items are tested in the field.
[4] As a result of committee feedback, we added an eighth construct, "parks."

transportation fields who have a deep knowledge of the field. These individuals can provide feedback on whether the items are adequately measuring the important constructs associated with active transportation and physical activity.

3. Conducting Focus Groups

The purpose of focus groups is to have an open-ended discussion in which an exchange of ideas centers around the content of items and constructs. Focus groups are typically conducted with approximately five to eight participants. A benefit of focus groups over individual interviews is that participants also respond to comments made by other members in the group. In addition to having someone take notes in person, it may be helpful to record focus groups for later analysis, assuming that the moderator obtains consent from participants.

Since the goal of the focus groups is to generate qualitative data that can help to inform revisions to items, a moderator may want to do the following:

a. State the definition of a particular construct to ensure that it is understood by all participants in the same way. For instance, the construct "multimodal transport infrastructure" is defined through examples such as sidewalks, bike facilities, traffic-calming features, and street-crossing design.
b. List the draft item(s) that are intended to measure that construct, and ask the focus group members if the item(s) are in fact doing this. For example, "One item we are considering is: 'The community I work in has specified policies or requirements that reduce emissions of exhaust fumes caused by public transportation.' Does this item measure the construct of 'multimodal transport infrastructure'?"
c. Ask the focus group if any key items that measure "multimodal transport infrastructure" are missing but should be included. If a focus group member provides another item, then the moderator should ask the other members of the focus group if this other item resonates with them.
d. Repeat this process for all eight constructs.
e. Conclude by reminding the focus group members of the eight constructs that were discussed, and ask them if there are key constructs that are missing. If key construct(s) are identified as missing, ask the focus group members to provide a definition of the missing construct(s) and examples of key items that may measure the missing construct(s).

4. Using Focus Group Data to Improve Items

Data obtained from the focus groups may be helpful in improving specific items and overall questionnaires. After the moderator conducts the focus groups, a team of at least two researchers should review the transcripts and/or audio recordings and identify salient themes that emerge from the data. These themes may reflect areas of agreement or disagreement in terms of how well the items measured the intended construct and whether any important items were missing. For example, the focus group may agree that the construct of "multimodal transport infrastructure" is important in assessing community supports for active transportation, but they may have different opinions on the items that most closely align with the construct. Over the course of the focus group, the members may ultimately reach consensus on the item(s) that are appropriate for measuring this construct, but if the

members remain split, then it may make sense to retain several items for the next phase of item and questionnaire development, cognitive interviewing.

III. Cognitive Interviewing

Cognitive interviewing is used to select and refine items, and is often conducted when pilot testing a questionnaire. The techniques for cognitive interviewing should be tested at a point in questionnaire development when there is still time to change the questionnaire.

As in focus groups, it is important in cognitive interviewing to engage with respondents who are representative of a target population. In a general population survey (the population for brief questionnaire #1), cognitive interview respondents should represent individuals in the general population. For questionnaire #2, respondents should represent members of the target population: working professionals who belong to professional organizations like the American Planning Association.

During the cognitive interview, the interviewer administers the questionnaire and then asks the respondent a series of questions designed to understand the respondent's interpretation, judgment, and thought processes when responding to each item. This approach is intended to access the respondent's metacognition, which may help to understand whether the item is measuring what we intend it to measure. The following strategies for conducting a cognitive interview can build an understanding of how the target population interprets and responds to recommended items.

1. Strategies for Conducting a Cognitive Interview

The research team may conduct the cognitive interview either in person or by telephone. The interviewer reads each item aloud and then pauses to allow the respondent time to answer the item. After the respondent has answered the item, the interviewer then asks a series of probes to assess how the respondent understood the item and how that understanding was reflected in the response. For example, item #6 in questionnaire #2 states: "The community I work in has specified policies or requirements that a defined percentage of residents live within a specified proximity to a park." At this point, the interviewer can use the **comprehension and interpretation** probe to understand how the respondent interpreted *policies or requirements*. Alternatively, the interviewer may use another comprehension and interpretation probe to ask about how a respondent understood the meaning of a *park*. Asking these questions of different respondents will help to generate useful data for improving not only items but also any instructions or guidance to respondents that may precede or be included in an item.

This probe may also help to determine which items in a pool of similar items should be retained. In the example in Section II, in which focus group members may be split on which item(s) most closely align with a given construct, researchers can use cognitive interviewing techniques to determine which of the items is best eliciting the intended information.

The comprehension and interpretation probe is a useful technique for conducting cognitive interviews but represents one of many different probes. The work by Willis (1999) is useful for individuals interested in a discussion of other probes mentioned in this protocol as well as other techniques and approaches for conducting cognitive interviews.

2. Using Cognitive Interview Data to Improve Items

Cognitive interviews can improve questionnaires by clarifying two main features of the items (1) the intent or purpose of an item and (2) the meaning of how individual words come together to form the item.

Intent of items. Data generated from cognitive interviews can help to refine the intent of items. For example, for the item that measures policies or requirements that a percentage of residents live in close proximity to a park, the intent is to understand whether or not there are *policies or requirements* that a defined percentage of people live close to a park. However, the respondent might interpret the item's intent as whether there is community interest in parks, so he or she may respond "strongly agree" even if there are no policies or requirements in place. Clarifying intent, an important aspect of questionnaire development, can be assessed through cognitive interviewing and may lead to emphasizing words in an item, such as "policies and requirements", by using formatting such as *italics*, **bold** font, or underlining key word or phrases.

Meaning of items. In the example above, several words must come together for a respondent to answer the item accurately. He or she must understand not only what is meant by a policy or requirement but also what is meant by percentage, residents, living, proximity, and park. For example, proximity is a word that is clearly subject to interpretation. What might be considered close for some individuals is not close for others. The cognitive interviewing process may help questionnaire designers to decide whether or not to include instructions that define words like proximity for respondents.

IV. Concluding Remarks

This validation protocol summarized two methods, **establishing content validity** and **conducting cognitive interviews**, for refining the items and the two brief questionnaires. These methods build on our earlier work of establishing face validity through literature reviews, a review of existing instruments, and iterative communication with the committee.

After a final set of items are endorsed by stakeholders, and when the items are interpreted and responded to by the target population as intended, researchers should then consider how these items might be included in existing surveillance systems (for example, as part of existing scales or as new scales). From there, researchers may want to initiate a validation study with a larger sample of respondents who represent the target population. As part of this validation study, researchers may want to investigate psychometric properties such as test-retest reliability and internal consistency (for example, average inter-item correlation, average total item correlation, split half reliability, and Cronbach's alpha). More advanced psychometric procedures involve establishing predictive validity and may require researchers to explore methods in factor analysis and structural equation modeling. When designing and conducting a validation study, researchers may want to consult with individuals who have expertise in measurement or quantitative psychology.

