PREVENTING CHRONIC DISEASE

PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

Promoting the Science and Practice of Implementation Evaluation in Public Health

Contents

About the Journal

Preventing Chronic Disease (PCD) is a peer-reviewed public health journal sponsored by the Centers for Disease Control and Prevention and authored by experts worldwide. PCD was established in 2004 by the National Center for Chronic Disease Prevention and Health Promotion with a mission to promote dialogue among researchers, practitioners, and policy makers worldwide on the integration and application of research findings and practical experience to improve population health.

PCD's vision is to serve as an influential journal in the dissemination of proven and promising public health findings, innovations, and practices with editorial content respected for its integrity and relevance to chronic disease prevention.

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Promoting the Science and Practice of Implementation Evaluation in Public Health

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Preventing Chronic Disease (PCD) recognizes that public health and clinical interventions are often collaborative, multifaceted, multicomponent, and multisite with diverse participants, stakeholders, and partnerships (1). As such, evaluation of these efforts cannot rely solely on linear approaches to assess the complex mix of individual, familial, organizational, economic, environmental, and other contextual factors that contribute to the success of interventions. In light of that complexity, it is critically important that researchers, evaluators, and program implementers not focus solely on program outcomes but also spend time to rigorously examine and describe how the program's components produced the reported outcome (2). It is important that they faithfully execute the implementation plan, success being contingent on the "degree to which a program is delivered as originally designed" (3) with consideration to local context to improve adoptability and sustainability (2).

In early 2018, PCD addressed these important considerations by introducing Implementation Evaluation, a new article type that provides the journal's readers (program planners, policy makers, evaluators, researchers, and diverse stakeholders) with information on how to refine evaluation methods, make health system improvements, strengthen collaborations and partnerships, build organizational infrastructure, measure return on investments, and enhance data collection approaches (www.cdc.gov/pcd/for_authors/types_of_articles.htm). Implementation Evaluation articles provide insights into factors that affect the ability of public health practice to successfully package and disseminate effective interventions implemented and evaluated in real-world settings. PCD's interest in this area extends to research that examines which factors positively or negatively impact the diffusion of proven interventions and the degree of integrity needed to generate success. Specific program elements such as "adherence to intervention, exposure, or dose, quality of delivery, participant responsiveness and program differentiation" are all factors associated with implementation fidelity (4). Implementation Evaluation articles published by PCD offer readers timely research that examines in comprehensive ways how evidence-based interventions are implemented in comparable real-world settings.

PCD was fortunate in its inaugural year of introducing this new article type to receive many outstanding submissions. The journal is excited to present this collection of 5 articles that highlight research findings from implementation evaluation efforts that address a variety of topics:

1. a call to action for public health professionals to advance dissemination and implementation science;
2. use of an alcohol surveillance system to assess quality, usefulness, and timeliness of data;

3. the application of a pragmatic framework to guide health care systems in assessing implementation and impact of an evidence-based physical activity program;
4. an assessment of the effectiveness and cost benefit of a program for weight loss and diabetes prevention in a rural setting; and
5. an evaluation of activities to reduce the intake of sodium in community settings.

As part of its effort to provide more research on topics related to implementation evaluation, PCD has recruited associate editors and editorial board members with considerable experience and expertise in implementation dissemination, implementation science, and implementation evaluation. The evolution of work occurring in these areas has expanded over the past 25 years, with the fundamental goal of better identifying program components in public health that contribute to achieving success in population health outcomes. A major component of this goal is to find cost-effective ways to disseminate effective interventions in alignment with local context and real-world settings. An essay from authors Estabrooks, Brownson, and Pronk of our editorial board and associate editor teams provides an overview of dissemination and implementation science, including a review of frameworks, models, theories, concepts, and principles over the past 25 years (5). These authors discuss the importance of developing individual and team-based skills and abilities among public health professionals that increase adoption and scalability of evidence-based interventions.

Public health surveillance systems are an important aspect of implementation evaluation in collecting and analyzing timely data and disseminating findings that guide public health response to pressing public health issues (5). Public health surveillance systems, when developed in with input from stakeholders, can be implemented and sustained on an ongoing basis (6). Hagemery and colleagues conducted an assessment of the alcohol surveillance system to assess quality usefulness and timeliness of data (7). Researchers completed this assessment through data collection, systematic literature searches, and an interview with the New Mexico Department of Health’s alcohol epidemiologist. Authors assessed that the alcohol surveillance system in New Mexico was a useful, stable, and acceptable system capable of monitoring trends and identifying interventions to reduce the prevalence of alcohol-attributable morbidity and mortality in New Mexico (7). Authors discuss how findings from the assessment were used to enhance the state’s alcohol-related surveillance efforts. The evaluation process used by researchers may be useful to others interested in assessing strengths and areas for improvement regarding alcohol-related surveillance at the state level.

In addition to public health surveillance systems, other systems-based approaches must strike a balance between rigor and relevance in considering ways to evaluate the adoption, scalability, and sustainability of interventions (8). Hence, implementation science research, evaluation, and practice should use tailored evaluation designs that carefully align with the components of the intervention (9). Stoutenberg and coauthors applied the RE-AIM framework, an approach to planning and evaluating factors related to internal and external validity, to guide health care systems in assessing the implementation and impact of the Exercise is Medicine (EIM) program (10). EIM is an initiative that integrates physical activity assessment, prescription, and patient referrals as a standard of care (10). Authors provide recommendations and insights into ways the EIM in health systems can be effectively implemented and evaluated.

Economic evaluations are another aspect of implementation evaluation that is becoming increasingly helpful in informing decision-making to operationalize and sustain implementation strategies and best practices (11). Economic evaluations are critical to public health professionals, health care organizations, and funders interested in deciding how to maximize use of limited fiscal and human resources (11). McKnight and associates assessed the effectiveness and cost benefit of replicating a 12-week wellness program targeting adults in 4 rural locations (12). Researchers reported information on participation, completion, and changes in several health outcomes and discussed how a combination of factors influenced researchers’ ability to achieve results similar to those derived in the original wellness program.

Finally, the collection includes research on reducing intake of sodium in community settings, which has remained a national public health issue (13). This public health goal is particularly important given that diets high in salt are linked to high blood pressure, which is a major risk factor for stroke among adults (14). Community-based salt reduction programs may be effective in a range of settings, but more robust evaluation methods are needed. Scaling up these efforts in coordination with national initiatives could provide the most effective and sustainable approach to reducing population salt intake (15,16). In 2016, the Centers for Disease Control and Prevention (CDC) launched the Sodium Reduction in Communities Program (SRCP) to help increase consumers’ options for lower-sodium foods and create healthier food environments in communities (17). CDC’s SRCP funded and provided technical assistance to 8 recipients to increase the availability and purchase of lower-sodium food options by implementing 1) food service guidelines and nutrition standards, 2) procurement practices, 3) meal and/or menu modifications, and 4) environmental strategies and behavioral economics approaches to increase consumers’ options of lower-sodium foods (17). Long and coauthors present findings generated from baseline and 1-year follow-up from the SRCP implemented in Arkansas (18). Researchers describe how program staff worked closely with personnel in a school district and in a community meal program to implement intervention activities to reduce dietary sodium among the food options available and served. Researchers reported that mean sodium content of meals was reduced among participants in both the schools and the community meal program.

This collection of articles from PCD's first year of Implementation Evaluation articles represents an exciting new area of focus for the journal. PCD will continue to identify and publish cutting-edge implementation evaluation research that helps all populations benefit from the dissemination of new and proven discoveries. Toward that end, the journal seeks to gain a deeper understanding of how factors like staffing capacity, economics, leadership support, and intervention fidelity influence scaling up and sustaining proven, culturally appropriate, and setting-relevant interventions. PCD is also committed to publishing articles that use implementation evaluation findings to identify circumstances under which intervention activities should be reduced or discontinued because of factors such as premature adoption (implementing intervention activities before or without having proven evidence of effectiveness), harmful effects, or wasteful use of fiscal or human resources (19). PCD encourages authors to visit the Author's Corner section of the journal's website at www.cdc.gov/pcd/for_authors/index.htm to learn more about requirements for submitting an Implementation Evaluation manuscript for consideration.

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ESSAY

Dissemination and Implementation Science for Public Health Professionals: An Overview and Call to Action

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A Selective Review of the Origins of Dissemination and Implementation Science

Preventing Chronic Disease has a mission to enhance communication between researchers, public health professionals, and policy makers to integrate research and practice experience with a goal of improved population health. As a result, those involved in dissemination and implementation (DI) science — a growing field of study that examines the process by which scientific evidence is adopted, implemented, and sustained in typical community or clinical settings — have submitted and published their rigorous and relevant work in the journal with a high degree of success. Over the previous 2 years, the journal also added a new article type — Implementation Evaluation — to facilitate submission of articles that examine the implementation of evidence-based public health interventions in community and clinical settings. In an effort to continue the focus on DI, we wrote this commentary with the following objectives: 1) to provide a brief DI description, 2) to demonstrate the shared systems–based focus of DI science and public health practice, and 3) to highlight pathways to move public health–focused DI science forward. We reflect on our own learnings and by doing so hope to motivate more public health researchers and practitioners to engage in DI research.

DI research emerged — by name — over the past 25 years (1), but its roots can be traced to a much earlier time (2–4). A review of current DI research areas likely would not have seemed out of place in the 1930s through the 1960s. Some examples include the need for clinically relevant and community-relevant research (5), engaging systems and communities as partners in the co-creation of evidence (6), and examining the characteristics of interventions to determine which are more likely to be taken to scale and sustained (7). These topics can be traced back to the origins of action research in the 1940s, the push and pull between pure and applied research in the 1960s, and the diffusion of innovations that spanned both those periods. Indeed, the works of Kurt Lewin (8), Archie Cochrane (9), and Everett Rogers (3,10) provide a strong foundation for DI science.

Kurt Lewin founded the field of action research (4,8). He and other scientists of his day struggled against a paradigm that did not consider practice professionals in the development, implementation, and interpretation of scientific studies. In a critique that sounds like it could have come from the last American Public Health Association annual meeting, Lewin criticized the lack of integration of science and practice as a lost opportunity to understand group dynamics and organizational change processes while also contributing to achieving a community benefit through research. He argued for a pragmatic epistemological approach that combined social theory, experimental or quasi-experimental methods, and practice perspectives that could be used for local decision making and contribute to generalizable knowledge. He developed numerous participatory methods that engaged organizational representatives from the settings where social solutions would be applied, members of the population intended to benefit, and social scientists to collectively conduct diagnostic, participatory, empirical, and experimental action research (8). Action research, whether described as a systems-based approach, participatory dissemination, community-based participatory research, or integrated research–practice partnerships, provides a methodological basis for much of the current DI research. It also underscores the ideal outcomes of public health–focused DI research — a balance of demonstrating local impact while concurrently contributing to generalizable knowledge on how best to move evidence into practice.

Archie Cochrane — the inspiration for the thriving Cochrane collaborative (11) and the myriad of systematic reviews developed with a goal to provide a summary of evidence that can be used for health care practice and decision making — railed against the focus on pure research over applied research during the course of his career (9,12). Indeed, this quote captures his view of the existing research paradigm in the late 1940s: "I remember being advised by the most distinguished people that the best research should be utterly useless" (9 p432). Cochrane's approach was grounded in his experience as a prisoner of war in Germany, where he provided care for thousands of soldiers and was concerned with the likelihood that he may have inadvertently provided therapies that did more harm than good because of the lack of scientific evidence for the medical approaches of the day. As a result, he became an advocate for the use of randomized controlled trials (RCTs) for practical, applied research that could contribute to health care practice in a timely manner. By the early 1970s Cochrane was advocating for systematic reviews of literature to compile the findings of research studies and allow for guideline and policy implementation across medical disciplines (2). Cochrane reviews and other systematic review approaches (13) are used broadly in DI and to support evidence-based public health (EBPH) practice as an indicator that a given intervention is either appropriate or inappropriate for broad-scale adoption, implementation, and sustainability.

Finally, Everett Rogers could be considered the Father of DI with his seminal work published in *Diffusion of Innovations* from the first edition in 1962 through the fifth and final edition in 2003 (3). With his roots in rural sociology, Rogers introduced a theoretical approach that considered the communication of an innovation, over time and through distinct channels, across a social system. He also proposed that an innovation could be described as an idea, practice, or product that is perceived as new to a social system. Rogers's introduction of the S-shaped curve demonstrated the relative rate of adoption across early innovators and adopters with a slower rate of spread of an innovation followed by a steep increase as the early and late majority take up the innovation, followed by a slowing of the rate of adoption when system laggards (a term Rogers referred to in personal communications as one for which he wished he had come up with a less "inherently negative" label) take up the innovation.

The characteristics of an innovation — compatibility, complexity, observability, relative advantage, and trialability (how easily an innovation can be tested) — that Rogers proposed are still foundational across the primary theoretical approaches being applied in DI research (14–16). In addition to being a foundation of DI theories, Rogers's work is the basis of many DI process models (ie, models that provide a guiding process for moving an innovation into practice) that include stages and focus on providing knowledge about the innovation, persuasion based on the innovation characteristics, selection of an appropriate innovation, testing the innovation through implementation, and confirming whether the innovation achieved the desired results for a sustainability or discontinuation decision (3,17–19). A simplified description of Rogers's theory is the application of this decision-making process across an S-shaped curve highlighting differences in the rate individuals or settings adopt a new innovation (ie, innovators, early adopters, early majority, late majority, and laggards), where an innovation enters a social system based on the activities of innovators and early adopters and the perceived characteristics of the innovation (ie, compatibility, complexity, cost, observability, relative advantage, and trialability). It is important to note that consideration of innovation characteristics and the applicability of the innovation–decision process occurs across and within each adopter category in a social system.

In case you think that these issues are not as relevant today as they were three-quarters of a century ago, the promulgation of evidence, the lack of relevance of evidence, and the time and capacity needed for public health professionals to adapt and implement new interventions has resulted in a considerable evidence–practice gap (20). Cochrane would be thrilled with the advances in summarizing research for implementation decisions, but we speculate that he would be disheartened to know that it takes 17 years for 14% of original research to make its way to practice (21). Furthermore, some scientists have posited that the largest return on the public and private investment for the approximately $116 billion that is spent annually on biomedical research in the United States will be from DI research focused on translating currently available research on behavioral contributors to public health — tobacco use, dietary intake, and physical activity (22,23). This underscores the need for scientific advancement in speeding the translation of public health research to EBPH practice.

Current Dissemination and Implementation Theoretical, Process, and Outcome Models

The more recent emergence of the DI field can be traced back to the early 1990s and the energy focused on developing a myriad of DI models to address the evidence–practice gap (17,24–26). To guide public health professionals in framing their DI work, a classification system was developed that arranged models into 3 primary categories — process, explanatory, or outcome models (17). Process models are those that specify steps, stages, or phases necessary to speed the adoption, implementation, and maintenance of evidence-based interventions in clinical or community settings (19). Explanatory models are theoretical approaches to DI and specify important constructs that can predict implementation outcomes and include propositions that can be tested scientifically (3). Outcome models provide a set of potential targets for DI research and allow researchers and public health professionals to plan implementation strategies for specific outcomes and to determine the level of success of a given project or initiative (27).

Most DI researchers use a process model, though few characterize the specific steps taken at each phase of a DI project (6). However, the recently published Practical Planning for Implementation and Scale-up (PRACTIS) guide is a nice example of a process model. PRACTIS was explicitly developed to provide a step-by-step approach for researchers interested in engaging in DI work relative to physical activity promotion in clinical and community settings (19). The guide directs investigators through 4 overarching steps that include 1) identifying and characterizing the implementation setting, 2) identifying and engaging key stakeholders across multiple levels within the implementation setting, 3) characterizing barriers and facilitators to implementation, and 4) problem-solving to address potential barriers. Each step includes numerous activities to complete with the ultimate goal focusing on co-creation of implementation strategies and new evidence to support future implementation initiatives. An appealing feature of PRACTIS and other process models (28–30) is that they provide a set of algorithms and pathways based on if–then questions on potential roadblocks that may be encountered during the implementation process (19).

It's hard not to use Rogers's *Diffusion of Innovations* as our example of an explanatory model (3). This theory has been applied broadly, and despite the label of "diffusion," it includes many propositions and hypotheses that can be applied to proactive adoption, implementation, and maintenance research studies; at the time of our writing this article Rogers's work had been cited nearly 97,000 times. Diffusion of Innovations concepts have been adapted and integrated into DI-specific theories in an effort to more thoroughly operationalize theoretical constructs and expand them to define the uptake, use, and sustainability of evidence-based interventions. For example, Wandersman et al's interactive systems framework for dissemination and implementation proposes that 3 systems interact to either facilitate or inhibit research–practice translation: a delivery system, a research synthesis and translation system, and a translational support system (16). The framework provides numerous testable hypotheses, for example, that systemic readiness for adoption of an innovation is a function of the underlying motivation for adoption based on perceptions of the innovation's relative advantage and compatibility with systems resources, the general capacity of the system to adopt new innovations (eg, transformational leadership, organizational innovativeness), and innovation-specific capacity based on systemic implementation supports and local expertise relative to the new innovation. Having explanatory theories and applying them is a critical component to move, as Lewis and colleagues recently wrote, from simply characterizing DI to advancing the understanding of the underlying mechanisms of change (25).

DI outcomes can be generally categorized as implementation, service, or client outcomes (31). One of the earliest proposed and most cited outcome models was the Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) planning and evaluation framework published by Glasgow and colleagues in 1999 (27). RE-AIM's goal was to provide a framework that would balance the focus on internal and external validity to improve the translation of public health interventions to practice. Researchers were encouraged to consider external validity factors associated with the population intended to benefit from the evidence-based intervention when planning and evaluating a project, including reach (penetration into the population and representativeness of those exposed to intervention efforts), effectiveness (changes in health outcomes for those exposed to the intervention), and maintenance (durability of changes in health outcomes for those exposed to the intervention). Researchers were also encouraged to consider contextual factors related to adoption at the staff and setting level (penetration into the population of potential staff and organizational delivery systems and their representativeness), implementation (cost, quality, consistency of delivery), and maintenance of implementation at the staff and organization level (durability of the quality and consistency of delivery). The RE-AIM framework has evolved over 20 years to include consideration of qualitative and quantitative data, consideration of cost across RE-AIM dimensions, and possible combinations of metrics to assess public health impact (32–37).