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PART II

USING GIS DATA: A "HOW TO" PROTOCOL

REPORT

FINAL

Revised: Using Geographic Information System (GIS) Data to Understand Community Supports for Active Transportation: A "How To" Protocol

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CONTENTS

TABLES

FIGURES

I. INTRODUCTION

Purpose and organization of this protocol

The purpose of this protocol is to help readers with a limited working knowledge of geographic information systems (GISs) successfully use GIS tools to assess local and national supports for active transportation in defined communities of interest. The protocol is designed to help users achieve three main objectives: (1) define an area and construct of interest aligned with community supports for active transportation, (2) capture GIS data at both the local and national level, and (3) store local and national GIS data in a central repository. Sections II, III, and IV provide detailed instructions for accomplishing each of these tasks, along with illustrative examples of community supports for active transportation at the local and national level.

Subsequent sections explore other aspects of GIS work for users who want to go beyond these three objectives. Section V describes how to manipulate GIS data using specialized software (such as ArcGIS) and provides step-by-step instructions for creating a static and multilayered map using a local data set in ArcGIS. Section V builds off of earlier sections of the protocol because in order to successfully manipulate GIS data, users must already complete the steps outlined in section II through IV. Section VI takes a more in-depth look at working with national GIS data sets, describing how they are created and the issues to consider when choosing a national database. This section also provides descriptions and examples of several national GIS data sets that users can trust.

What is GIS?

GIS is a framework for manipulating and analyzing geographic data by charting spatial locations and organizing layers of information into visualizations, such as maps and three-dimensional figures. Manipulating GIS data requires a specialized software program such as ArcMap 10.2.2, an ArcGIS Desktop software package from Esri. ArcMap 10.2.2 is the latest software supported by Esri for importing GIS data in order to conduct a variety of tasks related to the analysis of geospatial data. This software can run on desktop systems, web map servers, spatial database management systems, or be used in conjunction with programming languages to create digital maps from georeferenced data. In Section V of this protocol, which is intended for users who have some familiarity with ArcGIS Desktop, we use ArcMap 10.2.2 in our examples.

The Centers for Disease Control and Prevention (CDC) provides free introductory information on spatial data and trainings in ArcGIS.[5] More advanced courses in ArcGIS are available for purchase through the Esri Academy.[6]

[5] For more information on GIS training at CDC, see https://www.cdc.gov/dhdsp/maps/gisx/training/index.html.
[6] For more information on GIS training at Esri, see https://www.esri.com/training/.

How can GIS data help me identify community supports for active transportation?

By creating maps using GIS data sets, you can highlight the community supports that have been put in place in specific areas (such as local, county, state, or national areas) to encourage active transportation by communities. Community supports for active transportation are understood through eight categories, or constructs: land-use mix, street connectivity, multimodal transport infrastructure, traffic safety, zoning and related policies, public transit, parks, and programs.[7]

You can both identify and visualize detailed features of geographic space in your given area to better understand factors such as street connectivity, traffic volume, and ease of access for pedestrians and cyclists. You can then use this information to gain insights into the level of community support for active transportation.

[7] For more information on the constructs, Pate et al. (2018). Actions to Improve Physical Activity Surveillance in the United States. Discussion Paper for National Academy of Medicine.

II. IDENTIFYING AN AREA AND CONSTRUCT OF INTEREST

This section defines two key concepts necessary for successfully working with GIS data: area and construct. As a user of GIS, you must first articulate how your selected geographic area meets the goals of your GIS project and then identify how a construct related to community supports for active transportation can be better understood via a GIS approach.

Area

The first step for creating a GIS map is to identify a geographic area of interest. This area can be a state, county, city, or smaller area such as a census block group.[8] You should select the area based on your goals; for example, if you wish to understand features of a dense urban environment, you should not select a rural area like Alma, Missouri, as your area.

Construct

The relevant constructs are land use, street connectivity, multimodal transport infrastructure, traffic safety, zoning, public transit, parks, and programs. After choosing one, you can then specify a topic within the construct. In Sections III and V of this protocol, we use the "bikeability" topic, within the multimodal transport infrastructure construct, to show how to use GIS data at the local level (see the appendix for details on the topics used in this protocol).

[8] For more information on downloading cartographic boundary shapefiles, see Step 3, Section V.

III. CAPTURING GIS DATA

The ability to capture and store GIS data depends on the availability of a relevant GIS data set. Government agencies (at the federal, state, county, and municipal level) and academic institutions allow users to access their GIS data. For example, at the federal government level, relevant GIS data sets are available through the Open Data Initiative's website (http://opendata.dc.gov/), including city-, county-, and state-level data.[9] The Library Services Group at the Massachusetts Institute of Technology (MIT) also provides local GIS data. GIS researchers at MIT compiled a data inventory containing reliable and openly available U.S. data organized by state. [10]

You could also contact your local transport, planning, and public works departments or metropolitan planning organizations for additional guidance. Section VI of this protocol describes additional, trusted GIS data sets that are reliable and valid.

Capturing local GIS data

To capture local GIS data, you must first identify an area, construct, and topic. You can then capture the relevant GIS data using one of several websites. For example, let's say our area of interest is Washington, DC; our construct is multimodal transport infrastructure; and our topic is bikeability. For our website, we choose http://data.dc.gov/, which is a reputable resource for GIS data sponsored by the DC government.

Given our focus on multimodal transport infrastructure and bikeability, we enter the term "bike" into the search bar, which returns two data sets: "bicycle lanes" and "bicycle trails." Selecting the data set "bicycle lanes"[11] returns a map at the top of the page that highlights in blue all existing bicycle lanes in Washington, DC.

Many local government websites that contain data sets are organized in a similar way as DC's, with a page showing a visual map of the data set, a description of the data set, and options for downloading the data. To enable users to further refine their search or identify other constructs, some sites have a section at the bottom or side of the page for related data sets (i.e., other data sets which are similar to the results returned for the current search). Step 10 in Section V of this protocol describes how to incorporate multiple constructs into one data set to create multilayered maps.

Capturing national GIS data

In our discussion below about capturing national GIS data, we use a specific national data set for illustrative purposes. Section VI provides additional options for trusted national GIS data sets.

[9] For more information on the Open Data Initiative, see http://opendata.dc.gov/
[10] For more information on MIT's GIS data, see https://libguides.mit.edu/c.php?g=176295&p=1161385.
[11] For more information on this data set, see http://opendata.dc.gov/datasets/bicycle-lanes.

CDC houses several GIS data sources, including the National Environmental Public Health Tracking Network.[12] This data set contains a wide variety of national health data, including information on environments and hazards, health effects, and population health, and it includes a web application for easy manipulation.[13] When you open the web application for the first time, the site will prompt you to select which data to access. To return to this navigation page at any time, click the orange "Select Data" button on the top left, select the data, and click the "Go" button. A map will populate showing the locations and metrics specified.

Switch the view from the map to a bar chart or a table using the view buttons on the top right:  . If multiple years of data are selected, note that only one year will be displayed at a time. You can change the year by using the dropdown menu on the top left: 

.

If you want to save the map or chart as an image, you can download the current viewport, complete with a title and source, by clicking the download image button:  .

[12] For more information on the network, see https://ephtracking.cdc.gov/showHome.action.
[13] For access to the Data Explorer web application, see https://ephtracking.cdc.gov/DataExplorer/#/.

IV. DOWNLOADING AND STORING GIS DATA

If you wish to do more than simply view a single data set via a web application, you will need to download and store GIS data on a local computer. GIS data can come from shapefiles, which store data containing relevant geometric properties, or tabular files, which may contain coordinates for marking latitude and longitude but lack relevant geometric information. Shapefiles, which are discussed further in Section V, are the most common repository for spatial data and end with the .shp extension. Although this file type was originally developed by Esri for ArcGIS software, it has become universal, and any GIS data-processing software should be able to read and write it.

Working with GIS shapefiles

Shapefiles with .shp extensions are always accompanied by files with .shx and .dbf extensions. The .shx file contains information in code language about the shapefile and the .dbf file represents the local database for how the shapefile was saved. You should not need to use these adjacent files directly when conducting GIS analysis but should make sure they are present in the same folder as your shapefile. When you download a shapefile, or when the software writes a shapefile to your computer, these additional files are generated. These files must be present in the folder when you import the data into a program. In addition, when sharing data with another user, always include these additional files. Certain types of spatial data have more secondary files than other types of data; therefore, when writing to a shapefile, it is a good idea to keep all files relevant to that shapefile in a designated project folder.

Shapefiles usually contain spatial data at a 1:1 rate of data set per file; in terms of geographic features, for example, state boundaries would be one shapefile, rivers would be another shapefile, and roads would be a third shapefile. Despite the data being isolated, you can incorporate multiple shapefiles into a single map. In ArcGIS, these shapefile data sets are classified as separate "layers" of a map.[14] Section V describes how to import a geographic data set to create a layer on a map.

Working with GIS tabular files

GIS sites sometimes provide the option to download a .csv file of the data set. A .csv or any other tabular file (for example, .xlsx) contains data in an easy-to-read, easy-to-write format. But .csv files do not contain any references to geometries, even if there are columns with latitudes and longitudes. To show tabular data in a spatial context, you will need to use GIS software to join the data with a spatial data file, such as a shapefile. The most common files to use for joining tabular files to spatial data are the U.S. Census Bureau's state or county shapefiles, which can be found on a number of official government websites[15].

[14] For more information on ArcGIS layers, see http://desktop.arcgis.com/en/arcmap/10.3/map/working-with-layers/what-is-a-layer-.htm.
[15] For more information, see http://opendata.dc.gov/

Downloading GIS data

You can download and save a captured data set to a computer. In the example of bicycle lanes in Washington, DC, you can click the "Download" button in the top right corner. To download data from the National Public Health Network's web application, click the export button:  .

The downloaded files will save as a .zip file. To unzip the file, right-click and select "Extract all" to view and manipulate the files inside. As discussed earlier, the unzipped folder will contain a couple of different types of files, such as shapefiles (.shp).

Creating a geodatabase

If you are identifying multiple areas and constructs, and then following the steps in this section and Section III to download and store multiple data sets, you may want to create a file geodatabase. A geodatabase will enable you to collect numerous geographic data sets in one large file, denoted by a .gdb extension.[16] Instead of storing multiple shapefiles in different folders, a geodatabase can help you organize your data in one central location.

Supplemental sections

The remaining sections of this protocol are for users who are interested in going beyond capturing, downloading, and storing GIS data for areas, constructs, and topics of interest. Section V discusses how to manipulate GIS data in ArcGIS (other software options are available, but we focus on ArcGIS because it is popular and easy to use). Section VI provides tips for assessing the credibility of national GIS data sets, and provides additional trusted sources of GIS data related to community supports for active transportation.

[16] For more information on creating a geodatabase, see http://desktop.arcgis.com/en/arcmap/10.3/manage-data/geodatabases/a-quick-tour-of-the-building-geodatabases-tutorial.htm.

V. OPENING AND PROJECTING DATA IN ARCMAP 10.2.2

Identifying, capturing, and storing GIS data is a useful way to build a robust library of relevant GIS data sources. However, to capitalize on the benefits of these data, a user needs to work with the data in a GIS program such as Esri's ArcGIS Desktop. This section focuses on the ArcMap 10.2.2 interface. It describes how to open and project a simple map and introduces the "Join" function, which enables you to add supplemental data to one or more basemap layers or to the "bottom," foundational layer of a map. Basemaps are foundational layer maps which allow for more advanced maps to be projected.[17] This section also provides tips on how to make a visually impactful and accurate map using the layout view.

For simplicity, we will continue to use Washington, DC; the multimodal transport infrastructure construct; and the bikeability topic in our instructions below. However, these instructions can be applied to any area or construct.

1. **Preparing the data set.** First, prepare the data for use in ArcMap 10.2.2. To do this, ensure that the variable names are no more than 10 characters long and do not contain dashes, spaces, or brackets. (Many government shapefile data sets are already prepared for use in ArcMap 10.2.2.)
2. **Getting started with ArcMap.** Open ArcMap 10.2.2 by clicking the icon on the desktop or selecting the program from your computer's start menu. To get started, add a preloaded basemap by clicking on the "Add Data" icon () and selecting "Add Basemap." ArcMap has several preloaded data sets to choose from, including streets, topography, U.S. Geological Survey (USGS), and terrain. Since our focus is on active transportation, the best option to select is "topographic". The World Topographic Map, also known as "the community basemap," includes administrative boundaries, cities, water features, parks, landmarks, highways, roads, buildings, and other features overlaid on land cover. This example is instructive because it shows a large variety of features, from natural to manmade, which may affect active transportation. Depending on your research questions, you may want to select a map with fewer features, such as streets or terrain only.

   An alternative to using preloaded basemaps is to download geographic shapefiles from the U.S. Census Bureau's TIGER/Line® shapefiles, which include options for geographic areas and features such as roads, railways, and water.[18] Another option is to download data from OpenStreetMap (http://openstreetmapdata.com/data), a collaborative open-source project containing a myriad of physical and natural features including roads, buildings, amenities (such as healthcare and schools), natural resources, and more.[19]
3. **Defining the boundaries of the data set.** Boundary shapefiles are available from Esri or the U.S. Census Bureau.[20] (See Section II to recall which area was selected and which

[17] For more information about basemap layers, see http://desktop.arcgis.com/en/arcmap/10.3/map/working-with-layers/working-with-basemap-layers.htm.
[18] To download TIGER/Line® shapefiles, see https://www.census.gov/geo/maps-data/data/tiger-line.html.
[19] To download OpenStreetMap data, go to http://openstreetmapdata.com/data.
[20] An example of shapefiles are cartographic boundaries. For more information on these files, see https://www.census.gov/geo/maps-data/data/cbf/cbf_state.html.

boundaries are needed for a map, such as state, county, or city boundaries.) After downloading a boundary shapefile (following the steps in Section IV), you can add it as a "layer" to your map in ArcMap. For example, download a Washington, DC, boundaries layer,[21] and add it to the map by clicking the "Add Data" icon:  . In the menu that appears, click the "Connect to a Folder" icon:  . Navigate to the folder that contains the saved shapefile on your computer (for example, you can designate files to a local folder, GIS_Files) and click "OK." Now that the appropriate folder is connected to ArcMap, select the appropriate layer by navigating through the folder structure, and click "Add."[22]

4. **Using a spherical projection system.** Because the earth is a sphere, projecting it onto a flat surface causes distortions. As a result, using an unprojected map for analysis purposes leads to inaccurate results. To restore accuracy to the shape, area, distance, or direction of a map, it is necessary to project the map using a projected coordinate system.