The Natural Overlap of Public Health and Dissemination and Implementation Science: Systems-Based Approaches

Ultimately, public health practice is about changing systems through the use of an underlying evidence base, documenting outcomes of systems change, and capturing the underlying reasons (ie, mechanisms) of why a systems change occurred to allow for replication within and across public health settings (6). It is through this lens of systems that we consider a major goal of public health practice and DI science: to accelerate the uptake of evidence-based programs, practices, and policies in public health settings. A primary challenge to public health professionals and DI researchers alike is relevance of evidence developed through research studies to the contextual reality of practice settings (38).

Few evidence-based interventions can be implemented according to the same protocol, with the same resources, and the same level of expertise when translated from a research setting to a practice, system, or policy setting (39,40). Furthermore, top–down rollouts of an evidence-based intervention where talented and effective professionals are working to achieve population-level impacts can possibly inhibit innovation and lead to poor outcomes.

Systems-based, collaborative processes for DI ideally engage practice partners that contribute across the life course of any one project and often across multiple projects (6,41,42). These processes include generation of the research question, development of implementation strategies, adaptation of evidence-based interventions, selection of the research design, implementation of the research, and interpretation of the results. This process evolved from the Cochrane era, when limited evidence from different medical fields existed and the RCT was promoted as a gold standard. Indeed, an RCT is often not feasible when applied to DI projects and could inhibit intervention adoption (43,44). One characteristic of DI work is a reliance on matching research designs to specific problems and a focus on pragmatism to answer questions that can benefit the system that is partnering on the research (45). Part of the legacy of Lewin's work can be traced to complex systems and systems-thinking tools that are foundational areas of learning for public health professionals (46). Systems thinking tools such as multisector collaboration, iterative learning processes, and transformational leadership require the opportunity for a much broader adaptability of evidence-based interventions based on the underlying principles or processes (46). Public health professionals are often conveners and organizers of a cross section of community groups interested in improving population health (47). This convening role may include a horizontal systems approach that engages all stakeholder organizations that could be involved in the implementation of an evidence-based approach (eg, employers, faith-based organizations, community centers) as well as a vertical systems approach that acknowledges the need to engage both an administrative decision maker and staff members who would ultimately be responsible for implementation (48).

A key systems-thinking tool that is used in DI research and public health practice is an iterative learning process that includes the 1) identification of priority areas or needs within a system (similar to community needs assessments completed by public health departments), 2) matching of available evidence to the identified need (community action plans), 3) piloting or implementing strategies, 4) evaluating outcomes, and 5) deciding if a strategy should be sustained, adapted, or abandoned. Within this iterative learning process, numerous things need to be considered, and much is related to how we define evidence and evidence-based practice. Beginning with evidence-based practice, evidence is both used and produced by public health professionals (6). Kohatsu defined this EBPH approach as "the process of integrating science-based interventions with community preferences to improve the health of populations" (49 p419). The concept was also expanded to focus on evidence-based principles that can be used in the context of evidence-*informed* decision making (50–53). This concept recognizes that public health decisions are based not only on research but also on the need to consider key contextual variables (eg, political and organizational factors) (54).

Evaluation of the application of evidence-based principles and processes in the context of real-world systems is key in the iterative learning process. Often, the focus of evaluation is to provide evidence that the contribution of one or a few factors make a difference among a set of predetermined outcomes while holding all other factors constant. A systems-based approach acknowledges that in public health practice, all factors, even (or especially) those that are not being measured, are dynamic rather than static and influence the context of the evaluation. In other words, evaluations of programs, practices, and policies in the field of health and well-being are complex. The introduction of complex systems science provides an opportunity to consider an approach to evaluation that optimizes the context, does not attempt to control variables that cannot be controlled, and may be helpful in evolving the field of evaluation and pragmatic DI research to become more responsive to the needs of practitioners and decision makers (55,56).

Systems-based approaches, by nature, cannot be completed without representation from the system that is intended to change (6). This approach ensures understanding of system goals, resources, and structure and is especially critical to decision making. This approach also allows for translational solutions to align with and be responsive to the organizational context. Alignment with organizational practice priorities is paramount, and the inclusion of decision makers and implementation staff allows for both a consideration of priorities and the practicality of implementation. This need for alignment means that communications inside and outside the organization need to be kept simple and couched deeply in the work so that across all affected, people understand each other. This approach also allows for systems to set milestones and criteria necessary to determine whether a new EBPH strategy should be continued, adapted, or discontinued (6).

A Call to Action for Public Health Practice and Dissemination and Implementation Science

Throughout this article we have highlighted the sustained relevance of the work of some of the giants in our field, provided descriptions of the importance of explanatory, process, and outcome models, and outlined the common systems-focused basis for DI science and EBPH. Here, and in the Table, we have generated some recommendations and a call to action to align with a detailed scope of EBPH (57) and suggest public health professionals should 1) make decisions based on the best available, peer-reviewed evidence, 2) use data and information systems systematically, 3) apply planning frameworks that address population health and implementation outcomes, 4) engage community (and when feasible, research) partners in decision making, 5) conduct sound evaluation across population and implementation outcomes, and 6) share what is learned.

Building and sustaining opportunities for DI science in public health practice requires a combined emphasis on developing individual and team-based skills and capabilities as well as organizational capacity (5,58). Individual skills needed cover a range of core areas including community assessment, adaptation of evidence-based programs and policies, descriptive epidemiology, implementation and action planning, and evaluation. Team-based capabilities include skills to collaborate and the ability to bring together the necessary individual skills within work groups to optimize efficiency. To complement these individual and team-based skills, key organizational capacity includes supervisors' expectations to use EBPH, access to information resources (eg, academic journals), and a culture and climate supportive of EBPH.

As the field of DI science continues to mature, there is increasing urgency and need for new and expanded approaches for building DI research and practice capacity (59). Because many public health researchers and practitioners lack formal training in one or more core public health disciplines, on-the-job training is urgently needed to improve DI-related skills. In recognition of this need, the important role of capacity building (eg, more training and skill development among professionals) has been noted as a "grand challenge" for public health (60). Capacity for DI research has typically been built via some combination of graduate courses, degree programs, training institutes, workshops, conferences, and online resources. Using a concept mapping process (61), we identified a set of 9 essential concept clusters (Table). To apply these competencies, several large-scale DI research training programs (eg, Dissemination and Implementation Research in Health [62]), the Implementation Research Institute [63], Mentored Training for Dissemination and Implementation Research in Cancer [64]) and smaller scale regional training programs (eg, Great Plains IDeA CTR Dissemination and Implementation Research Workshop [65], and the University of Colorado Designing for Dissemination Workshop [66]) have been conducted. Similarly, several ongoing practitioner training programs support capacity building (57,67). For example, the *Physical Activity and Public Health Course for Practitioners*, has shown positive benefits in building capacity to design, implement, and evaluate interventions (68).

Given that the field of DI research is relatively young, many gaps exist in the science (69). Some of the most critical issues for practitioners are two closely-related concepts: scalability and sustainability. Scalability involves efforts to follow a systematically timed, planned, and graded series of steps that cumulatively account for the continuously increasing reach or adoption of an intervention until a critical mass is attained the entire target population is engaged (70), or the efforts to increase the impact have been successfully tested in pilot or experimental projects to foster policy and program development on a lasting basis, thus addressing population health and inequalities (71). Sustainability has been described as the extent to which an evidence-based intervention can deliver its intended benefits over an extended period after external support from the donor agency is terminated (72) or as the long-term, ongoing support for a program in relation to an accepted value proposition that balances allocated resources against generated revenues or benefits and includes the confirmation of long-term program support through adequate proof of performance (70). A priority area for research focuses on how best to overcome barriers to scalability and sustainability that limit the benefits of evidence-based practices (73). To date, much of DI practice and research has focused on initial uptake by early adopters of one health intervention at a time. Public health professionals are in a unique position to address challenges of scalability and sustainability with a systems approach, supporting uptake and maintenance of EBPH in complex community settings that serve vulnerable populations.

In summary, a rich body of research knowledge is not moving into the hands of practitioners and policy makers as quickly and efficiently as needed. The DI approaches outlined here can begin to speed up this translation. In doing so, we will more effectively apply EBPH approaches that will use resources more efficiently, account for dollars spent, and increase impact. We encourage public health professionals — in their day-to-day work — to generate evidence that is relevant and describes how best to implement new evidence-based strategies, report on the reasons why those strategies worked, and track the effect of those strategies on implementation and population health.

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Table

Table. Recommendations for Public Health Professionals to Engage in Dissemination and Implementation Research

Recommendation	Action Steps
Leverage existing system drivers to provide opportunities to advance DI science	• Study the process of adoption, implementation, and sustainability of new initiatives to integrate evidence-based principles/practice within your organization. • When adaptations are made to existing evidence-based approaches, report on the reasons for adaptation and the resulting characteristics of the newly adapted strategy. • Keep field notes to track the process of implementation, from the selection of an evidence-based approach to the testing of the impact of the approach, and share your results as public health DI case studies or implementation evaluations. • Partner with researchers whose mission is to move science forward in a way that will concurrently fulfill public health system needs (eg, establish academic health departments).
Focus on pragmatic evaluation	• Use existing measures as a cornerstone of an iterative learning approach to document the success (or not) of new evidence-based strategies. • Use principles of evaluability when assessing new interventions that have not been previously evaluated (74).
Identify and use an explanatory, process, and outcome model in your work	• Include, but move beyond, reporting on the effectiveness of your strategy to include a description of, if it worked, why it worked, and how you did it. Using consistent models across projects will allow for comparisons important in practice but will also provide research to move the DI field forward. • Use mixed methods and present the best data available to you. Qualitative data on outcomes, mechanisms that led to the outcomes, and processes that were used for implementation can move the field forward.
Develop key competencies related to DI science	Seek out opportunities to develop capacity in the 9 key competencies for public health research and practice professionals • Communicate research findings • Improve practice partnerships • Make research more relevant • Strengthen communication skills • Develop research methods and measures • Consider fit between evidence and practice settings • Enhance fit between evidence and practice settings • Increase capacity for practical research • Understand multilevel context

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IMPLEMENTATION EVALUATION

Evaluating Surveillance for Excessive Alcohol Use in New Mexico

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PEER REVIEWED

Abstract

Purpose and Objectives

Prevalence of excessive alcohol use and alcohol-attributable mortality is much higher in New Mexico than in other US states. In 2010, excessive alcohol use cost the state roughly $2.2 billion. Moreover, age-adjusted deaths from alcohol-related chronic liver disease increased 52.5% from 14.1 cases in 2010 to 21.5 cases in 2016. In 2017, the New Mexico Department of Health piloted the Recommended Council of State and Territorial Epidemiologists (CSTE) Surveillance Indicators for Substance Abuse and Mental Health, using 5 indicators to monitor alcohol use and health consequences. The purpose of this study is to evaluate the alcohol surveillance system implemented in New Mexico to ensure that the system yields useful, timely data that can help create effective public health interventions and that resources required for surveillance are adequate.

Intervention Approach

CSTE alcohol surveillance system data come from existing national and state-based surveys and vital statistics.

Evaluation Methods

This evaluation assessed attributes defined in Evaluating Behavioral Health Surveillance Systems and Centers for Disease Control and Prevention guidelines for evaluating public health surveillance systems. Assessment was informed through data collection, systematic literature review searches, and an interview with the alcohol epidemiologist at New Mexico Department of Health.

Results

The CSTE alcohol surveillance system in New Mexico is a useful, stable, and accepted system with good representativeness and population coverage. Data sharing and collaboration between centers within New Mexico Department of Health are well-established, making data access easy and timely. Lastly, the resources required for data collection are accountable and adequate.

Implications for Public Health

The CSTE alcohol surveillance system brings together information (alcohol consumption behaviors and associated morbidity, mortality, and policy-related measures) necessary to show a clear picture of the alcohol effects in New Mexico. This information yields useable, timely data from which the state can monitor trends and develop interventions to reduce the prevalence of alcohol-attributable morbidity and mortality.

Introduction

In the United States, excessive alcohol use accounts for more than 80,000 deaths annually, making it the third leading cause of preventable death (1) and a significant contributor to alcohol-related injury, disease, and death. Binge drinking, the most frequent and deadly type of excessive alcohol use (1–3), costs the US nearly $200 billion annually, including decreased workplace productivity losses and health care and criminal justice expenses (4). In 2016, the US age-adjusted liver disease and cirrhosis mortality rate per 100,000 people was 10.8, ranging from 6.7 (Maryland) to 24.9 (New Mexico) (5).

New Mexico has disproportionately higher excessive alcohol use and alcohol-attributable deaths compared with other US states. In 2010, excessive alcohol use cost the state roughly $2.2 billion (4). New Mexico has the highest age-adjusted alcohol-attributable death rate in the nation (1). The age-adjusted rate of alcohol-related chronic liver disease deaths in New Mexico increased 52.5% from 14.1 cases in 2010 to 21.5 cases in 2016, making it the leading cause of alcohol-attributable death in the state (6).

In response to substance abuse and mental health problems in the nation, the Council of State and Territorial Epidemiologists (CSTE) established a workgroup to develop behavioral health indicators in the domains of alcohol, other drugs, and mental health using a consensus methodology (7,8). After consensus by stakeholders at the 2016 CSTE Annual Conference, CSTE members recommended regular collection of the 18 indicators to measure and monitor substance abuse and mental health (SA/MH indicators) in state, territorial, local, and tribal surveillance. While many indicators already may be examined in a piecemeal fashion, consensus indicators provide an integrated view of the burden of behavioral health conditions, comparable across time and across jurisdictions (8).

On June 15, 2016, CSTE released a request for proposals for state and local jurisdictions to pilot the SA/MH indicators. The New Mexico Department of Health (NMDOH) was subsequently awarded funding from CSTE to implement the collection and reporting of key surveillance indicators to monitor alcohol use and other related measures: 1) adult binge drinking, 2) youth binge drinking, 3) alcohol-related crash deaths, 4) liver disease and cirrhosis mortality, and 5) state alcohol excise tax, herein collectively referred to as the CSTE alcohol surveillance system. Data collection took place from January to June 2017.

Evaluating public health surveillance systems is critical to ensure that resulting data are timely and useful for actionable public health interventions and that resources required for surveillance are adequate (9). Existing guidelines for evaluating public health surveillance systems are used generally for infectious diseases but present challenges for use with behavioral health surveillance systems (10,11). To address this gap, CSTE formed a workgroup to revise and adapt the existing guidelines to evaluate behavioral health surveillance systems (9). These revisions, along with guidelines from the Centers for Disease Control and Prevention (CDC) (10,11) were used to qualitatively and quantitatively evaluate the CSTE alcohol surveillance system implemented in New Mexico. The evaluation presented here took place from October through December 2017.

Purpose and Objectives

Factors considered in the development of the SA/MH indicators are published in Recommended CSTE Surveillance Indicators for Substance Abuse and Mental Health (7,8). The purpose of this study was to evaluate the CSTE alcohol surveillance system implemented in New Mexico to ensure that the system yields useful, timely data that can help create effective public health interventions and that resources required for surveillance are adequate.

Intervention Approach

The recommended CSTE surveillance indicators for SA/MH are designed for state-level data collection and draw from 7 existing data sources. Ultimately, all states will collect and report uniform data based on the specified indicator definitions and methods (7,8). The goal of this national surveillance system is to facilitate sharing data between public health authorities at the state and federal level, with stakeholders, and with the public. These data can be used to inform prevention and control and to evaluate public health programs. This article reports on an evaluation of the CSTE alcohol surveillance system implemented in New Mexico, based on data from the Behavioral Risk Factor Surveillance System (BRFSS) (2014), the Youth Risk Behavior Surveillance System (YRBS) (2015), the Fatality Analysis Reporting System (FARS) (2014), New Mexico vital records (2014), and the Alcohol Policy Information System (APIS) (2016).

Surveillance system description

CDC's BRFSS is an annual cross-sectional telephone survey that collects health risk behavior information from US resident adults aged 18 years or older (12,13). Several alcohol measures are captured in the survey, including CSTE's alcohol surveillance indicator *adult binge drinking*, defined as men having 5 or more drinks on 1 occasion and women having 4 or more drinks on 1 occasion.

The YRBS is national, state, territorial, tribal, and local school-based cross-sectional surveys that collect information on 6 areas of priority health-risk behaviors among high school youths (14). Several other alcohol measures are captured in the survey, including CSTE's alcohol surveillance indicator *youth binge drinking*, defined (before 2017) as 5 or more drinks of alcohol in a row, within a couple of hours (15).

The National Highway Traffic Safety Administration (NHTSA) maintains FARS, a standardized web database containing data from motor vehicle crashes that occur on public traffic ways resulting in at least 1 death within 30 days from the crash (16,17). FARS provides information on several alcohol-related measures, including CSTE's alcohol surveillance indicator *alcohol-related crash deaths* by highest blood alcohol concentration (BAC) in the crash and highest driver BAC in the crash. Highest BAC in the crash is defined as the highest BAC recorded among tested individuals involved in the crash, including drivers and nonmotorists (eg, pedestrians, bicyclists); highest driver BAC in the crash is defined as the highest BAC recoded among tested drivers (16).

According to New Mexico State Statute, a funeral service practitioner has the responsibility to obtain demographic data from the next of kin, obtain the medical certificate of cause of death, and file the death certificate for deaths occurring in the state (18). A death certificate for each death in the state is stored with the NMDOH, Epidemiology and Response Division, Bureau of Vital Records and Health Statistics. For New Mexico residents who die outside of the state, death certificate data can be obtained through the State and Territorial Exchange of Vital Events (STEVE). These data include information on several alcohol-related death measures, including CSTE's alcohol surveillance indicator *liver disease and cirrhosis mortality,* defined as an underlying cause of death with an *International Statistical Classification of Diseases and Related Health Problems* (ICD-10) code of K70.x, K73.x, or K74.x.

APIS, sponsored by the National Institute of Alcohol Abuse and Alcoholism (NIAAA), is updated annually to provide information on 33 alcohol-related policies in the United States (19), including CSTE's alcohol surveillance indicator *state alcohol excise tax*, reported for beer, wine, and spirits. Specific excise taxes are taxes charged per gallon either at the wholesale or retail level. An exception to reporting is made when a state acts as a control state, meaning that the "state sets the prices of and gains direct profit from wholesale and/or retail off-premises sales" (20).

Evaluation Methods

For pilot collection and reporting of the SA/MH indicators, the CSTE alcohol surveillance system was implemented in New Mexico and evaluated by using attributes defined in CSTE and CDC guidelines (9,10), using both qualitative and quantitative evaluation methods. Because the data for the CSTE alcohol surveillance system come from existing data sources, attributes are a function of those data sources. In these instances, each data source will be discussed alongside the CSTE alcohol surveillance system. Using both evaluation frameworks (9,10), system attributes were assessed as follows:

1. Usefulness was assessed by determining whether the system describes the public health impact of alcohol consumption at the state level and how that information assists the NMDOH in prevention and intervention efforts. Specifically, we calculated the average scores of perceived usefulness of each alcohol indicator, based on a scale of 1 to 5, from a structured interview with the alcohol epidemiologist in New Mexico.
2. Simplicity was assessed by investigating how the NMDOH collects and accesses the data for each alcohol indicator.
3. Stability was assessed for each alcohol indicator based on the respective system's operations availability and reliability in New Mexico, including the ability to collect, manage, and produce data useful to inform interventions.
4. Flexibility was assessed by determining how easily the CSTE alcohol surveillance system adjusts to a new demand (ie, adding or modifying a question).
5. Data quality was assessed in terms of the validity and completeness of data, reported in the existing literature, for each alcohol indicator in New Mexico.
6. Acceptability was assessed in terms of persons' and groups' willingness to participate in data collection and reporting for the CSTE alcohol surveillance system.
7. Representativeness was assessed by determining if the population under surveillance is representative of the overall population in New Mexico at risk for the respective behavior, risk factor, or health event.
8. Population coverage was assessed by determining if the population under surveillance accurately describes the base population the system was designed to survey.
9. Timeliness was assessed by the amount of time it took the NMDOH to access the appropriate database, abstract and process the data, and produce interpretation and report.

Data from 4 of the 5 alcohol indicators — adult binge drinking, youth binge drinking, alcohol-related crash deaths, and state excise tax — were accessed and collected according to specifications in Recommended CSTE Surveillance Indicators for Substance Abuse and Mental Health (7,8). Information from published literature was used to analyze the flexibility, data quality, acceptability, representativeness, stability, and population coverage of each alcohol indicator. Additionally, a structured interview with the alcohol epidemiologist at the NMDOH was conducted to inform much of the previously described attribute assessments for the liver disease and cirrhosis mortality indicator and the overall CSTE alcohol surveillance system.

Results

Usefulness

The CSTE alcohol surveillance system implemented in New Mexico combines key indicators collected from various data sources, described previously, to assess alcohol measures at the state level. The system incorporates morbidity, mortality, and policy-related indicators to help paint a more complete picture of the alcohol-attributable burden in New Mexico, of which the piecewise indicators are incapable. The alcohol indicator system helps estimate the magnitude of behavioral health measures such as binge drinking (adults and youths) as well as the morbidity and mortality of excessive alcohol consumption in the population. Additionally, this surveillance system may enable detection of trends in excessive alcohol use and the morbidity and mortality associated with excessive alcohol use. Moreover, it will be possible to assess how alcohol-related policy, specifically state excise tax, may affect excessive alcohol consumption.

Results from the structured interview in New Mexico determined that the usefulness of the CSTE alcohol surveillance system rated 4.4, where 1 is not useful and 5 is very useful. The individual indicators were rated as follows: adult binge drinking, youth binge drinking, and liver disease and cirrhosis mortality rate were rated 5, while state excise tax was rated 4 and alcohol-related crash deaths was rated 3. Unfortunately, APIS does not report excise tax for microbreweries in New Mexico, which is an important aspect to consider. In New Mexico, the excise tax on beer is $0.41 per gallon, with the exception of beer produced in microbreweries that are taxed at $0.08 per gallon for the first 310,000 gallons and $0.28 per gallon thereafter (21). The indicator for alcohol-related crash deaths, as written in 2016 (original document not available) was not a useful indicator because the definition was confusing and the desired information was difficult to locate in FARS. The NMDOH reports these collected indicators in New Mexico's Indicator-Based Information System (NM-IBIS), in community presentations, and in publications including the New Mexico Substance Abuse State Epidemiology Profile and the New Mexico Alcohol Fact Sheet (6,22).

Simplicity

The CSTE alcohol surveillance system implemented in New Mexico is moderately simple, despite the fact that it uses multiple information sources. Data sources used are routinely collected and reported to public health authorities. Moreover, the intradepartmental relationships that NMDOH has cultivated facilitates data accessibility for binge drinking and liver disease and cirrhosis mortality. On the other hand, the original CSTE definition of alcohol-related crash deaths was not easily interpreted nor obtainable. Terms used in the CSTE definition were not consistent with those published in FARS nor was it possible to directly abstract the indicator from crash fatality reports published in FARS. Rather, the indicator measure would require either 1) downloading a SAS (SAS Institute, Inc) data set and analyzing the data, or 2) accessing the FARS query system, a multistep process that may produce data of poor quality.

Stability

The CSTE alcohol surveillance system implemented in New Mexico is stable; data come from well-established systems, most of which are federally funded. For example, BRFSS has been used in New Mexico since 1986 (23), and is the gold standard of behavioral health surveillance among adults (12). New Mexico has conducted the Youth Risk and Resiliency Survey (YRRS) as a substitute for the YRBS since 1991 (24,25). In addition to behavioral health questions, the YRRS includes questions that assess resiliency factors (25). CDC provides fiscal and technical support for both the BRFSS and the YRBS/YRRS (26,27), while state coordinators have access to the BRFSS and YRRS data for New Mexico.

Another example is FARS, a very stable system in place since 1975 (16). Data, collected daily by FARS analysts, are used at the local, state, and federal levels as well as within public and private organizations to answer a wide range of questions. Data can be accessed through the FARS query system (1994–2016) or downloaded through NHTSA.

New Mexico death certificate data are also stable, as their collection is written into law. These data are housed within the NMDOH, Epidemiology and Response Division, Bureau of Vital Records and Health Statistics.

Finally, APIS is a stable system, funded by NIAAA and updated yearly. Data are available for most alcohol-related policies since 1998, and state excise tax information is available from 2003 through 2016 (19,28).

Flexibility

The CSTE alcohol surveillance system implemented in New Mexico is a moderately flexible system. Though all states are expected to eventually adopt and report core alcohol indicators, each state has the autonomy to add indicators that may be particularly important to monitor over time in their jurisdiction. Additionally, CSTE subcommittees and workgroups may choose to add, modify, or omit core indicators.

Data quality

The data quality of the CSTE alcohol surveillance system implemented in New Mexico is determined by the quality of the individual data sources from which the information is acquired. Questions on the BRFSS assessing alcohol and substance abuse have moderate reliability and validity (29). Binge drinking in particular yields lower but comparable estimates to both the National Health Interview Survey and the National Survey on Drug Use and Health (29). Similarly, a study that assessed the 1999 YRBS concluded that it had good test–retest reliability (30).

However, data quality of FARS is low without correction for missing BAC data that vary by state. In 2016 in New Mexico, 45% of drivers involved in a fatal crash had known BAC test results (31). To address this underreporting, the reports published by NHTSA use a validated multiple imputation method (32). Unfortunately, imputed calculations for BAC data are not included in the FARS query system, yielding results that may be biased. The FARS system provides quality control by using range and consistency checks. Other quality control measures for timeliness, accuracy, and completeness are conducted intermittently. The data quality of death certificate data in New Mexico is high. Death certificates filled out in the state undergo extensive edits for completeness and consistency (18). Additionally, staff who file death certificates are offered training annually. NMDOH is also able to capture data for deaths occurring outside of the state through STEVE (33,34). Lastly, the quality of data on state alcohol excise tax in New Mexico reported on APIS is moderate. While APIS collects and reports tax information and alcohol-related policies nationwide (20), it does not report the subtle differences in state policies. As previously mentioned, New Mexico excise tax for beer produced in microbreweries is unavailable.

Acceptability

The CSTE alcohol surveillance system has been accepted by NMDOH, 1 of the first 4 states to pilot collection and reporting of the SA/MH indicators, as an integral part of their annual substance abuse and mental health surveillance efforts. NMDOH has collected most of these measures for several years to inform the New Mexico Substance Abuse Epidemiology Profile published annually (22). The NMDOH state epidemiologist and alcohol epidemiologist also participated in the CSTE workgroup that identified and edited the recommended indicators (7).

In addition to assessing the acceptability of the CSTE alcohol surveillance system as a whole, we evaluated the acceptability for each data source (BRFSS, YRRS, FARS, and vital records). Each of these data sources are well-established and accepted systems among participants and/or data collectors and users. The New Mexico BRFSS response rate in 2014 was 52.8% and in 2015 was 52.5%, higher than the US average in both years (47.0% in 2014 and 47.2% in 2015). In 2015, the overall response rate for the New Mexico YRRS was 73%, with a school response rate of 94% and the student response rate of 78% (15). For comparison, the overall response rate for the 2015 national YRBS was 60%, while the school response rate was 69% and the student response rate was 86%. Similarly, FARS data collection and reporting is well established and accepted. State employees, in cooperative agreement with NHTSA, are formally trained as FARS analysts to gather data from state sources and report pertinent information into the standardized FARS web database daily (16). Lastly, the acceptability of death certificate data falls under the New Mexico Statute 24–14–20, which mandates the responsible party and timeline for death certificate reporting.

Representativeness

The CSTE alcohol surveillance system is representative, based on the representativeness of component data systems. While people without a landline or cellular phone are systematically excluded from the BRFSS, advanced weighting procedures make it representative of the state's general population (12). State-administered YRBS/YRRS are considered state-representative data for school-aged youths attending public schools (15). This survey does not include information on those youths in juvenile detention centers or private schools or those who are home-schooled. According to the American Community Survey, in 2015 in New Mexico, 92.1% of high school youths attended public school while 7.9% attended a private school. Though FARS does not collect information on fatal crashes on private property, it is still considered representative of the overall state population (35). Lastly, New Mexico death certificate data are representative. Not only does a death certificate have to be completed for each death in the state, STEVE allows NMDOH to access death certificate data for residents who died outside of the state.

Population coverage

The CSTE alcohol surveillance system has good population coverage, based on the population coverage from each data system it involves. The target population of the BRFSS is all resident adults aged 18 years or older with a landline or cellular telephone in the state. While refusal to participate may affect the population coverage, response rates for the survey are respectable. In regard to population coverage, the YRBS/YRRS cannot capture information on students who were absent on the day of the survey or on students who did not receive parental consent to participate. Additionally, youths who dropped out of public school are also missed by this survey; NM-IBIS indicates that the 2015–2016 graduation rate was 71%. High school dropouts and youths who skipped school may have a disproportionately higher affinity to binge drink given their risk behaviors (36). Additionally, population coverage might be affected if schools do not agree to participate in the YRBS/YRRS nonrandomly. The FARS database is a census of fatal traffic crashes occurring on public traffic ways in the United States, collected at the state level daily. Although unlikely, a fatal crash may not be reported. New Mexico death certificate data have good population coverage; a death certificate is completed for each death in the state. New Mexico also has access to death certificates for residents who died elsewhere. The system would miss only deaths that go unreported, which is unlikely.

Timeliness

The CSTE alcohol surveillance system implemented in New Mexico is moderately timely in the sense that most of the data can be collected quickly once they become available from the respective data sources. Data for binge drinking may be abstracted directly through the corresponding CDC webpage (BRFSS for adults [37], YRBS/YRRS for youths [38]) or accessed by requesting record level access from the New Mexico BRFSS and YRRS coordinators. Collecting information directly from the CDC webpage takes approximately 30 minutes. However, a long lag may occur among data collection, analysis, and final reports; for example, data collected in 2015 are released in the fall of 2016. Alternatively, after data collection and cleaning, record-level access can be requested from the respective coordinator. In New Mexico, data access is usually granted from the corresponding data steward within 1 hour of request. Subsequent analyses and reporting of BRFSS and YRRS would take approximately 1 hour.

Similarly, alcohol-related crash deaths and the liver disease and cirrhosis mortality rate can be reported from either a query system or record-level data. While the FARS query can be completed in a fraction of the time with respect to record-level data, users are advised to interpret results with caution because of missing BAC data. Unfortunately, downloading FARS data, which imputes missing BAC data, to conduct analyses would be time intensive as the user would need to become familiar with the FARS data set, the multiple imputation methods used, and SAS coding. The liver disease and cirrhosis mortality rate can be reported from the NM-IBIS (unfortunately, the latest data available in the query system are from 2013) or through CDC WONDER (CDC Wide-ranging Online Data for Epidemiologic Research), which too has limitations including timeliness and granularity. Alternatively, the measure can be reported directly from death certificate data. The NM-DOH, Epidemiology and Response Division, Bureau of Vital Records and Health Statistics, houses New Mexico death certificate data. Once a data request is made, full record-level access is usually granted within 1 day. Subsequent analysis and reporting would take approximately 2 hours.

Implications for Public Health

While existing data are used for New Mexico's alcohol surveillance system, the CSTE system concurrently monitors behavioral health measures (binge drinking), policy measures (state alcohol excise tax), and the associated adverse consequences (alcohol-related crash deaths and liver disease and cirrhosis mortality) in a new context. Viewing these indicators together provides a more complete and holistic understanding of the public health impact of excessive alcohol consumption and its health consequences. Relationships among the indicators may become apparent (eg, the association of excise taxes and binge drinking). In addition, the 2 evaluation frameworks used (9,10) aid in the understanding of this complex behavioral context in New Mexico, thus facilitating the development of effective interventions.

Data sharing and collaboration between centers within the NM-DOH and among federal partners are well established. These long-standing relationships have made the collection and reporting of the CSTE alcohol surveillance system feasible in New Mexico. Therefore, the amount of time and resources needed to collect this information are minimal and adequate. These indicators will yield useable and timely data from which the state can monitor trends and develop interventions if necessary. Anecdotally, state behavioral health departments and bureaus in the United States often work independently from health departments, making it difficult to understand behavioral health as whole. The use of the SA/MH indicators represents a great example of how to integrate existing behavioral health systems. These integrations aid the understanding of the complex nature of alcohol behaviors in New Mexico, and results could drive interventions to decrease alcohol-attributable deaths in New Mexico.

Through this evaluation, we learned that the CSTE definition for alcohol-related crash deaths needs to be redefined. The first version of the CSTE definition, published in 2016, did not use terms consistent with those from NHTSA nor was the requested information easily reported. As a result of this evaluation, the definition was updated in the second version of the Recommended CSTE Surveillance Indicators for Substance Abuse and Mental Health, published in 2017 (7).

This evaluation is informed through the data collection process, interviews, and published literature and is the first evaluation study to use the newly published Evaluating Behavioral Health Surveillance Systems (9), which reframes existing public health surveillance system evaluation criteria for evaluation of behavioral health surveillance. In behavioral health surveillance, sensitivity is closely related to completeness of data (ie, data quality attribute) (9), therefore sensitivity was not directly assessed in this evaluation. Although the new revised evaluation framework (9) provides alternative ways to evaluate sensitivity, this was not possible because of the lack of a gold standard.

The indicators included ICD-10 codes K70.x, K73.x, and K74.x; however, only K70.x codes are alcohol-related. The K73 and K74 codes are specified as not alcohol-related causes of death, with the exception of K74.6 and K73.9 which are "unspecified causes." This might result in an over-estimation of liver and cirrhosis mortality related to alcohol use. CSTE will examine this potential bias in any upcoming revision of the indicators.

Of the 9 items in the evaluation framework, only the usefulness indicator was scored because of its nature of being objective and interpretable. In future evaluation activities, scoring will be investigated for other system attributes. The evaluation of timeliness concerned the time needed to retrieve, analyze, and interpret the data and is closely related to feasibility. Because of use of existing data, time lag and year of occurrence may differ among data sources.

Liver disease is the only mortality indicator represented in the alcohol surveillance system evaluated here; one objective of indicator selection was to include a range of data sources and look at various types of impact (morbidity and mortality) for alcohol, drugs, and mental illness or self-harm, while balancing the burden of reporting. Among the 18 indicators (7), few rely on death data. In addition, the system does not include measurement of morbidity indicators to represent the cost of a chronic condition.

New Mexico's intradepartmental relationships and data sharing practices could serve as a model for other states. This evaluation did not address feasibility and cost of implementation in jurisdictions not using these indicators because this evaluation was conducted by a health department that was 1) involved in developing the indicators and 2) already collecting or using most of these indicators. An ongoing economic evaluation of 15 states piloting the indicators indicates that New Mexico's cost was high (about $1,110 per year) compared with the overall range of $20.24 to $4,065.78, an average of $697. While it is true that New Mexico was involved in the development of the indicators, staff who participated in the evaluation were not involved in development; furthermore, all states were thoroughly involved with ratification and adoption of the indicators. Thus, it would not have been possible to conduct the evaluation in a state totally blinded to indicator development.

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ORIGINAL RESEARCH

A Pragmatic Application of the RE-AIM Framework for Evaluating the Implementation of Physical Activity as a Standard of Care in Health Systems

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PEER REVIEWED

Abstract

Introduction
Exercise is Medicine (EIM) is an initiative that seeks to integrate physical activity assessment, prescription, and patient referral as a standard in patient care. Methods to assess this integration have lagged behind its implementation.

Purpose and Objectives
The purpose of this work is to provide a pragmatic framework to guide health care systems in assessing the implementation and impact of EIM.