   To do this, right-click the map and select "Data Frame Properties." Go to the "Coordinate System" tab and select the appropriate system, such as "Albers Equal Area Conic," in the search box. Select "Projected Coordinate Systems" → "Continental" → "North America" → and click "OK." **Note:** use the Albers Equal Area Conic projection system whenever mapping the entire U.S. or other countries or continents that are mainly East-West in orientation. For smaller geographic areas, other projection systems are preferable[23].

5. **Cropping basemaps.** Given that ArcMap's basemaps include data from all around the world, you might want to crop the selected basemap to a specific area. To do this, click the "View" menu and "Choose Data Frame Properties." In the "Data Frame" tab, look for "Clip Options," and choose "Clip" to shape. In the "Specify Shape" box, select "Outline of Features," choose the appropriate boundary layer, and click "Apply." The basemap will now be cropped to the specified boundaries.

6. **Using an appropriate color scheme.** Notice that the imported Washington, DC, boundary layer is solid blue, which obscures the basemap. To change a layer to a different color or hollow (no-fill), double-click the box below the layer name in the "Table of Contents." The outline width, color, and other style preferences can also be modified. When choosing colors, it is best to use pale yellows, greens, and light browns to represent land. Avoid using blues for land because blue is typically associated with water. When there are several shades of the same color on a map, the darker shades tend to connote more of something (such as a higher density of people or greater incidence of crime).

   Try to limit a map to no more than three colors and no more than three symbols (for example, circle, square, or star to represent landmarks). Limiting the number of colors and symbols will make the map more user-friendly. Be mindful that if the map is going to be printed, not all colors may print as they appear on the computer screen. If this is a major concern, consider using gray scale for the map.

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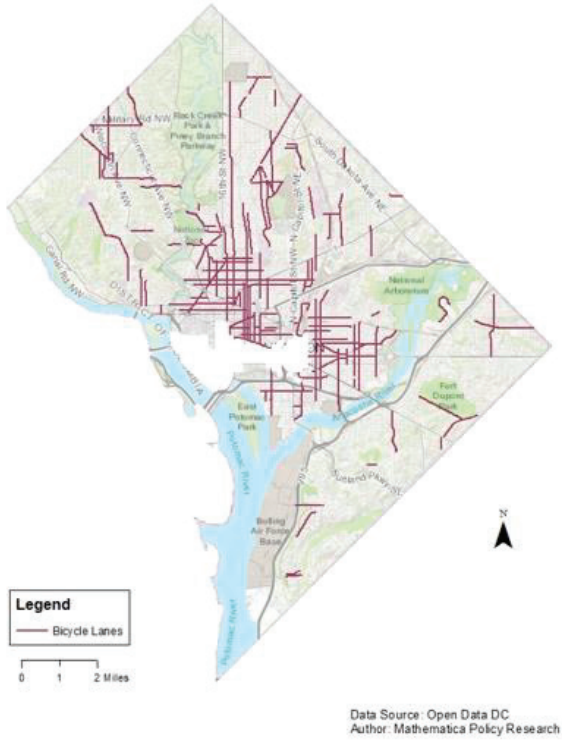
[21] For more information on the Washington, DC, boundary layer, visit http://opendata.dc.gov/datasets/state-of-washington-dc.

[22] You can right-click and select "Zoom to Layer" in the "Table of Contents" on the left side of the screen to quickly zoom in on an area to examine.

[23] See the Projection and Coordinate fact sheet in Appendix C of the ArcMap users' manual for more details.

7. **Adding layers to the map.** To add a layer to the map saved in Section IV—for example, the bike lanes shapefile—follow the directions in Section III. If you are a more advanced ArcGIS user, pull data from the file geodatabase created in Section IV.
8. **Viewing and printing the map.** There are now three layers in the "Table of Contents" on the left panel of ArcMap: bicycle lanes; the state boundaries of Washington, DC; and the topographic basemap. Having learned the basics of adding data to a map, you can begin to create a map suitable for dissemination. In "Layout View," add important features such as a map legend, scale bar, and compass, which will make the map easier to interpret. (Keep in mind that the goal of a map is to convey a message to a general audience with as little text as possible.) Click "View" → "Layout View" to see what the map will look like upon printing or exporting.
    a) To ensure that the map prints correctly, go to "Page and Print Setup" to change the orientation to landscape, if necessary.
    b) Click "View" → "Data Frame Properties → "Size & Position" to change the length, width, and height of the map.
    c) Insert a scale bar and compass (for example, a north arrow). Make sure to size the scale bar and north arrow so that it does not draw attention away from the map.
    d) Insert a legend. The legend reflects the same naming conventions used in the "Table of Contents."
    e) Adjust the map scale to show only the appropriate area.
    a) Include an appropriate title and add a text box to cite the data source and author.
9. **Outputting the map.** Output the map to a .jpeg file by clicking "File" → "Export Map" → "Save as Type: JPEG." Figure V.1 shows the final version of the map created following Steps 1–9.

Figure V.1. Bicycle lanes in Washington, DC

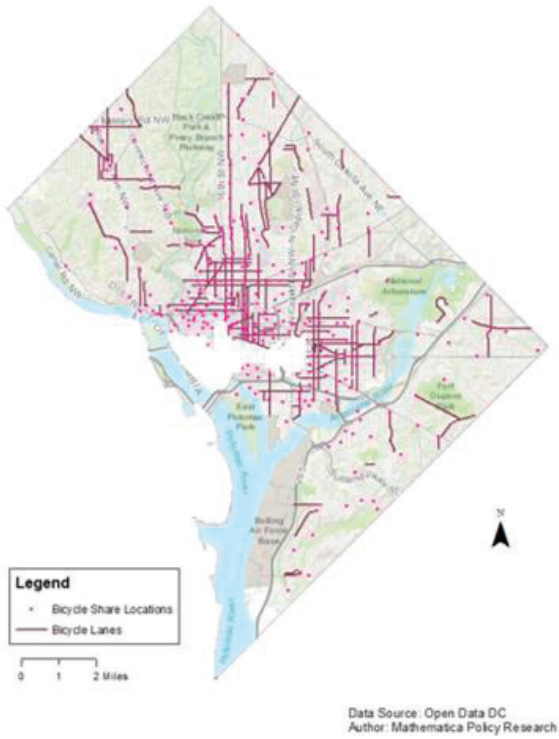


10. **Creating multilayered maps.** You can also create multilayered maps, such as maps with multiple constructs. Suppose you want to make a multilayered map that includes all locations of programs that offer a "bike share" option, in addition to bike lanes, in Washington, DC. One example is Capital Bikeshare, a program that enables people to rent bicycles for a small fee throughout DC and drop the bicycles off at designated locations.[24] When downloading the relevant GIS data (see Section IV for guidelines), you should include not only the bicycle lanes but also the Capital Bikeshare program locations. Once the data are downloaded, repeat Steps 1–9 in this section.