Evaluation Methods
A working group of experts from health care, public health, and implementation science convened to develop an evaluation model based on the RE-AIM (Reach, Effectiveness, Adoption, Implementation, and Maintenance) framework. The working group aimed to provide pragmatic guidance on operationalizing EIM across the different RE-AIM dimensions based on data typically available in health care settings.

Results
The Reach of EIM can be determined by the number and proportion of patients that were screened for physical inactivity, received brief counseling and/or a physical activity prescription, and were referred to physical activity resources. Effectiveness can be assessed through self-reported changes in physical activity, cardiometabolic biometric factors, incidence/burden of chronic disease, as well as health care utilization and costs. Adoption includes assessing the number and representativeness of health care settings that adopt any component of EIM, and Implementation involves assessing the extent to which health care teams implement EIM in their clinic. Finally, Maintenance involves assessing the long-term effectiveness (patient level) and sustained implementation (clinic level) of EIM in a given health care setting.

Implications for Public Health
The availability of a standardized, pragmatic, evaluation framework is critical in determining the impact of implementing EIM as a standard of care across health care systems.

Introduction

Physical activity prevents, delays, or is used to manage many chronic conditions, such as diabetes, high blood pressure, and cardiovascular diseases (1,2). Yet, in 2014, only 21.5% of American adults met both aerobic and muscle strengthening guidelines (3). Although this percentage reflects an increase from 15.1% in 2000, these physical activity levels are still well below the recommended levels necessary to achieve population health benefits. Insufficient physical activity is estimated to account for 11.1% of aggregated health care expenditures in the United States, which translates to $117 billion, or slightly more than $1,300 per capita for inactive, versus active, persons (4).

Numerous reports have advocated for a collaborative approach to improving physical activity levels across multiple sectors of society (5,6). Given that more than 75% of all US adults had contact with a health care professional from 2013 to 2015 (7), multiple calls to action have advocated for the health care sector to take on a greater role in promoting physical activity at a population level (8–10). In 2014, the US Preventive Services Task Force recommended that adults with cardiovascular disease risk factors should be referred to intensive behavioral counseling interventions to promote physical activity and healthful diet (11).

During the past several decades, several studies have evaluated single-level interventions to integrate physical activity into health care settings, such as physician counseling (12,13), assessing patient physical activity levels (14,15), and providing patients with a physical activity prescription (16,17). A small number of multilevel interventions have been conducted in health care settings to support physicians in their physical activity counseling efforts (18,19). Meta-analyses and systematic reviews show that physician counseling and exercise referral systems lead to improvements in patient physical activity levels for up to 12 months (20,21). Furthermore, physical activity counseling and referral schemes can provide early return on investment because of lower health care utilization and costs (22,23). However, few efforts have evaluated the potential for large-scale implementation of these referral schemes in clinical practices across larger health care systems.

Simultaneously, we are witnessing a rapid transformation in clinical practice within health systems with the goal of achieving the new "quintuple" aim of health care: improving the health of populations, improving the patient experience, increasing patient engagement, reducing the per capita cost of health care, and improving the work–life balance of health care providers (24). Integral to achieving these aims are strategies that 1) aggregate and analyze patient data, 2) identify at-risk patient groups, 3) develop risk-specific action plans, and 4) create patient-engagement tools (25). To incorporate these strategies in a systematic approach to integrating physical activity into health systems, Exercise is Medicine (EIM) was launched by the American College of Sports Medicine (ACSM) in 2007. The goal of EIM is to make physical activity a standard in patient health care for the prevention and treatment of chronic diseases (26). To date, EIM has been adopted in more than 40 countries worldwide (27), as well as in clinic settings (28) and entire health care systems (29) in the United States.

Purpose and Objectives

Despite greater reliance on data-driven approaches to patient health, methods to assess the integration of physical activity into typical health care practices — across both patient and organizational indicators — has lagged behind its implementation. The complex processes and multilevel factors associated with implementation need to be formally assessed to inform future efforts. Developing data collection and evaluation strategies that extend beyond traditional markers of efficacy or effectiveness is critical in providing more generalizable evidence for physical activity initiatives in health care settings (30). At the same time, it is essential to develop *pragmatic* evaluation strategies that take into consideration the barriers experienced by health care providers (31), that account for the realities and constraints of the current health care environment, and that are feasible in real-world settings (32).

Our understanding of the implementation of physical activity interventions in health care settings is limited by a lack of comprehensive evaluation frameworks. Recognizing this limitation, ACSM convened a working group to develop a pragmatic framework for evaluating the implementation of EIM as a standard of care in health systems that can be used by researchers, clinicians, and policy makers around the world.

Evaluation Methods

A working group of 7 experts from health care, public health, family and sports medicine, and implementation science, convened to develop a model for evaluating the implementation of the EIM Solution in health care systems. The EIM Solution is the strategic implementation of physical activity in health care settings that involves a series of discrete steps designed to create clinical–community linkages to engage patients in sustained physical activity (26). In the clinic setting, the first 3 steps of the EIM Solution include 1) systematically *assessing* and recording patient physical activity levels, 2) providing patients with brief physical activity counseling and/or a physical activity *prescription*, and 3) *referring* patients to a network of physical activity resources for guidance and support (Figure 1). In some health systems, an intervention advisor, a role filled by a person in the health system, such as a care manager, nurse practitioner, or a health coach, is necessary to facilitate the referral process by providing basic behavioral counseling and connecting patients to appropriate physical activity resources.

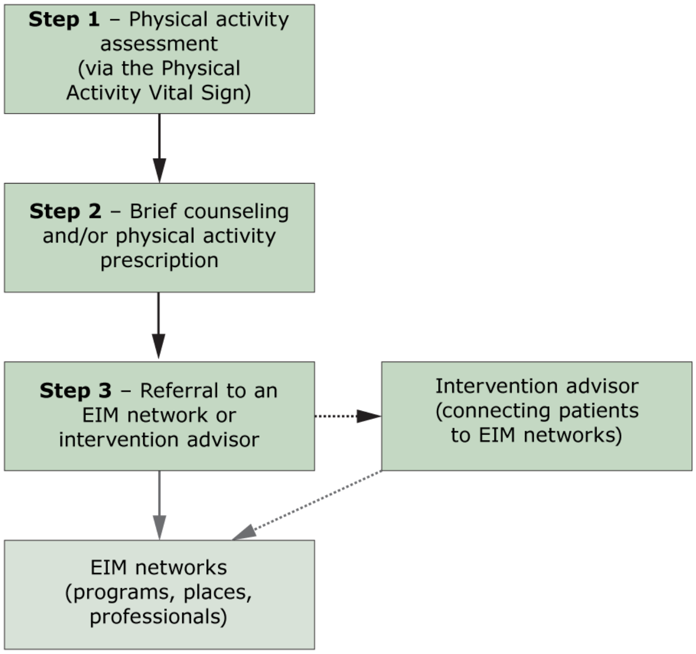

Figure 1. The clinical phase of the EIM Solution. Steps 1 through 3 of the EIM Solution take place primarily in the clinic setting and involve patients having their physical activity levels assessed, receiving brief counseling from a member of the health care team and/or receiving a semi-customized physical activity prescription, and receiving a referral to EIM network of physical activity resources. In some health systems, patients may also interact with, or be referred to, an intervention advisor. The role of the intervention advisor could include behavior change counseling and connecting the patient to the EIM network of physical activity resources. Dashed lines indicate an indirect or alternative pathway. The gray box indicates the community phase of the EIM Solution. Abbreviation: EIM, Exercise is Medicine.

When identifying potentially eligible patients to engage in the EIM Solution, health systems adopting the EIM Solution should aim to assess the physical activity levels of most of their patients (step 1). Assessing physical activity levels should be conducted as if it were a vital sign (8) in the electronic medical record (EMR), similar to body weight or blood pressure, with all patients in the health system, except for patients for whom it is clearly not relevant (ie, patients with acute illness). It is recommended that the Physical Activity Vital Sign (PAVS), a brief, pragmatic assessment tool that has been tested and validated in several health systems (33,34), be used to capture data on patient physical activity levels to standardize measures across different health systems. The PAVS can be administered, typically in 30-seconds or less, by any member of the health care team, and has good face validity in identifying people not meeting national physical activity guidelines (35). People not engaging in 150 minutes of moderate-intensity physical activity per week are then eligible to receive a physical activity prescription and/or brief counseling (step 2), followed by a referral to a network of physical activity resources (step 3).

The fourth step of the EIM Solution involves the development of EIM networks consisting of physical activity programs, places and professionals capable of receiving patients referred from health care providers (Figure 2). EIM networks may include 1) self-directed, b) internal (ie, within the health system), or c) external (ie, community-based) physical activity resources. Self-directed resources include internet-based programs or smart-phone apps that support patient autonomy in becoming more physically active. Internal resources include physical therapists, wellness programs and facilities, and rehabilitation programs available to patients in a health system. An internal network may be a compilation of existing resources or comprise a more formal, standardized process to ensure a consistent level of quality and performance. Internal EIM networks will likely not have sufficient capacity to accommodate all referred patients. Therefore, referrals will also need to link patients to external resources located in the community, such as local places (eg, YMCAs), evidence-based programs, and credentialed exercise professionals (36). For quality control purposes, the programs, places and professionals in an external network may be required to meet established standards to receive patients from a health care system.

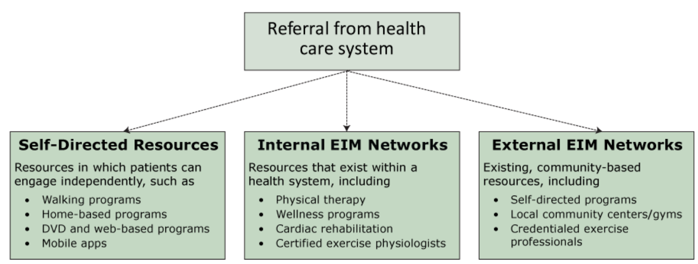

Figure 2. The "community" phase of the EIM Solution. The fourth step of the EIM Solution involves the linkage of patients from health care systems to a supportive network of physical activity programs, places, and professionals. These EIM networks may be developed by using existing programs and professionals internally within a health system or externally in the community setting or connecting patients to resources for self-directed management. The dashed lines indicate alternative pathways. Abbreviation: EIM, Exercise is Medicine.

The working group first met in-person in January 2016 to develop an outline for the evaluation framework. Further communications refined the framework, which was presented at the 2016 ACSM annual meeting. The goals of the working group were to provide 1) pragmatic guidance on operationalizing and evaluating the implementation of the EIM Solution using data that is typically available in health care settings, and 2) recommendations for assessing additional indicators where existing data may not be readily available. The working group also identified indicators for the community settings (step 4 of the EIM Solution) to evaluate patient engagement and participation in internal and external EIM networks.

The RE-AIM (Reach, Effectiveness, Adoption, Implementation, and Maintenance) framework informed the development of the evaluation model. RE-AIM was selected because of its ability to provide an approach to planning and evaluation that balances factors related to both internal and external validity while focusing on patient and organization level outcomes. At the patient level, RE-AIM assesses the degree to which EIM reaches a large and representative proportion of at-risk (ie, physically inactive) patients and effectively produces and maintains changes in their health. At the organizational level, RE-AIM determines the ease and degree to which EIM is adopted by health systems, implemented with high fidelity, and sustained long-term (37). RE-AIM has been used in evaluating diabetes prevention and weight loss programs, and nutrition interventions (38,39).

Results

A consensus was reached by the working group for the development of an evaluation model that relies on readily available data that are collected as a part of routine clinical practice. The model provides guidance for an array of health systems — from smaller practices to large, clinically integrated health systems or networks — while allowing for basic comparisons across these different settings. The working group considered measures to be pragmatic if they could be collected as a part of standard practice, are inexpensive, actionable, placed a low burden on staff, and are sensitive to change over time (32). Given the availability of pragmatic data in health systems via EMRs, the working group focused on the clinical care components of the EIM Solution (steps 1–3), rather than patient engagement and participation (step 4), where pragmatic data are often not readily accessible to a health care system and/or evaluation team. The working group also provided recommendations for additional (or expanded) indicators that could be reasonably collected and assessed where existing health system data are not currently available.

Evaluating the EIM Solution in clinical care settings

Reach

Reach can be assessed by estimating the number of patients that were 1) screened for their current physical activity levels, 2) received brief counseling and/or a physical activity prescription, and 3) were referred to physical activity programming. The proportion of participants reached can be estimated by dividing the number of patients receiving each of these steps over the pool of potentially eligible patients. Those eligible to receive physical activity counseling and/or a physical activity prescription (step 2) and a referral to physical activity programming (step 3) include patients not meeting national aerobic activity recommendations based on their physical activity assessment. The representativeness of patients engaged is determined by comparing characteristics (ie, age, body mass index [BMI], race/ethnicity, payer status) of those reached (numerator) to all eligible patients (denominator) for each of the first 3 steps of the EIM Solution.

For health care organizations that use an internal or external EIM network (step 4), an expanded reach indicator is used to collect information on the number and proportion of referred patients that participate in the EIM networks. Representativeness is determined by comparing the characteristics of patients who receive a referral and participate in an EIM network compared with 1) eligible patients who did not receive a referral and 2) eligible patients who received a referral but did not attend a physical activity program.

In most cases, data for assessing the reach of the EIM Solution should be available through the patient EMR. Notes in the EMR (ie, drop down menu options or manually entered notes) can be used to record physical activity counseling, provision of physical activity prescriptions, and referral to physical activity resources. For systems that do not have EMRs, health care teams can record results from the physical activity assessment, as well as notes for brief counseling and provision of physical activity prescriptions and referrals, on paper-based patient records.

Effectiveness

The effectiveness of integrating the EIM Solution into health care systems should be evaluated across each of the 3 clinic-based steps. Measures of effectiveness should include changes in 1) self-reported physical activity or, as technology advances, physical activity objectively assessed by wearable devices, 2) cardiometabolic biometric values, and 3) the incidence of chronic disease, disease burden, and/or disease complications. The impact of physical activity assessment, providing brief counseling and/or physical activity prescriptions, and giving physical activity referrals on each of these outcomes can be compared with patients that did not receive any of these steps.

Data for assessing the effectiveness of the EIM Solution should be available through the EMR and include data on patient physical activity levels and cardiometabolic biometric values, such as body weight, BMI, waist circumference, systolic and diastolic blood pressure, lipid concentrations, triglyceride levels, and fasting blood glucose levels. Data on disease incidence, burden, and complications may include disease rates (ie, diabetes, cardiovascular diseases) and chronic disease complications (ie, the Charlson Comorbidity Index) calculated from existing tools and/or captured in the EMR. Data from paper-based health records can also be used when EMR data are not available.

An expanded measure of effectiveness is to assess differences in health care utilization and costs between patients exposed, versus those not exposed, to any of the EIM Solution steps. Health care utilization and costs, such as the number of annual physician or emergency department visits, are considered expanded measures because these data may not be readily obtained from the EMR. A second expanded measure is to examine the dose response, based on whether a patient receives 1, 2, or all 3 steps of the EIM Solution, and measures of effectiveness. Similarly, the frequency with which patients receive steps of the EIM Solution over a defined period of time (ie, all visits within a calendar year) and how frequency affects patient outcomes (listed above) can also be examined.

Adoption

The adoption of the EIM Solution can be assessed at both the health care system and provider levels. At the system level, adoption includes the number and proportion of health settings that adopt any or all of the steps of the EIM Solution. Representativeness can be determined by comparing characteristics of the health settings (ie, number of providers, payer-mix ratio, support-staff-to-provider ratio) that adopt components of the EIM Solution with all other health settings that had the opportunity, but did not adopt the EIM Solution. Similarly, adoption can be assessed by determining the number, proportion and representativeness (ie, sex, age, specialty) of health care providers that adopt any of the clinical steps of the EIM Solution in their practices compared with peers in the same health setting that do not adopt the EIM Solution. A final adoption indicator is to characterize the extent to which EIM internal/external networks are developed by a clinic for use with their patients.

Implementation

Implementation assesses the extent to which the EIM Solution is carried out as intended in the clinic setting. Implementation can be assessed by determining the extent to which all 3 steps are conducted with each eligible patient (ie, the 3 steps of the EIM Solution are delivered to 40% of eligible patients). The level of implementation can also be examined as the extent, or proportion, to which health care providers implement 1, 2, or all 3 clinic-based components of the EIM Solution with their eligible patients. Characteristics of health care providers that implement the EIM Solution with a high proportion of their patients can be compared with those that implement it with a low proportion of their patients. Baseline implementation levels can serve as benchmarks (ie, health care providers delivered all 3 steps of the EIM Solution to 50% of their eligible patients) so that incremental goals for improvement can be adjusted over time. Expanded assessments of implementation can be obtained through surveying patients to determine the number, proportion, and representativeness of those who receive 1, 2, or all 3 of the clinic-based steps of the EIM Solution. Finally, the use of checklists by a member of the health care team or an evaluation team can be used to ensure fidelity in the delivery of the EIM Solution.

Maintenance

Indicators of maintenance should be assessed at both the patient and organizational level. At the patient level, maintenance includes the effects of physical activity assessment, counseling and/or prescription, and referral on long-term (6, 12, 24, 36 months) patient outcomes. Patient physical activity levels and other effectiveness outcomes over time can be compared with eligible patients that did not receive the EIM Solution. At the institutional level, indicators of maintenance include the long-term institutionalization and sustained delivery (6, 12, 24, 36 months) of the EIM Solution. This can be assessed by examining the rate of using the EIM Solution by health care teams over time. An expanded indicator would be to examine patient maintenance (ie, long-term physical activity levels) by the dose of the EIM Solution (ie, number of times physical activity levels were assessed) received.

Evaluating physical activity referrals to internal and external EIM networks

The fourth step of the EIM Solution is the development and utilization of an EIM network consisting of physical activity resources located either internally within a health system or externally in the community. Evaluating the utilization of EIM networks in community settings poses a unique set of challenges because of a lack of integration with health systems. This lack of integration makes the transfer of patient information from one setting to another (ie, participation rates in community programs integrated into EMRs) difficult. Many of the implementation indicators for the utilization of EIM networks relies upon this integration and, therefore, are not considered a part of the pragmatic framework, but as part of our expanded model.

When examining referrals to an EIM network, the number and proportion of referred patients that interact with either an intervention advisor or an exercise professional or attend a physical activity program in the EIM network should be quantified. The referral success rate will quantify the number of patients participating in at least 1 session (numerator) over all patients referred to an EIM network (denominator). Characteristics of participating patients can be compared with 1) patients who did not receive a referral or 2) patients who received a referral but did not attend. An expanded reach indicator is to compare the number and representativeness of patients who attend 25%, 50%, and 75% of planned sessions with those who attend a lesser number, or none, of the sessions.

For effectiveness, outcomes for patients receiving counseling by intervention advisors, working with exercise professionals, or attending programs in an EIM network can be compared with referred patients who do not attend, or attend a fewer number of, sessions. To optimally assess both reach and effectiveness, summary data for attendance at programs in an EIM network need to be captured and available for analysis. This may be achieved by automatically migrating data on patient attendance to EMR files or through third-party software solutions. An expanded effectiveness indicator involves assessing the dose–response relationship of the number of physical activity sessions attended compared with improvements in patient outcomes.

The number of physical activity resources (ie, intervention advisors, programs, places, and professionals) that participate in an EIM network can serve as an indicator of adoption. Describing these resources available in an EIM network and their capacity to provide physical activity opportunities for referred patients is an essential component of adoption. An expanded adoption indicator is to examine the proportion and characteristics (ie, size of programs, target population) of physical activity resources that participate in an EIM network compared with 1) existing programs and professionals that were approached but did not participate and 2) all existing programs and professionals in a community regardless of whether or not they were approached to participate in the network. By considering all programs in a community, stakeholders will get a true indication of adoption rates and the level of penetration of the EIM network.

All measures of implementation for using EIM networks are considered expanded measures because these data are often not routinely collected. A first recommended implementation indicator is to examine the extent to which intervention advisors adhere to their training protocol and procedures in guiding patients to physical activity resources. Other implementation indicators include the extent to which exercise professionals adhere to training protocols in offering the physical activity programs as originally designed. Implementation measures, as described above, can be evaluated via checklists that monitor (ie, through direct observation) the fidelity with which intervention protocols are implemented by intervention advisors and exercise professionals. Finally, the costs to the physical activity programs, places, and professionals to participate in an EIM network and offer programming to patients should be recorded on an ongoing basis.

Maintenance of EIM networks should be examined at both the patient and the organizational level. The long-term (6, 12, 24, and 36 months) effects of referring patients to an intervention advisor, or directly to an EIM network, can be assessed by examining changes in physical activity levels and health outcomes compared with baseline levels. These long-term changes can be compared with patients who did not interact with an intervention advisor or participate in an EIM network, either by choice or because they did not receive a referral. This information can be obtained via review of patient data from their EMR or notes in paper-based records, combined with information on their participation in the EIM network. At the organizational level, the continuity of maintaining updated internal and external resources in the EIM network, as well as the length of time, number of programs and professionals, and the sustained delivery of programs and professionals in an EIM network should be assessed over time.

Costs of implementing the EIM Solution

A final component of the evaluation framework is to evaluate the costs of implementing the various components of the EIM Solution. Data on costs should be captured for each indicator in the RE-AIM framework. First, as a part of evaluating the effectiveness of the EIM Solution, data on changes in health care utilization costs, as well as laboratory and prescription drug expenditures, should be captured through insurance and billing charges. Second, the costs of adopting methods to 1) integrate physical activity assessment into the EMR, 2) provide patients with physical activity counseling and/or prescriptions, and 3) provide physical activity referrals should be collected. These adoption costs will typically appear as 1-time fixed expenditures. When evaluating the costs to implement the EIM Solution, it is necessary to track personnel costs, such as the training of providers and the time that they spend implementing the EIM Solution. Costs associated with personnel time spent implementing the EIM Solution in a clinic setting is an indirect process that is difficult, but necessary, to quantify. Long-term costs include expenses associated with maintaining the systems that support the EIM Solution in a health system (ie, updating software systems and programs). Finally, an overlooked expense includes the funds necessary to provide ongoing evaluation (ie, data extraction and analytics) of the EIM Solution.

For step 4 of the EIM Solution it is important to track the costs associated with developing and maintaining EIM networks, such as ongoing staff hiring and training. In internal EIM networks, data on these costs will be available through the health system and their accounting records. In external EIM networks, the costs of physical activity programs, places, and professionals participating in an EIM network and offering physical activity programming should be recorded on an ongoing basis.

Implications for Public Health

With the increasing adoption of physical activity assessment, prescription, and referral by health care systems, there is a need to develop a comprehensive evaluation framework that clearly defines the types of evaluations necessary, key concepts to measure, and the steps involved with evaluation process. The evaluation framework described in this article is similar to other efforts that advance the evaluation of health disparities research (40), sustain community health initiatives (41), use health information systems and technology in complex health systems (42), and evaluate diabetes prevention and management initiatives (43). These evaluation approaches, much like ours, focus on a multitude of intervention outcomes, such as rates of participation and utilization of available resources. Our pragmatic evaluation framework accounts for individual and organizational factors related to patients receiving the appropriate level and type of physical activity assessment, counseling, prescription, and referral to supportive resources to reduce physical inactivity for the prevention and management of chronic health conditions.

Efforts to evaluate the EIM Solution in health care systems are likely to occur in real time alongside implementation efforts, rather than being carefully planned ahead of time (40). To prepare for this, we described a road map for evaluating the implementation of the EIM Solution in a health care system. Furthermore, many health clinics and systems may not have dedicated research or evaluation staff to plan a detailed evaluation plan or control timing of the implementation effort (44). Our fully defined framework can be used concurrently with implementation efforts to allow for an efficient evaluation process, while providing guidance on the roles and responsibilities of involved staff members.

A strength of our work originates from the pragmatic nature of this evaluation framework. Most of our recommendations can be executed with existing resources, independent of external or additional personnel. The use of the RE-AIM framework allows for the comparison of equivalent indicators across different health systems and clinics, providing greater generalizability of results when implementing the EIM Solution from one setting to the next. This framework also provides flexibility for cultural, contextual, and practical modifications in health settings. As health care leaders make choices about which components of the EIM Solution to implement in their health system, evaluators will be able to select the most relevant portions of this framework to develop a customized evaluation plan.

This evaluation framework is not intended to describe robust analytic approaches (ie, consideration of clustering, control of confounding factors and covariates) or strategies to ensure internal validity (ie, utilization of unbiased control groups). Instead, our intent is to outline strategies to capture system-level information on whether the EIM Solution is being implemented as intended using existing resources for data collection and analysis. Our evaluation framework provides the foundation for basic data collection that can be used in ongoing quality improvement efforts and as a part of future comprehensive analyses seeking to identify potential causal relationships. In health systems that adopt the EIM Solution, patient exposure (ie, quantity and quality) to the EIM Solution will likely vary. External evaluation teams may use various analytic approaches (ie, matched cohort studies, interrupted time series designs) to examine differences in health outcomes in patients receiving varying levels of care (or no care at all), as well as the potential impact of different covariates, just as they would for any other clinical information available in EMRs.

Although our framework provides guidance in evaluating the implementation of the EIM Solution in health systems, several challenges remain. Administrative hurdles and technological barriers, such as retrieving data from the EMR and accessing patient information and claims data (ie, ethical standards), may impede even the best-laid plans. Furthermore, some metrics valued by investigators for advancing the scientific field may not be as important to health care administrators, necessitating clear communication among involved parties in establishing a consensus on essential indicators to track. Whereas a research team may want to focus on characteristics of adoption to enhance scaling up in other health systems, administrators may be more interested in addressing low-performing providers or clinics and maximizing the return on their investment.

Even though we endeavored to develop a pragmatic evaluation model, the expanse of these recommendations can result in a complicated process if not carefully organized. We described several expanded metrics that investigators may want to consider if they have additional funding and resources when developing their evaluation plans. These expanded metrics might also serve as troubleshooting mechanisms if the desired outcomes are not achieved. Lastly, one of the most important metrics may be the cost of implementing the EIM Solution in a health system across each of the RE-AIM indicators. Costs estimates, particularly as they relate to physical activity counseling and promotion, are not pragmatic measures regularly tracked or readily available in a health system. In determining the long-term value of the EIM Solution to health systems, these cost values must become a standardized, pragmatic measure.

We described a roadmap for assessing the implementation of the EIM Solution that can be used across a spectrum of health systems. As physical activity is increasingly integrated into health care systems, our pragmatic evaluation framework will be critical in determining the impact of the EIM Solution as a standard of care. This evaluation framework allows for the collection of data across multiple levels in a health system (patient, provider, and clinic settings) in a standardized format that can be compared with similar efforts taking place in other health settings. When using this framework, evaluation teams should ensure that the data being collected aligns with the mission of the health system and includes key metrics desired by clinicians and administrators to maximize the utility of the evaluation process for the health care system, and even more importantly, in support of improving patient health outcomes.

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ORIGINAL RESEARCH

Assessing Effectiveness and Cost-Benefit of the Trinity Hospital Twin City Fit For Life Program for Weight Loss and Diabetes Prevention in a Rural Midwestern Town

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PEER REVIEWED

Abstract

Introduction

Obesity is a top public health priority in the United States. This article reports on the Fit For Life (FFL) health education program designed to address the determinants of obesity in rural settings and help participants lose weight.

Purpose and Objectives

We evaluated the implementation of the original FFL program, a replication program, and a diabetes-focused program.

Intervention Approach

The original FFL program (2006 to 2012) was a 12-week session of classes meeting once weekly. Lecture topics included stress management, nutrition, healthy eating, reading food labels, fitness, disease prevention, and healthy aging. The replication program, conducted in 4 locations from 2012 to 2015, helped determine if the FFL program could be implemented on a larger scale, with outcomes similar to the original program. The longer, more-intensive FFL diabetes prevention program, conducted in 2016 and 2017, sought to reduce the number of rural adults at risk for diabetes.

Evaluation Methods

We evaluated FFL participation and outcome data from 2009 through first quarter 2017. We calculated rates of course participation and completion and measured changes in several health indicators. We constructed a linear regression model to examine the impact of health behaviors on weight loss and calculated program cost-effectiveness.

Results

From 2009 to 2017, FFL was delivered to over 1,200 people; 82% of participants completed the program. Completing participants lost an average of 2.7 kg or 3% of their total weight. Overall, 68% of participants said they exercised more per week at the end of the program than at the beginning. Estimated cost per kilogram lost for replication sites was between $73 and $101 for original FFL, in line with other programs. The more resource-intensive diabetes prevention program cost per kilogram lost was $151 to $171.

Implications for Public Health Practice

Weight loss and lifestyle management are major ways to counteract obesity. Improving program options, especially in rural locales, should be a key policy priority. These programs should be considered for population-based expansion, perhaps by health departments or public–private health care consortiums.

Introduction

Obesity and other lifestyle-related chronic diseases are a top US health policy priority (1–3). Obesity costs the United States at least $147 billion annually in direct healthcare costs and $4 billion in other costs, including lost productivity (4–6). Obesity dramatically affects the largest areas of spending — on diabetes ($237 billion) and ischemic heart disease ($88 billion) (7). Obesity and overweight are drivers of heart disease–related and other circulatory-related deaths, which are now the leading cause of death in the United States (8).

The policy priority for reducing obesity and improving heart health has driven the creation of initiatives, both large and small (9–12). From the Million Hearts Initiative to proprietary health improvement programs, the United States is now awash in potential interventions to fight obesity and improve heart health. A major class of programs includes lifestyle interventions, also known as behavioral weight loss interventions or weight management programs, whereby individuals are educated and motivated to improve their own health through behavior change (13). These programs usually include modifications to diet and exercise regimens. A 2017 systematic review from Sun et al showed that 64 studies of dietary interventions all demonstrated statistically significant weight loss, ranging from −1.17 kg to −3.15 kg (13). Internet- or computer-based interventions also showed some promise as an effective modality (14). That review included few robust findings in rural settings. A recent study by Radcliff et al found better cost-effectiveness for telephone-based programs ($33/kg) versus face-to-face programs ($47/kg) in a rural setting, although face-to-face participants lost more weight, on average (15).

This article aims to contribute to the gap in the literature on the adoption of rural weight loss programs and lifestyle interventions. It relays the experience of a lifestyle intervention delivered in person, specifically focused on assessing the effectiveness, replicability, and cost-effectiveness of lifestyle changes for weight loss, as implemented in a rural Appalachian county.

Purpose and Objectives

Tuscarawas County is an Appalachian county located in east central Ohio. The county is home to about 92,000 people, of whom 97% are non-Hispanic white. About 86% of the population have graduated from high school, and 14% have a bachelor's degree or higher (compared with 26% in Ohio and 30% nationwide). About 9% of Tuscarawas County residents do not have health insurance. The median household income in the county is just over $45,000 (compared with $49,000 statewide and $54,000 nationwide). Thirteen percent of the population lives in poverty (16). Tuscarawas County ranks in the middle of the pack for health outcomes and behaviors — about 35% of residents have obesity, compared with 30% statewide (17).

In 2006, Trinity Hospital Twin City received funding from the US Department of Health and Human Services (HHS), Health Resources and Services Administration (HRSA), Office of Rural Health Policy (ORHP) Rural Health Outreach Grant Program to offer the Fit For Life (FFL) program in Tuscarawas County, Ohio. IRB approval was not sought because analyses were performed on de-identified secondary data.

After the pilot program (2006–2009), HRSA supported growth of the FFL program and systematic data collection on health outcomes associated with the program. Health outcomes were pre and post measures of weight, total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglycerides, and blood pressure (systolic/diastolic). In 2012, for the replication study, pre- and post-program surveys were administered to participants, focusing largely on individual health behaviors. In 2015, with the diabetes prevention (DP) program, HbA_{1c} was added as a pre/post measurement and a repeat measurement was added 3 months after conclusion of the 12-week program.

Intervention Approach

Original FFL program

Trinity Hospital Twin City's original FFL Program (from 2006 to 2012) provided health education and promotion through FFL curricula on wellness and disease prevention in classes designed specifically for adult men and women. In a 12-week session of classes that met once weekly for 90 minutes, students heard lectures on stress management, nutrition, healthy eating, reading food labels, fitness, disease prevention, healthy aging, and more (18). In the program, lectures and health education were provided by the Program Director (a medical doctor and Board Certified Family Practitioner). Additional FFL professional presenters often included chiropractors, health coaches, fitness instructors, and wellness educators. In 2012, HRSA provided funding to begin FFL replication studies; in 2015, HRSA funded a diabetes-specific prevention program.

Replication program

The primary aim of the Fit For Life Replication Project was to assess whether the original program could be implemented on a larger scale with similar clinical outcomes. The replication project sought to provide a multi-agency approach to reduce the number of adults with overweight or obesity in rural Tuscarawas County, Ohio and replication sites in the bordering Appalachian counties of Carroll, Harrison, Holmes, and Jefferson. Effectiveness and sustainability were primary outcomes of interest, leading to an increased number of sites and, ultimately, individuals served by FFL. The curriculum taught at the replication sites was the same as taught in the original FFL project, though different trainers were used. The replication project used a train-the-trainer approach, with 4 replication sites offering services in their respective counties after being trained by staff from the original site. In the first year, 2 half-day trainings were held, and for the last 2 years, 1 half-day training was held each year. A standardized trainer's manual with a step-by-step guide about how to set up an FFL program was developed. Evaluators participated in the replication site courses to ensure fidelity to the curriculum. Two replication sites left after year 1 of the 3-year project and were replaced in year 2 by other partners. The sites that ceased operation of FFL did so because of staffing constraints and resourcing issues. Of the 4 replication sites, 2 were physician-led, 1 was led by a master's level health educator, and 1 was co-led by a chiropractor and a master's level health educator. All other aspects of the program remained the same.

Diabetes prevention program

The most recent evolution of FFL is in prediabetes management. Interventions for prediabetes are critical, but consistent evidence is lacking about the effectiveness of such programs (19,20). The FFL Diabetes Prevention (DP) program was designed as a time- and resource-intensive intervention to help those at risk for type 2 diabetes, as defined by hemoglobin A_{1c} (HbA_{1c}) ≥5.7% or a BMI ≥25). The aim of the DP program was to reduce the number of adults at risk for diabetes – measured through weight loss or BMI change and changes to HbA_{1c}. Like the original FFL program, this curriculum also involved the foundational 12-week session that met once a week for about 90 minutes, and it added 3 classes that met once a month. FFL DP students also had access to 3 individual counseling sessions and 3 personal training sessions at no additional cost. This program was conducted at the original FFL site in Tuscarawas County, beginning in late 2015.

Evaluation Methods

Data management

General health outcomes data were aggregated, by year, for FFL participants. The health outcomes data set and the health behavior survey data set were linked through a participant ID number. No names or contact information were included in analytic data sets. Outcomes were organized by FFL project type: original FFL (classes ending in 2010–2012), FFL replication (2013–2015), and FFL DP (2016 and 2017).

Measures

The primary outcome of interest was change in weight. Other outcomes were changes in BMI (measured as weight in kg divided by height in m^2), cholesterol, triglycerides, blood pressure, and, for the DP program, HbA_{1c}. Individual health behaviors were assessed, including intake of sugar-sweetened beverages, use of Nutrition Facts labels, and exercise (days per week), all of primary interest in this analysis. Additional variables examined were daily servings of fruit and vegetables, daily servings of whole grains, avoidance of *trans* fats, and how often the individual ate outside the home. Age and gender were also accounted for. Anyone who signed up for the program became a participant; no exclusion criteria were used. Completion of the program was defined as a participant attending 7 or more classes (minimum dosing requirement) and not missing more than 3 classes in a row (sequential requirement). Completions were only counted once per person for the years analyzed.