[24] For more information about Capital Bikeshare, see https://www.capitalbikeshare.com/.

Figure V.2 shows the final version of the map created by following Steps 1–10.

Figure V.2. Bicycle lanes and Capital Bikeshare locations in Washington, DC



VI. WORKING WITH TRUSTED GIS DATA SETS

Local and national GIS data are only as reliable as their source. Some data sets that are publicly available online are created by novice GIS users, so beware of simple Google searching when looking for relevant data sets. It is important to identify and use only reliable data.

Data sets from government sites and universities and for purchase from software sites like Esri are more reliable than data sets found on blogs, message boards, and private sites. This is because mapping something spatially is a complex process, with many opportunities for small errors. Data that come from a professional or government-sponsored database are generally held to a higher standard.

National data sets

National data sets show locations and relationships across the United States. Well-constructed national data sets provide homogenous criteria that can be used to compare and contrast locations. For example, the USGS National Transportation Data Set[25] enables users to visualize landmarks such as airports and railroads across the United States, providing information on the regions accessible via these modes of transportation.

These national data sets are made up of smaller data sets that may not be based on similar geographic units—some may have data only at the state level, others at the metropolitan or county level, and others at the census track or block group level. For example, the USGS data set contains more than 50 smaller data sets, each corresponding to a different state or U.S. territory. Being able to identify the method used to construct the smaller components of a national data set (in the case of the USGS data, the 50 states and the territories) is important because the method must be standardized in order for intercomponent comparisons to be accurate.

For example, suppose you want to map hiking trails across the United States. First, you must define what is meant by a "trail." A trail in one state might not be defined the same way as in another, even when the data come consistently from a reputable source. For example, Massachusetts derives its trail data from its department of transportation, whereas Connecticut derives its trail data from its department of environmental protection. Even though both departments are reputable sources of GIS data, the criteria for defining trails is different between the two states, and thus their data cannot be compared.[26]

When comparing trail data across states, it is best to use a national data set that defines "trail" the same way for all states. The USGS data set, for example, includes trails as part of its transportation network. Although the overall data set contains more than 50 linked data sets, the information retains its internal consistency because all the data were constructed by the same federal department.

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[25] For more information on accessing the USGS National Transportation Data set, see http://catalog-web-test.datagov.us/dataset/usgs-national-transportation-dataset-ntd-downloadable-data-collectionde7d2.

[26] Criteria for trails varies widely, with some criteria requiring the trail to be paved, officially flagged as a trail, or designated as preserved land.

Other trusted national data sets

EPA's Smart Location Database. EPA's Smart Location Database is a useful GIS data set for measuring location efficiency, or factors within the local context that relate to travel behavior.[27] It includes characteristics such as housing density, diversity of land use, neighborhood design, destination accessibility, transit service, employment, and demographics for most census block groups across the United States.

For information on how to view the data set online or download the zip file, see the technical documentation within the user guide for the Smart Location Database.[28] Use Table 1 in the user guide to identify the variables in the data set that act as proxies for your areas and constructs of interest. After downloading the zip file, follow the directions in Section IV to store the data and proceed to Section V to visualize the data in a map.

CDC's Behavioral Risk Factor Surveillance System. Another helpful resource is CDC's Behavioral Risk Factor Surveillance System, which consists of telephone survey data on U.S. residents' health-related behaviors, chronic health conditions, and use of preventative services.[29] Using the survey and location data from its surveillance system, CDC compiled GIS data sources and documentation, saved in zip files, for both states and metropolitan areas.[30] Users can combine the survey data and GIS resources to create interesting maps and other features.

Urban Design 4 Health: Natural & Social Environmental Indicator Database. A third option is the Natural & Social Environmental Indicator Database, developed by Urban Design 4 Health and funded by the Robert Wood Johnson Foundation. This database focuses on the use of standardized metrics to assess features of neighborhood environments known to predict physical activity and overall health.[31] The datasets contained in this database are not currently available to the public for download but they are searchable and available to the public at the Urban Design 4 Health website.

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[27] For more information about the Smart Location Database, see https://www.epa.gov/smartgrowth/smart-location-mapping#SLD.
[28] The Smart Location Database's user guide is located at https://www.epa.gov/sites/production/files/2014-03/documents/sld_userguide.pdf.
[29] For more information on the Behavioral Risk Factor Surveillance System, see https://www.cdc.gov/brfss/about/index.htm.
[30] GIS data and documentation on the Behavioral Risk Factor Surveillance System are located at https://www.cdc.gov/brfss/gis/gis_maps.htm.
[31] For more information on the Natural & Social Environmental Indicator Database, see http://urbandesign4health.com/projects/ned.

VII. CONCLUDING REMARKS AND FURTHER RESOURCES

The aim of this protocol was to provide users with some working knowledge of GIS resources and how to use GIS tools to assess local and national supports for active transportation in defined communities of interest. We recognize that some users may be ready to pursue more advanced GIS activities and thus we provide two resources to support these efforts. The first resource was developed by Ann Forsyth and describes methods for measuring environmental variables for walking using GIS procedures (http://designforhealth.net/resources/other/gis-protocols/). The second resource was developed by the International Physical Activity and Environment Network (IPEN). Some of the key aims of the IPEN are to stimulate research in physical activity and the environment, and recommend common methods and measures (https://www.ipenproject.org/index.html).

VIII. APPENDIX: LINKING THE TERM "BIKEABILITY" TO THE CONSTRUCT "MULTIMODAL TRANSPORT INFRASTRUCTURE" AND CAPTIONS AND SCREEN SHOTS

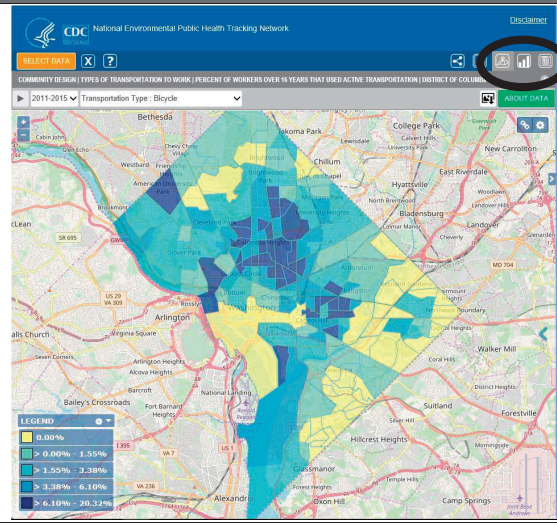
Table VIII.1 connects the term "bikeability" used in this protocol with the appropriate construct of "multimodal transport infrastructure" documented in Pate at al. (2018). It also provides the sections where the term "bikeability" is used.

Table VIII.1. Identifying the term "bikeability" in the protocol

Term	Description	Construct	Sections
Bikeability	Bicycle facilities; bicycle lanes; separated lanes; neighborhood streets; bicycle boulevards; cycle tracks	Multimodal transport infrastructure	II, III, V

Table VIII.2 provides additional screen shots to better highlight the action figures presented throughout this protocol.

Table VIII.2. Captions and screen shots

Image in Text	Text Location	Application Location
 Map, Chart, Table	Page 6, Line 9	

Year

Page 6, Line 11

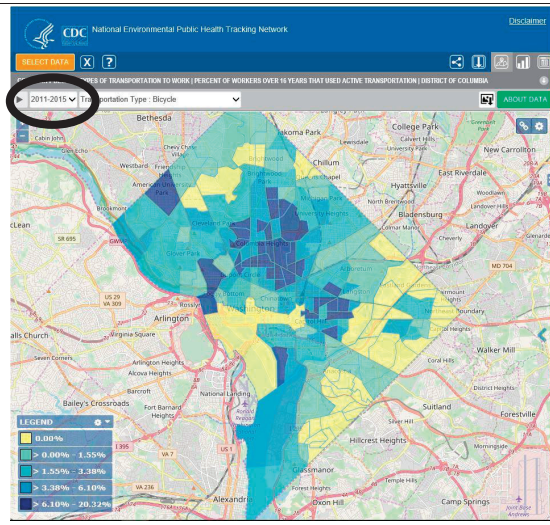
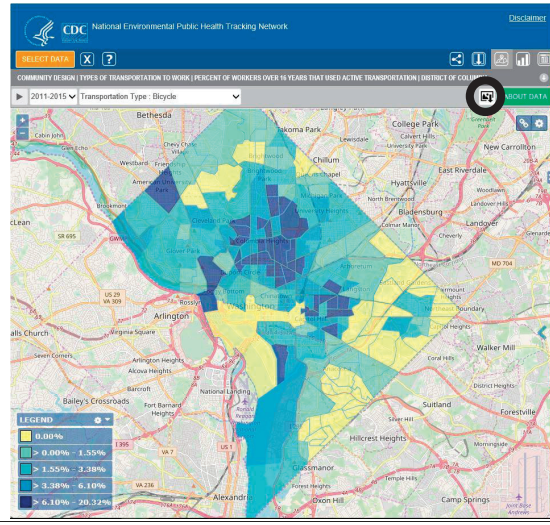


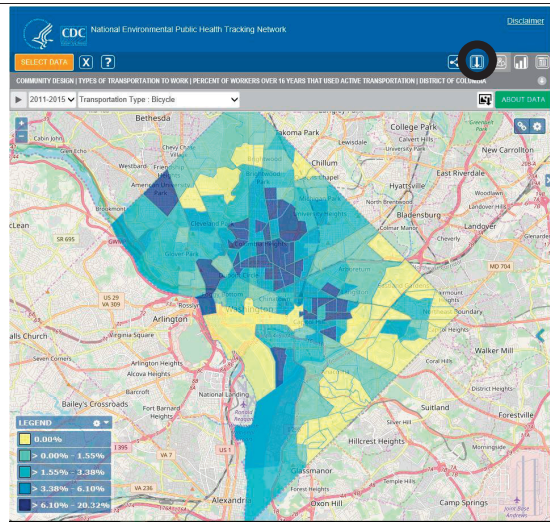
Image Export

Page 6, Line 13



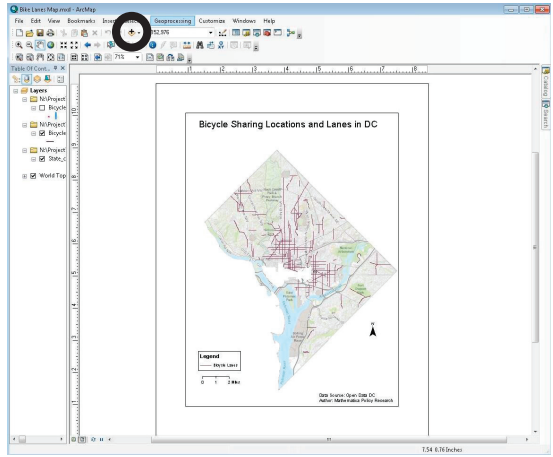
Data Export

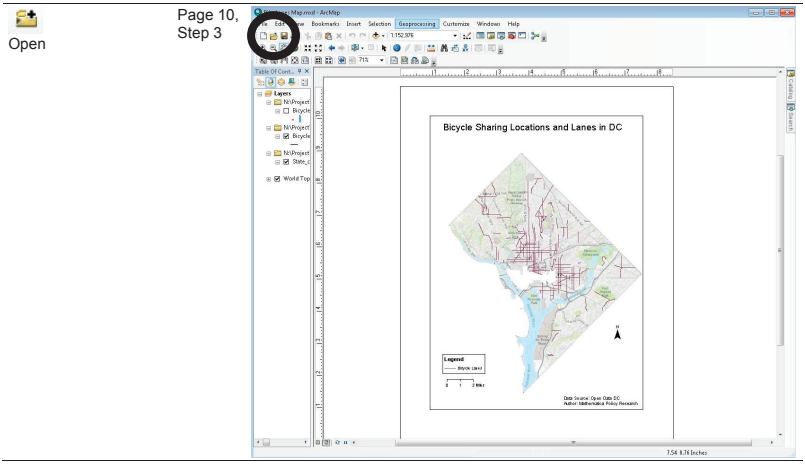
Page 8, Line 4



Add Data

Page 9, Step 2; Page 10, Step 3





PART III

USING AUDIT OBSERVATION DATA TO UNDERSTAND COMMUNITY SUPPORTS FOR ACTIVE TRANSPORTATION: A "HOW TO" PROTOCOL

REPORT

FINAL

Revised: Using Audit Observation Data to Understand Community Supports for Active Transportation: A "How To" Protocol

February 21, 2019

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CONTENTS

TABLES

I. INTRODUCTION

Purpose and organization of this protocol

The purpose of this protocol is to introduce readers to the key elements for planning an audit observation study to assess community supports for active transportation. Section I defines audit observations and how they may be used to study community supports for active transportation. Section II provides a more detailed examination of audit observations by describing approaches for conducting audits, tradeoffs for using the various approaches, the feasibility of using audit observations to measure key constructs associated with community supports for active transportation, and methods for integrating audit data with geographic information system (GIS) data.

How can audit observation data help with identifying community supports for active transportation?