Analytic / Evaluation approach

Measures of change were of primary interest in the FFL program, the replication project, and the DP project. Data from the first years of the post-pilot project (2009 through 2012) are presented as summary measures only, because the program was still in development and only historical summary measures existed (ie, aggregate information only, no individual record data sets remain). For 2013–2017, individual-level pre/post records are available. We describe changes to health outcomes, focusing especially on weight loss and, for the DP program, changes to HbA_{1c} measures pre and post FFL. Outcomes by replication site were examined and pairwise mean comparisons were conducted to examine site outcome variations, by using the Tukey test for multiple comparisons. Similar comparisons were conducted for years 1 and 2 of the DP program.

In addition to descriptive analyses, we constructed a linear regression model by using robust variance estimators. Weight change in kilograms was the primary dependent variable. Independent variables included baseline information: weight, age, gender, days of exercise per week, consumption of any sugar-sweetened beverages in a week (yes/no), and whether the individual used Nutrition Facts labels "most of the time" or "always." The model also controlled for program iteration and FFL site. Other variables were examined for inclusion, including baseline daily servings of fruit and vegetables, daily servings of whole grains, avoidance of *trans* fats, and how often the individual ate outside the home. These variables were excluded from the final model because of high correlation with other covariates (as measured through variance inflation factor analysis).

The analytic data set used in the regression consisted of pre/post measurements from participants who completed FFL, the replication project, or the DP project. Respondents were excluded from overall analyses if they did not complete the program. We also conducted a cost-effectiveness analysis in an effort to quantify potential utility of FFL if replicated more broadly. HRSA and Trinity Hospital Twin City have made substantial investments in the program's creation since 2006. However, replication program costs (ie, educational materials, site, staffing, and incentives) are relatively modest. We conducted cost-effectiveness analyses for potential replication sites for both original FFL and FFL DP, using cost per kilogram (kg) lost as the primary outcome of interest. This is in line with previous examinations of the cost-effectiveness of weight management interventions (13). We estimated cost-effectiveness by number of students graduated, assuming approximately 20% of FFL participants drop out. This is based on programmatic data for FFL in 2013–2017. Costs were based on actual program costs from 2016–2017. Using results from the original FFL and FFL DP alongside estimated cost for delivering the service, we estimated cost per kg lost among completing participants for class sizes of 30 and 50. Size estimates are based on average class size (ie, 30) and the largest size we believe to be reasonable (ie, 50). We did not include non-service delivery costs (eg, travel, conferences, program administrator) as these costs are not necessary to deliver the FFL program in replication sites. Additionally, we did not include the cost of the curriculum, as it is a one-time purchase. For the original FFL session, we used site data from the replication study in 2012–2015. Data were managed and analyzed in Stata 13.1 (StataCorp LP, College Station, Texas).

Results

Demographics and program characteristics

Between 2009 and 2017, FFL was delivered to over 1,200 people in 3 distinct iterations. First, between 2009 and 2012, FFL was delivered at its primary site. Second, between 2012 and 2015, FFL was delivered at 4 replication sites. Third, in 2016 and 2017, FFL was delivered at its primary site in an expanded format to individuals at risk for diabetes (the DP program). Overall, more women than men participated – 74% versus 26% (Table 1). Most participants were aged between 45 and 64 years. Overall, about 43% of respondents said their household income was below \$51,000. Among the FFL DP participants who completed bloodwork (n = 108 in 2016 and 2017), the mean and median HbA_{1C} value was 5.7. The 25th and 75th percentiles were 5.4 and 6.0, respectively. The mean and median BMI were 36 and 34, respectively.

Since 2009, FFL completion rates have been tracked by session and delivery site. Table 2 shows overall completion rates and program outcomes for 2009, 2013, and 2017. In total, 82% of participants completed FFL in 2009–2017, almost 1,100 in total. On average, participants lost 2.7 kg, or 3% of their total weight, from the beginning of the 12-week program to the end, and 1.25 points of BMI. This amount increased during the course of the program, with average weight loss increasing from 1.4 kg in 2009–2012 to 2.7 kg in 2013–2015 to 6.1 and 5.0 kg in 2016 and 2017, respectively.

During 2013–2015, participants' weight changed:
20% lost more than 5 kg
29% lost between 2.5 and 5 kg
34% lost between 0 kg and 2.5 kg
15% gained between 0 and 2.5 kg, and
2% gained more than 2.5 kg.

Overall, 52% of individuals in 2013–2015 lost 3% or more of their bodyweight, and 27% lost 5% or more. Comparatively, for the 2016 and 2017 FFL DP, 74% of individuals lost 3% or more of their total weight, and 48% lost 5% or more.

In FFL DP during 2016 and 2017, participants' weight changed:
41% lost more than 5.0 kg
28% lost between 2.5 kg and 5.0 kg
20% lost between 0 kg and 2.5 kg
9% gained between 0 and 2.5 kg, and
2% gained more than 2.5 kg.

At the 3-month post-intervention follow-up, FFL DP participants (n = 62) had lost 6.1 kg on average, representing further weight loss after the conclusion of the 12-week program (median = 5.5 kg). The median weight regain from the end of the 12-month program to 3-month follow-up was 0 kg. Among those further losing weight (n = 31), the average was an additional 3.3 kg. Among those regaining weight (n = 31), the gain was 2.0 kg, representing a net decrease of 1.3 kg from the beginning of the program for these participants.

On average, not only weight, but also blood pressure, total cholesterol, and triglycerides were reduced. Between original FFL and FFL DP, the change in systolic blood pressure was not substantial or statistically different (−4.4 vs −3.4 points, $P = .6$), although diastolic was (−0.94 vs −3.5 points, $P = .02$). Cholesterol (total, HDL, and LDL) and triglycerides were not statistically different between the 2 programs.

The replication study included the primary site and 4 additional sites. After the first year of the replication study, 2 sites discontinued the program and 1 new site began offering the program. The primary site had 253 total participants during the replication project period and Sites 1, 2, 3, and 4 had 13, 12, 84, and 61 participants, respectively. Course completion for the primary site was 83% and for Sites 1, 2, 3, and 4 completion rates were 85%, 75%, 75%, and 62%, respectively.

Weight change was comparable across sites (Figure 1). Although the primary site showed a larger average change in weight during the replication study period (mean, 3.0 kg, standard error [SE], 0.25 kg), these differences were not statistically significant compared with all replication sites (mean = 2.3, SE = 0.26, P = .08). All sites had participants whose weight change was negative. The null hypothesis was that the program would have no effect on weight change.

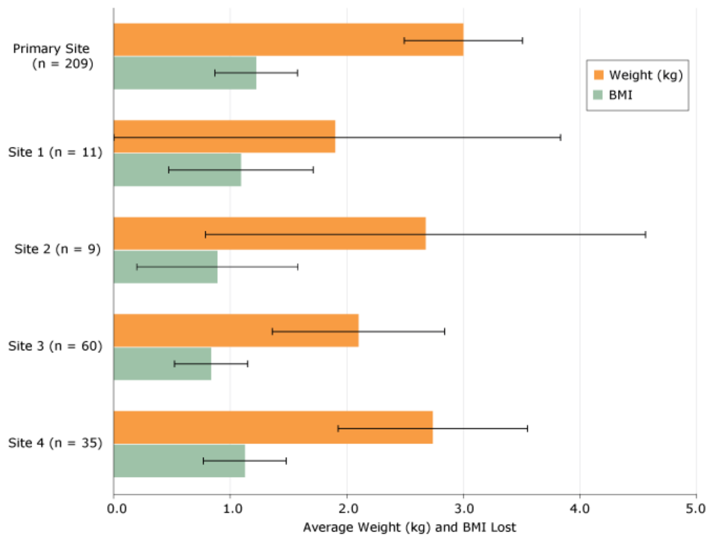

Figure 1. Weight and BMI changes by primary and ancillary replication sites, Trinity Hospital Twin City FFL Program, 2013–2015. Outcomes are shown as average weight (kg) and BMI lost, with 95% confidence intervals.

Abbreviations: BMI, body mass index; FFL, Fit For Life Program.

Participants at the primary site lost 3 kg on average (n = 187 completing measurements, standard deviation [SD] = 3.47, $P < .001$).
At Site 1, participants lost 1.9 kg on average (n = 11, SD = 3.2, P = .08)
At Site 2, participants lost 2.7 kg on average (n = 9, SD = 2.9, P = .023)
At Site 3, participants lost 2.1 kg on average (n = 52, SD = 2.7, $P < .001$)
At Site 4, participants lost 2.7 kg on average (n = 35, SD = 0.4, $P < .001$).

Improvements in health behaviors were noted at the replication sites and in the FFL DP. At the beginning of the 12-week program, 46% of participants who completed the survey (n = 347) said they exercised 0 times per week, 37% said 1–3 times, and 17% said 4–7 times. At the end of the program, 11% said they exercised 0 times per week, 49% said they exercised 1–3 times, and 39% said they exercised more than 4 times. Overall, 68% of participants said they exercised more per week at the end of the program than at the beginning. Among these individuals, average increase in weekly exercise was 2.6 times per week (median 2, SD 1.4). Similar positive changes in health behaviors were observed with eating fruit and vegetables (67% improved habit), eating whole grains (54%), avoiding *trans* fats (54%), avoiding high fructose corn syrup (59%), and using Nutrition Facts labels (56%, Figure 2). Among DP program participants, 54% saw HbA_{1c} values improve about 1.5% on average. Overall, about 34% of participants whose HbA_{1c} was 5.7% or higher at the beginning of the FFL diabetes prevention program decreased it to normal levels by the end of the program.

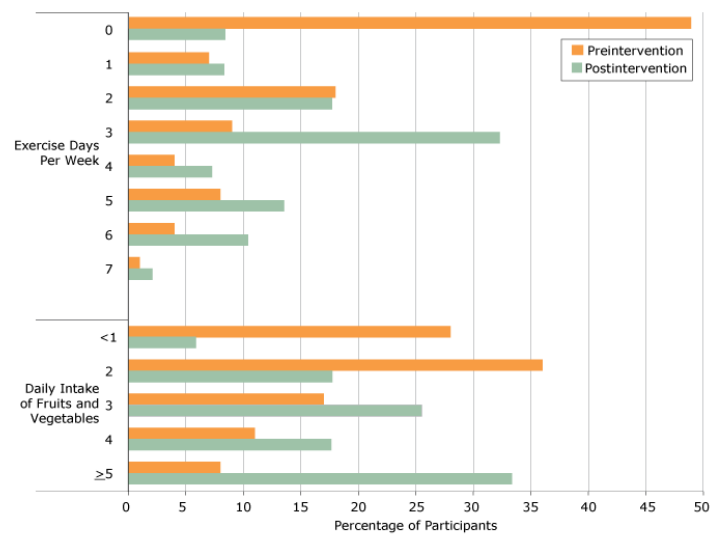

Figure 2. Health behavior outcomes among replication study sites and diabetes prevention site, Trinity Hospital Twin City FFL Program, 2013–2015.

We conducted a linear regression, modeling weight loss in kgs for participants in the replication study and the DP group (Table 3). After controlling for weight and age, gender, days of exercise by the end of the program period, consumption of sugar-sweetened beverages by the end of the program period, using nutrition labels by the end of the program period, and the program type (original FFL versus FFL DP) all had statistically significant effects on weight loss. Each additional day of exercise per week was associated with a 0.4 kg decrease in weight over the 12-week period, all else equal (P = .001). Being in the FFL DP program was associated with greater weight loss compared with the original FFL program (2.4 kg, $P < .001$).

Estimating cost-benefit

We estimate program costs at $5,750 for original FFL and $7,188 for the longer FFL DP (Table 4). This is equivalent to $192 per participant in a original FFL program with a class size of 30 participants completing the program (assuming 80% of the original class completes the program). Add to this the variable cost per person (including incentives, workbooks, and other supplies) for the original FFL program, and a class of 30 completing students costs about $261 per person, or $279 per completing student assuming an 80% completion rate. The DP program has somewhat higher fixed costs (for 3 extra sessions), but substantially higher variable costs — as participants had access to personal training sessions and counseling. As such, cost per completed student is significantly higher in the DP program. However, because participants tended to lose substantially more weight on that program, per kg costs were more modest. From a purely cost-effectiveness perspective, original FFL performs better (incremental cost-effectiveness ratio, $178–$184, depending on class size, comparing original FFL with FFL DP). Cost based on the number of completions with a 3%+ and 5%+ weight loss are even higher: $544 per student with weight loss of 3% or more (FFL) and $1,029 (DP), and $1,056 and $1,587 per student with weight loss of 5% or more (FFL and FFL DP, respectively).

Implications for Public Health Practice

The FFL programs showed consistent, statistically, and clinically significant weight loss results between 2009 and 2017. Participants in the original FFL program lost 2.7 kg and 3.2% of their BMI on average, and participants in the FFL DP program lost 4.8 kg and 4.8% of BMI. Cholesterol improved (ie, was lower) by 3.6%, blood pressure by 2.3% (systolic) and 1.4% (diastolic), and triglycerides by 4.8% on average. Moreover, participants, on average, said they exercised more, ate more fruits and vegetables, and employed more healthy behaviors after completion of FFL compared with before initiating the program.

Estimates for cost-effectiveness for original FFL ranged between $73 and $101 per kg lost among completing students, contingent on class size. This is in line with findings from a recent meta-analysis on the cost and effectiveness of similar lifestyle interventions (13,15,21–26). The program was lower cost than commercial weight loss interventions, the least expensive of which is around $155 per kg lost (95% CI, $110–$218) and pharmaceutical interventions, the least expensive of which is $204 per kg (21). The FFL program is considerably less expensive and more effective than more expensive interventions (eg, $2,204 per kg lost in the Be Fit Be Well program) (27). However, several interventions were more effective (13) and cost-effective (lowest cost was $34 per kg lost). Additionally, a small number of interventions including technology, like multi-sensor armbands, were more cost-effective ($51/kg) (23).

In the higher-risk and higher-cost population — those in the DP program — estimates of cost effectiveness ranged from $150 to $170 per kg lost, based on class size. As the United States spends $237 billion a year in direct medical care for diabetes (28), FFL DP may be a cost-effective alternative. We posit this may be especially true in rural areas (16). Beyond weight loss or improved heart health, FFL and similar lifestyle interventions have other potential benefits that are more difficult to quantify (22), such as reduced personal healthcare costs from improved health. In the experience of FFL staff, participants often dramatically reduce the number of medications they take after experiencing weight loss and improved heart health. Moreover, healthy eating and lifestyle choices may spill over to a participant's family and friends.

In our view, cost-benefit and cost-utility analyses of lifestyle interventions and other weight-loss interventions must be expanded to include the broader set of benefits that participants realize (29,30). Although it is beyond the scope of this article to propose alternative measures of cost-benefit analyses, we do support moving beyond facile cost-per-kilogram approaches to evaluation. We recognize the importance of the use of a simple, universal comparator, but, from a policy perspective, do not think that cost-per-kilogram-lost is the best choice.

Implementing a replication program and a diabetes prevention intervention: lessons learned

The replication of FFL into other jurisdictions was successful; results were relatively consistent across sites, and all experienced reasonable participation rates. However, 2 sites did discontinue participation early on in the process. Circumstances at the sites themselves caused these changes, not the FFL program. In the withdrawal letter from 1 organization, a newly appointed leader cited the need to discontinue participation because of the organization's small staff and the need to shift priorities to other projects within their jurisdiction; the project was something he "inherited" with the retirement of the prior leader, with whom Trinity Hospital Twin City had an excellent working relationship. The second site that discontinued participation was a critical access hospital. In their withdrawal letter, the CEO indicated a lack of staffing and resources for the program because the doctor who had been trained by Trinity Hospital Twin City was about to take maternity leave. About a year after the critical access hospital discontinued participation in FFL, the hospital experienced significant financial trouble which led to its sale. It is our belief that the hospital's broader staff shortage and financial situation also played a role in the decision to discontinue. Successful partnerships in the replication phase required good institutional support from partners and ongoing technical assistance and collaboration from the primary site.

We view the FFL DP program as a modest success. Because of the high number of Tuscarawas County adults at risk for diabetes, Trinity Hospital Twin City created FFL DP to target more specifically those at highest risk for diabetes (ie, only adults with prediabetes and high diabetes risk factors such as obesity, family history, and elevated HbA_{1c} levels were accepted into the DP program, as opposed to original FFL, which was open to anyone in the community). HRSA's funding created the opportunity for the hospital to make the DP program affordable; however, for cost-effectiveness reasons, the program will be sustained beyond grant funding by returning to an adapted original FFL curriculum. The following adaptations will be made to the original FFL as a result of the success of the DP program: there will be continued involvement of the counseling and fitness professionals on a smaller scale by providing some services in-kind during class time and the 3 monthly classes will likely continue after the initial 12-week course is completed. We believe this maximizes sustainability while still using successful components of the DP program.

Limitations

Analyses presented in this article are subject to numerous questions related to both external and internal validity. Most important is the potential critique of generalizability. Fundamentally, individuals participate in FFL because of some desire to effect behavior change. Although over half of FFL participants said they had "recently" or "this month" resolved to have a healthier lifestyle, FFL participants are inherently a motivated group of individuals or are brought to the class by a friend or family member who is. It seems, then, that FFL participants ought not be generalized to the general public – merely those considering a lifestyle intervention or weight-management program. Measurement error is always a threat to internal validity. To address this, equipment was calibrated, the same equipment was used for all repeated measures, and all clinical diagnostic tests were conducted by certified laboratory staff. A final consideration is post-intervention measurement. Three-month follow-ups were conducted starting in 2016, with about 60% of those who completed the program participating in the follow-up. Long-term weight regain remains a valid concern. Our experience with weight regain is limited by those participating in the study — about half continue to lose weight, and half regained some (although net weight loss remained).

Conclusion

Trinity Hospital Twin City FFL is one among numerous lifestyle intervention and weight loss programs available in the United States (13). It seeks to harness the motivation of its participants, offering access to health education and nutrition information. It was designed to serve a rural population, and its focus goes beyond diet and exercise, to include health improvement holistically. From a policy perspective, funding these types of weight management and lifestyle interventions, especially in rural jurisdictions, could prove extremely productive and cost-effective. Rather than Medicaid or other publicly subsidized insurance paying to manage multiple chronic conditions or an individual dealing with the health and economic ramifications of diabetes, primary prevention is both the prudential and cost-effective alternative. As such, jurisdictions, especially rural ones, should consider offering weight management and other lifestyle interventions for interested parties. Our work with governmental public health agencies in the replication studies suggests public health departments may be a natural ally of local hospitals and clinics on this particular topic.