Audits are systematic observations of communities and can be used to identify community features for analysis and policy decision making. Community supports for active transportation are understood through eight categories, or constructs: land-use mix, street connectivity, multimodal transport infrastructure, traffic safety, zoning and related policies, public transit, parks, and programs.[32] By conducting audits, researchers, planners, and other stakeholders can document relevant features within communities that support active transportation. For instance, the construct "multimodal transport infrastructure" is defined through examples such as sidewalks, bike facilities, traffic-calming features, and street-crossing design, so an individual could include a sidewalk assessment as part of an audit protocol. Using data generated from the audit observation, one could understand how well sidewalks are maintained in order to better understand one element of the construct multimodal transport infrastructure. These methods can supplement GIS-related work or can be conducted independently. Audits may be particularly useful for assessing characteristics of the built environment that are typically missing in GIS databases, such as sidewalks, crosswalks, street furniture, and aesthetics. In contrast, audits cannot be used for assessing zoning or programs.

[32] For more information on the constructs, Pate et al. (2018). Actions to Improve Physical Activity Surveillance in the United States. Discussion Paper for National Academy of Medicine.

II. ASSESSING ENVIRONMENTAL DETAILS USING AUDIT DATA

Approaches for conducting audits

When deciding on an approach for conducting audits to assess community support for active transportation, one should consider a number of options and priorities. The first decision is whether **humans** or **machines** will conduct the audit. The majority of this protocol refers to human conducted audits since machine methods are new and still emerging. Assuming humans are selected to conduct the audit, the second question is whether the audit will be conducted **live** or **remote**. A third question is whether to use **citizen scientists** or **trained professionals**. When using citizen scientists, a final question concerning whether or not to use a **qualitative or quantitative approach** must be determined. These various approaches are described below.

11. **Humans v. machine learning methods.** A first consideration for conducting audits is whether to use **human observers** or a **machine learning approach**. With machine learning, datasets with labeled images are used to train supervised learning algorithms to recognize features of the image and appropriately code the different features. After the algorithms have 'learned' from the training data, future images are automatically labeled with the correct features of the given landscape. These image-based machine learning methods are not well established so their reliability and validity is uncertain. Although not recommended as a main source for conducting audits, this method has been included in this protocol because it is an approach that could be used more widely in the future.
12. **Live or remote audit methods.** Assuming human observers are selected to conduct the audit, another consideration is whether the audit will be conducted **live or remote**. Live methods involve humans going out into the field, walking the communities where the audit is being conducted, and making their observations in real time. Remote methods involve humans conducting their audits remotely in their office or home, using tools like Google Street View to extract data on the relevant features of a community.
13. **Citizen scientists or trained professionals.** A third consideration with human observers is whether to employ **citizen scientists or trained professionals** (for example, professional planners, civil engineers, or public works employees). Citizen scientists are members of the public who are interested in participating in research or science-related efforts. Citizen scientists may or may not be trained and certified in collecting audit data. On the other hand, trained professionals are familiar with the tools for completing an audit exercise, and already conduct audits (both live and remote). These individuals may produce high quality audits compared to citizen scientists, but these audits come at a cost. Professionals may be substantially more expensive than even certified citizen scientists so this approach may not be as scalable as using citizen scientists.
14. **Qualitative or quantitative approach.** The final consideration with human observers is whether to use a qualitative or quantitative approach. This determination only comes into question when selecting citizen scientists to conduct audits because trained professionals almost always use a standardized, quantitative tool for the observation. The qualitative approach does not require the human observer to receive any standardized trainings or certifications to conduct community observations. While this approach may be useful for advocacy work, it is not appropriate for surveillance work and will not be discussed further in this protocol. In contrast, the quantitative approach is considered to be more rigorous and

robust, and therefore, appropriate for surveillance work. The approach of using citizen scientists to conduct quantitative audits requires a tool developed by a group such as the American Planning Association, and requires the completion of a training for certification. The cost and time associated with training is considered a key drawback of this approach but as discussed earlier, trained and certified citizen scientists may still be less expensive than professional experts. Of note, the quantitative approach could be supplemented with qualitative comments and photos for a richer assessment.

In the next section, we discuss the feasibility of using audit data to assess community support for active transportation.

Feasibility of using audit data to assess community support for active transportation

Audit data can be useful in assessing many of the eight constructs associated with community supports for active transportation, but audits also have their limitations. The ranking shown in Table II.1 reflects the feasibility of using audits to assess the relevant eight constructs. We determined feasibility based on whether the constructs had static or changeable features. Constructs that are stable (i.e., do not move) lend themselves to easier observation (for example, land space and streets) because an observer can focus their attention on features of the construct without interruption. Changeable constructs—those subject to movement or affected by factors like time of day—are more difficult to assess via audit methods. Other constructs like zoning and programs are infeasible to assess via audit methods because they do not necessarily represent visual features of communities.

Table II.1. Feasibility of assessing constructs via audit methods

Constructs	Human conducted live or remote audit methods
Land use	1
Street connectivity	1
Multimodal transport	2
Traffic safety	3
Zoning	N/A
Public transit	2
Programs	N/A
Parks	1

1 = High likelihood of success with method
2 = Moderate likelihood of success with method
3 = Low likelihood of success with method
N/A = Not viable to assess with method

In the next section, we discuss integrating audit data collected using human observers with GIS data.

Integrating audit and GIS data

Audit and GIS data can be combined to provide a rich perspective in geospatial analysis on community supports for active transportation. In order to integrate audit and GIS data, an auditor must first identify an area and construct of interest. Next the auditor follows the four key steps below. In the example below, the auditor has identified a local community as their area of interest and selected parks as their construct.

15. **Identifying salient features.** The first step is to identify landmarks within the park or other elements of saliency. Features of parks (for example, playgrounds or walking trails) are examples of salient elements that are supportive of physical activity.
16. **Scoring salient features.** Once the salient features are identified, the auditor uses their standardized coding scheme to appropriately rate each feature. One simple example of scoring would be to have a standard scale from 1 to 10, where 1 denotes observations of features which do not meet expectation and 10 denotes observations of features which exceed expectation. Using this scaling approach, higher scores indicate features that are more supportive of active transportation. The auditor then sums the scores across features for each construct.[33]
17. **Data entry.** After calculating scores for each construct of interest, a trained data entry technician should enter the scores into a specified database. The trained technician should have been exposed to key logical coherency and reasonableness rules to ensure quality data entry and reduce future burden on the analyst.
18. **Data analysis.** Upon the completion of data entry, a trained data analyst can then perform the appropriate cleaning and reduction techniques to ensure the data's logical coherency and reasonableness. In order to prepare the data for integration and analysis with GIS data, the analyst should assign the appropriate geocodes so the data is ready for integration. The US Census Bureau (https://geocoding.geo.census.gov/geocoder/)[34] is a trusted source for assigning geocodes. Once the geocodes are assigned, the data analyst should conduct a merge using the appropriate software (for example, Excel, SAS, R) to integrate observations from the audit with the relevant GIS data. For information on how to successfully work with GIS data, users should review the "Using Geographic Information System (GIS) Data to Understand Community Supports for Active Transportation: A "How To" Protocol on the use of GIS data to understand community supports.

[33] It is important to point out that the methods for deriving a domain or construct score are not well-established at this time.
[34] For more information on geocoding https://geocoding.geo.census.gov/geocoder/

Concluding remarks

Audit observation methods are useful for documenting features of communities to understand supports for active transportation that are not present in GIS data. This protocol summarizes various approaches to conducting audits, and weighs the tradeoffs that planners should consider when selecting one of these approaches. In this protocol, we also discuss the feasibility of using audit data to measure the eight constructs associated with community supports for active transportation, as well as how to integrate audit and GIS data to produce a more comprehensive understanding of community supports for active transportation.

Appendix F

Committee Member Biosketches

Russell R. Pate, Ph.D., M.S., is professor of exercise science at the Norman J. Arnold School of Public Health, University of South Carolina, Columbia. Dr. Pate's research interests and expertise focus on physical activity measurement, determinants, and promotion in children and youth. He also directs a national postgraduate course aimed at developing research competencies related to physical activity and public health. Dr. Pate is involved in the Centers for Disease Control and Prevention–funded Prevention Research Center at the University of South Carolina. His research includes studies on preschoolers' physical activity levels and how schools can influence these levels, as well as multicenter trials on the promotion of physical activity among middle and high school–age girls. Dr. Pate was a member of the Physical Activity Guidelines Advisory Committee of the Department of Health and Human Services (2008 and 2018) and served on the 2005 Dietary Guidelines Advisory Committee. He is a past president of both the American College of Sports Medicine and the National Coalition on Promoting Physical Activity. Dr. Pate served as a member of several obesity-related committees including the National Academies of Sciences, Engineering, and Medicine's standing Committee on Childhood Obesity Prevention, the Roundtable on Obesity Solutions, and was the chair of the Committee on Fitness Measures and Health Outcomes in Youth. He received a Ph.D. in exercise physiology from the University of Oregon.

Genevieve Fridlund Dunton, Ph.D., M.P.H., is an associate professor of preventive medicine and psychology at the University of Southern California (USC). Dr. Dunton's research examines the etiology of health behaviors

related to chronic disease risk in children and adults, with a focus on physical activity and nutrition. Dr. Dunton is the director of the USC REACH (Real-Time Eating Activity and Children's Health) lab, whose goals are to develop, test, and apply real-time data capture methodologies, including ecological momentary assessment (EMA) and wearable sensors, to better understand the effects of time-varying psychological, social, and environmental factors on eating and physical activity episodes. She is the principal investigator on six large studies funded by the National Institutes of Health and the American Cancer Society, author of more than 120 peer-reviewed publications, and past chair of the American Public Health Association Physical Activity Section. She earned a doctorate in health psychology from the University of California, Irvine, and an M.P.H. from USC. Dr. Dunton received postdoctoral training in physical activity, nutrition, and cancer prevention from the Cancer Prevention Fellowship Program at the National Cancer Institute, where she worked in the Health Promotion Research Branch.

Elizabeth A. Joy, M.D., M.P.H., is the medical director for Community Health, Health Promotion and Wellness, and Nutrition Services at Intermountain Healthcare in Utah, and practices family medicine and sports medicine at the Salt Lake Clinic LiVe Well Center. She is an adjunct professor at the University of Utah School of Medicine in the Department of Family and Preventive Medicine. Dr. Joy served as president for the American College of Sports Medicine (ACSM) (2016–2017). She serves on the Exercise is Medicine Governance Committee for ACSM, and chairs the Healthcare Workgroup for the National Physical Activity Plan. She completed her master's degree in public health at the University of Utah and received her M.D. from the University of Minnesota. Dr. Joy completed a family medicine residency and sports medicine fellowship at Hennepin County Medical Center in Minneapolis, Minnesota.

Keshia M. Pollack Porter, Ph.D., M.P.H., is a professor of health policy and management at the Johns Hopkins Bloomberg School of Public Health. Her research advances policies that create safe and healthy environments where people live, work, play, and travel. Dr. Pollack Porter focuses on identifying policy solutions to prevent injuries, promote active transportation and play, address social determinants of health, reduce disparities, and advance health equity. She directs the national Centers for Disease Control and Prevention–supported Physical Activity Policy Research Network Plus (PAPRN+), which advances the dissemination and implementation of policies and programs that promote physical activity and address inequities. Dr. Pollack Porter also works on optimizing the use of health impact assessment and related approaches to advance health in all policies at the local,

state, and federal levels. Dr. Pollack Porter received her Ph.D. from Johns Hopkins University and an M.P.H. from the Yale School of Public Health.

Daniel A. Rodriguez, Ph.D., M.S., is the Chancellor's Professor of City and Regional Planning and associate director of the Institute for Transportation Studies at the University of California, Berkeley. His research focuses on the relationship between transportation, land development, and the health and environmental impacts that follow. His most recent work focuses on the health and equity impacts of urban transportation policy. Prior to joining Berkeley, Dr. Rodriguez served in the faculty of University of North Carolina at Chapel Hill, where he was distinguished professor of sustainable communities in the Department of City and Regional Planning and adjunct professor in the Department of Epidemiology. Dr. Rodriguez earned a doctorate in regional and urban planning from the University of Michigan and an M.S. from the Massachusetts Institute of Technology.

James F. Sallis, Ph.D., is distinguished professor emeritus of family medicine and public health at the University of California, San Diego, and professorial fellow at Australian Catholic University in Melbourne. Dr. Sallis's primary research interests are promoting physical activity and understanding policy and environmental influences on physical activity, nutrition, and obesity. He has made contributions in the areas of measurement, correlates of physical activity, intervention, and advocacy. He is the author of more than 700 scientific publications and is one of the world's most cited scientists. Dr. Sallis is a frequent consultant to universities, government agencies, health organizations, and corporations worldwide. He is a member of the National Academy of Medicine. He received his Ph.D. in clinical psychology from Memphis State University.

Laurie P. Whitsel, Ph.D., FAHA, is currently the vice president of policy research and translation for the American Heart Association (AHA), helping to translate science into policy at a national level in the areas of cardiovascular disease, stroke prevention, and health promotion. She focuses on AHA's prevention policy portfolio and has written numerous published papers in the areas of nutrition, physical activity, and obesity prevention, and has led the development of AHA's strategic policy agenda. Dr. Whitsel helps manage several national relationships for AHA with key public health partners and serves on the Board of Directors for the Health Enhancement Research Organization and the National Coalition for Promoting Physical Activity. She has served on expert advisory groups with RAND, the Bipartisan Policy Center, the Centers for Disease Control and Prevention, and the Robert Wood Johnson Foundation. She has been a sector co-leader for the National Physical Activity Plan and leads AHA's internal strategic

plan for physical activity. She serves as an expert peer reviewer for several scientific journals and is a consultant on research grant teams. She gives regular guest lectures at Columbia University. Her Ph.D. is from Syracuse University in nutrition science and she is a fellow and member of AHA's National Scientific Council on Lifestyle and Cardiometabolic Health.