Regardless of location or particular curriculum, lifestyle intervention programs and other behavioral interventions must come to form a foundation of universal access to health education and nutrition assistance. The programs are relatively inexpensive and relatively effective (31). Individual behaviors account for 30% of an individual's health outcomes (32), so cost-effectively motivating individual behavior change must remain a top research and policy priority.

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Images and tables are original work.

Parties interested in using Fit For Life materials (including evaluation surveys and so forth) should contact Dr. McKnight and Ms. Demuth.

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Tables

Table 1. Demographics of Participants in the Trinity Hospital Twin City Fit For Life Weight Loss and Diabetes Prevention Programs, Rural Ohio, 2009–2017

Demographic	Original FFL				Replication Study			Diabetes Prevention Program		Total
Year	2009	2010	2011	2012	2013	2014	2015	2016[a]	2017[a]	–
Participants (n)	134	335	116	71	86	147	195	55	92	1231
Returned Surveys (n)	127	305	107	64	68	97	85	42	70	965
Gender (%)										
Female	71	76	63	73	74	82	69	70	83	74
Male	28	23	36	27	26	18	31	30	17	26
Missing	1	1	1	0	0	0	0	0	0	0
Age Group, y (%)										
18–44	26	25	35	17	10	19	13	15	18	22
45–64	58	67	51	67	60	60	68	54	66	62
≥65	16	8	14	16	30	21	19	30	16	16
Missing	0	0	0	0	0	0	0	0	0	0
Household Income, $ (%)										
0–30,999	25	12	17	14	11	11	14	27	12	15
31,000–50,999	24	24	27	27	31	38	26	44	37	28
≥51,000	36	56	48	48	53	41	51	26	46	48
Declined to answer	14	9	8	11	4	9	9	3	4	9

Abbreviation: FFL, Fit For Life.
[a] Fit For Life Diabetes Prevention Program, full course.

Table 2. Health Outcomes for Select Years, Trinity Hospital Twin City Fit For Life Weight Loss and Diabetes Prevention Programs, Rural Ohio, 2009–2017

Health Measure	2009	2013	2017
No. of Participants	134	86	92
% completing	91	79	78
% of completions participating in final measurements	80	100	99
% of class participating in final laboratory measurements	70	96	97
Weight loss, kg			
Total weight lost	173	191	302
Avg. loss	1.2	2.8	4.3
Avg. % of weight loss	3	3	4
BMI averages			
BMI lost	1.1	1.0	1.6
% of BMI	2	3	4
Blood pressure, average change			
Systolic	3.5	6.0	2.2
Diastolic	−2.7[a]	0.2	3.3
Lipids, average change			
Cholesterol	10.3	11.0	7
HDL	0.0	−0.6 [a]	−0.7 [a]
LDL	8.1	8.7	4.8
Triglycerides	5.6	17.3	14

Abbreviations: BMI, body mass index; HDL, high-density lipoprotein; LDL, low-density lipoprotein.
[a] Negative numbers reflect gains.

Table 3. Regression Results, Trinity Hospital Twin City Fit For Life Weight Loss and Diabetes Prevention Programs, Rural Ohio, 2009–2017

Variable	Coefficient (weight loss, kg)	95% CI	*P* value
Exercise (days per week)	−0.39	(−0.61 to −0.17)	.001
≥1 sugar-sweetened beverage per week	1.05	(0.21–1.9)	.014
Use Nutrition Facts panel/label			
Never/Rarely/Sometimes	[Reference]		
Most of the time/always	−1.23	(−2.18 to −0.28)	.011
FFL program type			
Original/replication study	[Reference]		
Diabetes prevention	−2.44	(−3.51 to −1.37)	<.001
Controls			
Weight (kg)	−0.05	(−0.06 to −0.03)	<.001
Age (years)	0.05	(0.02–0.08)	.003
Female	1.06	(0.15–1.97)	.022

Table 4. Estimating Cost-Benefit for a Replication Site, Trinity Hospital Twin City Fit For Life Weight Loss and Diabetes Prevention Programs, Rural Ohio, 2009–2017

Cost Factor	Original FFL 3 months (12 sessions)[a]	Diabetes Prevention 6 months (15 sessions)[b]
Fixed cost ($)		
Facilitator[c] ($313 per session)	3,750	4,688
Staff coordinator[c] ($75 per session)	900	1,125
Space rental ($50 per session)	600	750
Contracted speaker (2 at $250 per class)	500	625
Subtotal (fixed costs)[d]	5,750	7,188
Variable cost per person ($)[e]		
Supplies/Workbooks	20	20
Incentives	20	20
Blood draws[f]	30	30
Counseling	–	300
Fitness training	–	100
Subtotal (variable costs)	70	470
Cost per completed students ($)[g]		
30 per class	279	827
50 per class	203	731
Cost per kilogram lost among completed students ($)		
30 per class	101 (95% CI, 89–117)	170 (95% CI, 146–205)
50 per class	73 (95% CI, 65–85)	151 (95% CI, 129–181)
Average weight loss post intervention (kg)	2.75 (95% CI, 2.4–3.1)	4.8 (95% CI, 4.0–5.7)

Abbreviations: CI, confidence interval; FFL, Fit For Life.
[a] Assumes 80% completion.
[b] Provided at a substantial discount to FFL participants.
[c] Includes 25% fringe benefits.
[d] Estimates do not include one-time purchase cost of curriculum (approximately $2,000).
[e] Cost per person assumes students who do not complete course still consume all variable goods/services.
[f] Provided at discount from the hospital.
[g] Cost for *c* completed students for *n* total students calculated as (Fixed cost + (variable costs×*n*))÷*c*.

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IMPLEMENTATION EVALUATION

Reducing the Intake of Sodium in Community Settings: Evaluation of Year One Activities in the Sodium Reduction in Communities Program, Arkansas, 2016–2017

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PEER REVIEWED

Abstract

Purpose and Objectives

The Centers for Disease Control and Prevention's Sodium Reduction in Communities Program (SRCP) aims to reduce dietary sodium intake through policy, systems, and environmental approaches. The objective of this study was to evaluate and document the progress of the first year of a 5-year SRCP project in northwest Arkansas.

Intervention Approach

In collaboration with 30 partner schools and 5 partner community meals programs, we sought to reduce dietary sodium intake through increased implementation of 1) food service guidelines, 2) procurement practices, 3) food preparation practices, and 4) environmental strategies.

Evaluation Methods

We collected daily menus, information on nutritional content of meals, and procurement records and counted the number of people served in partnering schools and community meals programs. We used a pretest–posttest quantitative evaluation design to analyze changes in the sodium content of meals from baseline to Year 1 follow-up.

Results

From baseline to Year 1 follow-up, participating schools lowered the mean sodium content served per lunch diner from 1,103 mg to 980 mg (−11.2%). The schools also reduced the mean sodium content of entrées offered (ie, entrées listed on the menu) from 674 mg to 625 mg (−7.3%) and entrées served from 615 mg to 589 mg (−4.2%). From baseline to follow-up, participating community meals programs reduced the mean sodium content of meals offered (ie, meals listed on the menu) from 1,710 mg to 1,053 mg (−38.4%). The community meals programs reduced the mean sodium content of meals served from 1,509 mg to 1,258 mg (−16.6%).

Implications for Public Health

In both venues, our evaluation findings showed reductions in sodium served during the 1-year evaluation period. These results highlight the potential effectiveness of sodium reduction interventions focused on food service guidelines, procurement practices, food preparation practices, and environmental strategies for schools and community meals programs.

Introduction

The *2015–2020 Dietary Guidelines for Americans* recommends that daily dietary sodium intake not exceed 2,300 mg for people aged 14 years or older (1). However, people in the United States consume more sodium than is recommended (2–4). Among Americans aged 2 years or older in 2013–2014, males consumed a mean of 3,915 mg of sodium per day, and females consumed 2,920 mg (5).

Approximately 25% to 30% of US adults have hypertension (6,7). Hypertension is strongly associated with risk for cardiovascular disease (8), the leading cause of death in the US population (6). Consensus on dietary sodium intake is that sustained excessive sodium intake is associated with hypertension and increased risk for cardiovascular disease and that reducing excessive sodium intake has a direct effect of lowering blood pressure (9–14). Across a range of approaches, health impact assessment models consistently predict sizeable health benefits of reduced sodium intake (15). An analysis published in 2017 indicated that a 10% reduction in sodium intake worldwide over 10 years would avoid 5.8 million disability-adjusted life years (16).

The Centers for Disease Control and Prevention (CDC) implemented the Sodium Reduction in Communities Program (SRCP) to achieve the benefits of reduced dietary sodium intake across large populations in the United States by reducing sodium intake to recommended levels (17,18). Program awardees are charged with increasing access to healthy, lower-sodium foods in venues that serve food to relatively large numbers of community members (19). Program activities focus on increasing the number of lower-sodium foods offered rather than restricting food choices. Program venues include correctional facilities, early childhood education centers, institutions of higher learning, hospitals, worksites, and others (18). Each awardee is required to evaluate the effectiveness of the strategies in its targeted venues (19).

Purpose and Objectives

In 2016, the University of Arkansas for Medical Sciences (UAMS) received a 5-year SRCP award to implement sodium reduction strategies in northwest Arkansas in public school cafeterias and in community meals programs (programs that offer free meals to low-income patrons). UAMS and local stakeholders selected these venues because they serve populations in northwest Arkansas at elevated risk for hypertension, namely Pacific Islander, low-income, and food-insecure populations (6,7,20). This project presented a unique opportunity to evaluate the effects of the simultaneous implementation of multiple sodium reduction strategies in 2 venues. The objective of our study was to describe the strategies, intervention, and outcomes during Year 1 of UAMS's SRCP project.

Before applying for an SRCP award, UAMS assembled an internal team of researchers, a registered dietician, policy experts, and staff with experience in implementing health-related interventions in food system venues. UAMS also engaged key stakeholders in northwest Arkansas. These stakeholders represented local community meals programs, school districts, large employers, vendors, community groups, and a center for culinary arts. Stakeholders engaged in quarterly group meetings and monthly one-on-one meetings with UAMS. These meetings focused on discussions about their interest in and capacity to support an SRCP project in various potential venues. UAMS and stakeholders agreed that school districts and community meals programs should be selected as venues.

School districts

The public school districts in northwest Arkansas serve food daily to more than 100,000 students and staff (21). Several school districts were particularly enthusiastic about participating in SRCP because of planned changes to the US Department of Agriculture's (USDA's) school lunch policy. The USDA's proposed standards required schools participating in the National School Lunch Program to comply with reduced sodium standards. For example, standards for high school cafeterias reduced the allowable amount of sodium in lunches from an average of 1,588 mg to 1,420 mg or less in 2014 and — if implemented as scheduled — will further reduce the allowable amount of sodium to 740 mg or less in 2022 (22).

UAMS selected the public school district in Springdale, Arkansas, as the first school district partner for project implementation because of its socioeconomic and health-related challenges. In 2017, Springdale school district cafeterias served more than 24,000 students and staff daily (23). Among Springdale's more than 20,000 students, the prevalence of overweight/obesity was 43% in school year 2016–2017 (24). Many of Springdale's students came from low-income households and were Pacific Islanders; both groups are associated with an increased risk for hypertension (6,7). Approximately 71% received free or reduced-price lunch (25), higher than the prevalence observed in the United States (51.8%) and Arkansas (62.3%) (26). Approximately 13% of the school district's students were Marshallese (Pacific Islander) (27).

Community meals programs

In 2016, northwest Arkansas community meals programs served approximately 4,000 people daily. These community meals programs included free community meals served on site (eg, in soup kitchens) and weekend food bags for children to supplement their weekend meals. These programs were selected because many of their patrons have health challenges associated with food insecurity, homelessness, poverty, and unemployment. Food insecurity and low income are associated with increased risk for hypertension (6,20). Five community meals programs were selected as Year 1 partners for project implementation. These programs were selected on the basis of the following 4 criteria: 1) their reach (ie, the programs' self-reported collective reach was ~3,000 meals per day), 2) their diversity of approach (eg, 3 programs served meals on site and 2 programs provided weekend food bags for children), 3) their diversity of location (ie, throughout northwest Arkansas), and 4) their willingness to participate.

Intervention components

Intervention components at each venue were based on increased implementation of 4 broad strategies recommended by SRCP: 1) food service guidelines that discuss sodium, 2) procurement practices to reduce sodium content in foods and ingredients purchased, 3) food preparation practices to reduce sodium content of menu items and meals, and 4) environmental strategies that encourage reductions in dietary sodium intake. The effectiveness of these 4 components was evaluated at each venue according to the following 4 evaluation questions, common to all SRCP projects:

1. How and to what extent have sodium reduction interventions been implemented in specific venues and entities?
2. How and to what extent has the food environment changed since the implementation of sodium reduction interventions, specifically addressing availability of lower-sodium food products?
3. To what extent have lower-sodium food products been purchased or selected by either consumers or larger service providers?
4. What promising and innovative sodium reduction strategies have been found effective that could be replicated by similar communities (28)?

Intervention Approach

Upon notification that UAMS's application was successful, UAMS convened a food policy committee for each venue (Figure). For the school district, the food policy committee consisted of child nutrition administrators, and they scheduled monthly meetings; however, they met 7 times during Year 1. For the community meals programs, the committee consisted of staff responsible for administration, procurement, operations, and food preparation for each program. The community meals committee initially met monthly but then changed to bimonthly after feedback from committee members; they met 10 times during Year 1.

Venues	People	Strategies and Year 1 Activities	Evaluation Questions and Year 1 Outcome Measures
Schools Springdale, Arkansas, public school district • 3 high schools • 4 junior high schools • 4 middle schools • 18 elementary schools • 1 pre-kindergarten 30 total schools **Community Meals** • 3 on-site (eg, "soup kitchen") meal programs • 2 weekend food bag (eg, "backpack") programs 5 total community meals programs	**UAMS project staff (% full-time equivalent)** • Project director (25%) • Project manager (50%) • Evaluation director (50%) • Schools venue coordinator (100%) • Community meals venue coordinator (100%) • Registered dietitian (100%) **Titles of schools food policy committee members** • School District Director of Child Nutrition • School District Assistant Director of Child Nutrition **Titles of community meals food policy committee members** • Director of Operations • Director of Food Services • Director of Missions • Outcomes/Systems Manager • Café Program Coordinator • Backpack Program Coordinator	**Food service guidelines that discuss sodium** • Implemented comprehensive food service guidelines that include sodium reduction standards and practices **Procurement practices to reduce sodium content in foods and ingredients purchased** • Implemented standardized purchasing list with lower-sodium items • Identified and purchased lower-sodium alternatives for products and ingredients • Focused school's USDA Foods commodity orders on low-sodium or no-sodium items • Taste tested lower-sodium ingredients for venue staff **Food preparation practices to reduce sodium content of menu items and meals** • Developed and served lower-sodium recipes for higher-sodium entrées • Modified the menu cycle to add new lower-sodium entrées • Implemented policy to eliminate "free salting" • Developed and served recipes for lower-sodium menu items that incorporate restaurant-donated foods **Environmental strategies that encourage reductions in dietary sodium intake** • Placed posters featuring sodium reduction messages in food preparation areas • Sent monthly newsletters of sodium reduction tips to venue personnel • Implemented flavor stations in junior high and high school cafeteria dining areas • Placed multilingual educational signs and dining table tents that address sodium reduction in dining areas • Moved salt shakers from dining tables to locations across the room	**Evaluation questions** • How and to what extent have sodium reduction interventions been implemented in venues and entities? • How and to what extent has the food environment changed since the implementation of sodium reduction interventions, specifically addressing availability of lower-sodium food products? • To what extent have lower-sodium food products been purchased or selected by either consumers or larger service providers? • What promising and innovative sodium reduction strategies have been found effective that could be replicated by similar communities? **Year 1 outcome measures:** • Sodium mg served per diner • Sodium mg per entrée offered and per entrée served • Entrees offered with ≤480 mg of sodium • Sodium mg per meal offered and per meal served

Figure. Overview of implementation of the Sodium Reduction in Communities Program, Arkansas, 2016–2017. Abbreviations: UAMS, University of Arkansas for Medical Sciences.

To prepare for each committee meeting, SRCP staff researched potential implementation strategies, prepared materials, and developed examples of how each venue could implement each of the 4 SRCP strategies. During committee meetings, project staff presented and discussed this information. For example, during an initial meeting with the school food policy committee, project staff proposed options for environmental strategy implementations (eg, hanging posters featuring sodium reduction messages in food preparation areas of school cafeterias, rearranging dipping sauces on the lunch line to make lower sodium options more accessible), and the committee selected the options they wanted to implement. Topics at subsequent food policy meetings included targeting and modifying high-sodium recipes to reduce sodium and identifying educational materials most suitable for each location. All implementation of intervention strategies in both venues resulted from decisions made in committee meetings. In addition, food policy committees could choose to reject, partially implement, or delay activities until Year 2 or later (Table 1).

During food policy committee meetings, project staff discussed implementation challenges and successes, solicited committee's feedback on implementation progress, and collaborated with committee members to identify potential improvements. Project staff aimed to minimize the time and effort required from committee members by limiting meetings to approximately 1 hour.

Intervention activities in the school district

At the project's beginning, UAMS's registered dietitian and other UAMS staff engaged school district personnel in discussions to augment existing school district nutrition policies to include sodium-focused annual health and nutrition training to all cafeteria staff. This intervention activity provided a policy foundation for other intervention activities. The school district's Child Nutrition Department centrally managed the district's child nutrition policies, procurement, and food preparation practices, so any changes implemented by the Child Nutrition Department would affect almost all food served in the district's 29 cafeterias. One of the district's 30 schools, a stand-alone prekindergarten facility, did not have on-site lunch preparation and was unable to participate in Year 1 activities, although students and staff did have access to lunch prepared at participating schools.

Throughout the year, UAMS staff engaged school district personnel to implement procurement practices to reduce sodium content in foods and ingredients purchased by the school district. The school district personnel involved in implementing these practices included the Child Nutrition Director, Child Nutrition cafeteria managers, and food service staff. Procurement practices to be implemented included 1) developing a standardized purchasing list to increase ordering of lower-sodium items, 2) focusing the school district's USDA Foods commodity orders on low-sodium and no-sodium items, and 3) identifying and purchasing lower-sodium alternatives for products and ingredients. To encourage procurement of lower-sodium foods and ingredients, the UAMS registered dietitian and a registered nutrition and dietetic technician taste-tested lower-sodium recipes with district personnel.

At the same time, UAMS staff worked with school district personnel to implement food preparation practices to reduce sodium content of menu items and meals. Food preparation practices included 1) collaborating with students from a local center for culinary arts to develop lower-sodium recipes for higher-sodium entrées identified by school district personnel and 2) modifying the menu cycle to add new lower-sodium entrées. Entrées were classified by school district personnel as food that met the USDA's definition of "meat/meat alternate" and was served as a main dish (29). UAMS and school district personnel aimed to reduce sodium content of all entrées on the lunch menu to 480 mg or less by Year 5 and adopted the USDA's Smart Snacks in School sodium guideline for entrées as a target (30). In addition, UAMS staff worked with school district personnel to implement environmental strategies that encourage reductions in dietary sodium in school lunches. Environmental strategies included 1) an educational campaign that placed posters featuring sodium reduction messages in dining areas of school cafeterias, 2) an educational campaign that placed posters featuring sodium reduction messages in food preparation areas of school cafeterias, 3) a monthly newsletter of sodium reduction tips sent by UAMS staff to venue personnel, and 4) implementation of flavor stations in junior high school and high school cafeterias, presenting diners with the choice to add a range of low-sodium and no-sodium seasonings to their meals.

Intervention activities in community meals programs

In the community meals programs, intervention activities were similar to activities in the school district. However, in contrast to the centralized organizational structure of the school district, each community meals program had its own organizational structure, policy environment, and operating procedures. To encourage sharing of knowledge among the community meals programs and to facilitate communication between the UAMS team and community meals program staff, representatives from all 5 programs were invited to semi-annual peer learning-exchange meetings hosted at UAMS. These meetings included lower-sodium food preparation demonstrations, lower-sodium product taste-testing (eg, lower-sodium versions of ranch dressings, salsas, and marinara sauces), and data sharing between UAMS staff and community meals program staff.

At the project's beginning, UAMS staff engaged community meals program staff in discussions to either establish nutrition policies or augment existing policies to incorporate food service guidelines that discuss sodium. At each program, the UAMS registered dietitian and other UAMS staff collaborated with community meals program personnel to develop a work plan and comprehensive food service guidelines that include sodium reduction. As with the school district, this intervention activity was intended to provide a unifying rationale for the other intervention activities in the community meals programs.

Throughout the year, UAMS staff engaged community meals program staff to implement procurement practices to reduce sodium content in foods and ingredients. The UAMS registered dietitian and other UAMS staff encouraged personnel at each program to create a standardized food purchasing list, and the UAMS registered dietitian and registered nutrition and dietetic technician identified the most commonly purchased ingredients and presented and taste-tested lower-sodium alternatives with community meals program staff.

UAMS staff also worked with the food service staff (sometimes including food service volunteers) at each community meals program to implement food preparation practices to reduce sodium content of menu items and meals. For example, a policy to eliminate "free salting" (ie, adding unmeasured quantities of salt at the end of meal preparation) was encouraged. Also, after UAMS staff identified that restaurant-donated foods were a primary contributor to the highest-sodium meals served at the venue, the UAMS registered dietitian worked with community meals program staff to develop recipes for lower-sodium menu items that incorporated restaurant-donated foods (eg, lowering sodium by adding cooked dry black beans and rice to restaurant-donated "chicken burrito bowls"). In addition, UAMS staff worked with community meals program staff to implement environmental strategies that encouraged reductions in dietary sodium in the meals served. Environmental strategies to be implemented included 1) consultation with venue staff to create and place multilingual (ie, English, Marshallese, and Spanish) educational signs and table tents that addressed sodium reduction and health concerns common to patrons and 2) moving salt shakers from the dining tables to a location across the dining room.

Methods

SRCP requires annual evaluation of project progress. To meet this requirement, we used a pretest–posttest quantitative evaluation design at each venue. We selected this design because it facilitated monitoring progress toward project objectives (eg, reduction in community members' sodium intake) at each venue, and it provided standardized quantitative indicators that 1) can be collected repeatedly across the life of the project, 2) were responsive to each evaluation question, and 3) can be aggregated by CDC across projects in its overall evaluation of SRCP. In addition, this approach saved costs by leveraging nutrient data, daily diner counts, procurement records, and daily food production records that the schools were required to collect as part of other regulatory obligations.

We collected data at each venue immediately before intervention implementation and again 10 or 11 months later, minimizing variability due to seasonal factors (eg, seasonal changes in availability of fresh fruits and vegetables). In the school district, we collected baseline data during 2 consecutive weeks of meals in December 2016 and follow-up data during 2 consecutive weeks of meals in October 2017. In the community meals program, we collected baseline data during 4 consecutive weeks of meals in January 2017 and follow-up data during 2 consecutive weeks of meals in October 2017.

We included in evaluation data collection all schools or community meals programs that implemented sodium reduction interventions. The data sources for the schools venue evaluation included annual procurement records, daily food production records, daily counts of people served per school, menu item nutrient reports, and the UAMS team's implementation records. Food production records, counts of people served, and menu item nutrient reports were generated for each school by school district staff using PrimeroEdge school nutrition software (Cybersoft Technologies, Inc) and shared with the UAMS team. Daily sodium information for each menu item at baseline and follow-up was included as part of the menu item nutrient report and was based on USDA's Child Nutrition database (31).

The data sources for the community meals venue evaluation included the UAMS team's implementation records and each program's weekly or monthly procurement records, daily menus, and daily counts of people served. In addition, the UAMS registered dietitian and other UAMS staff visited each program each day it was open during the data collection period, observing and documenting how food was prepared by community meals program staff. The documentation process included recording amounts of each ingredient used (weight or volume, depending on the ingredient and method of preparation), names of all food products used, pictures of food product labels, and menu item serving sizes. The UAMS registered dietitian calculated the daily sodium value for each menu item at baseline and follow-up by entering ingredient and serving size data into Nutritionist Pro software (Axxya Systems, LLC), which hosts a database of nutritional information for more than 80,000 foods.

For the schools venue, we evaluated point-of-service and sodium data from 193,232 diners served during 12 days at 28 schools during baseline data collection. During follow-up data collection, we evaluated point-of-service and sodium data from 173,087 diners served during 10 days at 29 schools. (We excluded 1 school from baseline calculations because of differences in menus, purchasing, and food preparation compared with other cafeterias in the district; at follow-up, the school had standardized its menus to match those of the other schools in the district and was included in follow-up calculations. We excluded the standalone pre-kindergarten site from both baseline and follow-up calculations because it did not have on-site lunch preparation.)

For the community meals venue, we evaluated point-of-service and sodium data from 13,319 meals served to diners during 12 days at all 5 programs during baseline data collection. During follow-up data collection, we evaluated point-of-service and sodium data from 10,136 meals served during 6 days.

We did not conduct power calculations because the evaluation 1) focused on descriptive analyses for outcomes and 2) sampled the entire population of participating entities in each venue. Statistical analyses were conducted in SPSS Statistics version 25 (IBM Corp) and Microsoft Excel version 15.0 (Microsoft Corp). Missing data were minimal, and we did not impute missing values. In the schools venue, data from only 2 (0.3%) of the 626 lunch services across the included cafeterias during the data collection periods were not recorded by cafeteria staff. In the community meals venue, no data were missing.

For each venue, we prepared data sets by aggregating all data from each entity without any weighting, allowing calculation of venue-level totals for number of diners served, mg sodium served, number of entrées offered, and other measures. For categorical or count variables, we tabulated venue-level counts and percentages. For continuous variables for which sodium mg was the unit of measure, we tabulated results as venue-level means. For example, in each venue, we calculated mean sodium mg served per diner by dividing the total sodium mg served across all participating entities during the data collection period by the number of diners served across all participating entities during the data collection period.

The evaluation was ruled exempt by UAMS's institutional review board.

Results

Schools venue

Approximately 24,000 diners (~20,000 students and ~4,000 staff members or visitors) were exposed to the sodium reduction intervention in the schools venue daily during the school year. In general, 29 of 30 schools (96.7%) implemented the sodium reduction interventions (Table 2). Across the schools venue, the amount of sodium served per lunch diner during the evaluation period decreased 11.2%, from 1,103 mg at baseline to 980 mg at follow-up (Table 3). The schools also reduced the mean sodium content of entrées offered (ie, entrées listed on the menu) from 674 mg to 625 mg (−7.3%) and entrées served from 615 mg to 589 mg (−4.2%).

The recipes of 7 (2.5%) of the schools' 277 lunch menu items were modified to reduce sodium content. For example, by using no-salt-added tortilla chips in place of regular tortilla chips, the sodium content of the taco salad entrée was reduced from 818 mg at baseline to 543 mg at follow-up, and the sodium content of the cheesy nachos entrée was reduced from 806 mg at baseline to 609 mg at follow-up. Twelve (4.3%) lunch menu items were modified through ingredient or product substitution to reduce sodium content. For example, by replacing breaded pork patties with pork patties made with a whole-grain breading that was lower in sodium, the schools reduced the sodium content of their pork sandwiches from 603 mg at baseline to 203 mg at follow-up.

Community meals venue

Approximately 3,100 unique diners per day were exposed to the sodium reduction intervention in the community meals venue during the year. Adoption of sodium reduction intervention activities varied among sites; only 2 programs implemented standardized purchasing lists with lower sodium items, but all 5 programs received newsletters of sodium reduction tips sent by UAMS (Table 2).

The amount of sodium served per diner during the evaluation period decreased 16.6%, from 1,509 mg to 1,258 mg (Table 3). From baseline to follow-up, participating community meals programs reduced the mean sodium content of meals offered (ie, meals listed on the menu) from 1,710 mg to 1,053 mg (−38.4%). Because each community meals program served identical meals to all of its diners on a given day (ie, did not allow diners choices), the amount of sodium served per diner was equivalent to the mean sodium content of meals served.

The recipes of 6 (4.1%) of the community meals programs' 148 menu items were modified to reduce sodium content. For example, one community meals program replaced canned corn with frozen corn, which reduced the sodium content of the corn from 320 mg per serving (1/2 cup) at baseline to 0 mg per serving at follow-up. Two (1.4%) menu items were modified through ingredient or product substitution to reduce sodium content. For example, one community meals program stopped purchasing ranch salad dressing and began making honey mustard dressing on site. This substitution reduced the sodium content of dressing from 260 mg per serving (2 tablespoons) at baseline to 15 mg per serving at follow-up.

Implications for Public Health

The northwest Arkansas SRCP project intervention yielded reductions in the amount of sodium served per diner during the evaluation period, reducing the amount sodium served to thousands of diners across the year in local schools and community meals programs. These results highlight the potential effectiveness of sodium reduction interventions focused on food service guidelines, procurement practices, food preparation practices, and environmental strategies for schools and community meals programs.

Overall, the evaluation findings address each SRCP evaluation question. Collectively, the findings establish evidence of the effectiveness of SRCP interventions in reducing the amount of sodium served in schools and community meals, contributing to the evidence base established by evaluations of SRCP activities in other venues in other communities (32–34). A key characteristic underlying the effectiveness of SRCP interventions is likely their comprehensive approach to sodium reduction, implicating food service guidelines, procurement practices, food preparation practices, and environmental strategies.

However, the comprehensive nature of the intervention is also a potential weakness. For example, intervention implementation was time and staff-intensive, relying on technical expertise of registered dietitians and experienced implementation staff, as well as intensive collaboration with venue personnel. Results in one community for one venue may not be easy to replicate in a similar venue in a different community. In addition, the comprehensive nature of the intervention makes it difficult to determine whether certain components of the intervention were more effective or less effective than others.

An additional limitation of the study is the evaluation approach itself. The intensive nature of negotiating access to data, data collection, and data processing for each participating site precluded the use of control groups. The lack of control groups leaves open the possibility of a general trend toward sodium reduction across schools and community meals, whether they had participated in the intervention or not. Similarly, the evaluation focused on measures of food served rather than food consumed. Although our study was designed to evaluate changes in the amount of sodium served to diners, it does not provide precise measures of the amount of sodium consumed or the ratio of sodium served to sodium consumed, which could have varied in unexpected ways from baseline to follow-up. Likewise, the decision to rely on nutrient databases rather than laboratory analysis of foods served raises the possibility of error based on discrepancies between the database entries and what was actually served to diners. However, a strength of the use of nutrient databases was that evaluation results included every food item served, which would have been prohibitively time-consuming and expensive had we used laboratory analysis.

Limitations notwithstanding, our evaluation study sampled the entire population of diners and meals served in participating schools and community meals programs and showed an 11.1% to 16.6% reduction in sodium per diner per school lunch or community meal. These percentages are consistent with health impact assessment models that predict sizeable health benefits of reduced sodium intake (15). These levels of sodium reduction suggest that SRCP's policy, systems, and environmental approaches to intervention have promise in schools and community meals programs, including those that serve racial/ethnic minority, low-income, and food-insecure populations at risk for hypertension.

Although these initial results are promising, evaluation of Years 2 to 5 of the project will demonstrate whether reduction in daily sodium intake is sustained, is improved, or erodes. In Years 2 to 5, UAMS will implement additional intervention components in both venues to promote even greater sodium reduction. For example, UAMS will implement product placement interventions in school cafeterias, moving unflavored (ie, lower-sodium) milk to the front of beverage coolers. Likewise, UAMS will offer training in knife skills and fruit and vegetable preparation to food service staff in both venues to increase feasibility of incorporating fresh, low-sodium ingredients in meals. In addition, UAMS will seek partnership opportunities to implement sodium reduction interventions with additional school districts and community meals programs and has begun work in a third venue, early childhood nutrition programs operated by the Arkansas Department of Human Services.

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Tables

Table 1. Rejected, Partially Implemented, or Delayed Intervention Activities Presented to the Food Policy Committees at Schools and Community Meals Programs Participating in the Sodium Reduction in Communities Program, Northwest Arkansas, 2016–2017

Intervention Strategies and Activities	Food Policy Committee Decision[a]	Reason for Decision
Schools		
Procurement practices to reduce sodium content		
Form a purchasing cooperative with neighboring school districts to negotiate favorable prices for lower-sodium products and ingredients	Reject	Districts were served by different vendors and had very different menus and student populations
Remove high-sodium items from the menu, including pizza and cookies	Reject	District personnel indicated that these items were popular with students
Food preparation practices to reduce sodium content of menu items and meals		
Implement recipe modifications developed by students at local center for culinary arts	Partially implement	Many proposed recipes were impractical because of expense and number of ingredients and use of uncommon or noncommodity ingredients
Increase use of fresh ingredients (eg, herbs, vegetables) to add flavor in place of salt	Delay	Food preparation staff lacked time to devote to preparing additional fresh ingredients; insufficient number of staff with sufficient knife skills
Environmental strategies that encourage reductions in dietary sodium intake		
Place posters featuring sodium reduction messages in student dining areas of cafeterias	Delay	District personnel wanted to delay implementation to generate student enthusiasm by placing posters at the beginning of a new school year
Re-order list of menu items on digital menus to highlight lower-sodium items	Delay	Staff lacked time and knowledge to reprogram digital signage
Rearrange drinks in coolers to promote lower-sodium options	Delay	Some coolers (eg, those with fixed shelving) could not be reconfigured to highlight lower-sodium options
Purchase and implement upgraded displays (eg, fruit baskets) to promote lower-sodium options	Delay	The 2015–2016 equipment purchasing cycle had ended
Community Meals Programs		
Procurement practices to reduce sodium content		
Reduce the amount of high-sodium–donated restaurant food served	Reject	Community meals programs expressed concern that they could not afford to purchase enough lower-sodium food to replace high- sodium–donated restaurant food
Replace canned vegetables at 1 program with lower-sodium frozen vegetables	Reject	Community meals program indicated it lacked sufficient freezer space (freezer space was filled with donated restaurant food)
Remove donuts from meals at 1 program	Reject	Community meals program indicated that donuts were popular with diners
Implement new lower-sodium recipes	Partially implement	Community meals programs expressed concern about the expense and difficulty of acquiring several lower-sodium ingredients from vendors and stores
Food preparation practices to reduce sodium content of menu items and meals		
Increase use of fresh ingredients (eg, herbs, vegetables) to add flavor in lieu of salt	Delay	Food preparation staff lacked time to devote to preparing additional fresh ingredients; staff lacked consistent access to low-cost fresh ingredients
Replace prepackaged salad dressings with lower-sodium dressing made on site	Reject	One community meals program indicated that salad dressing was often received as a donation, so they did not want to spend budget to make their own

[a] "Reject" indicates that the food policy committee declined to implement the activity. "Partially implement" indicates that the food policy committee implemented some components of the activity but not all. "Delay" indicates that the food policy committee decided to delay implementation of the activity until project Year 2 or later.

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Table 1. Rejected, Partially Implemented, or Delayed Intervention Activities Presented to the Food Policy Committees at Schools and Community Meals Programs Participating in the Sodium Reduction in Communities Program, Northwest Arkansas, 2016–2017

Intervention Strategies and Activities	Food Policy Committee Decision[a]	Reason for Decision
Environmental strategies that encourage reductions in dietary sodium intake		
Implement flavor stations in dining areas to replace salt shakers	Reject	Community meals programs expressed concerns about food safety and disruption of the flow of diners through the serving area while using flavor stations

[a] “Reject” indicates that the food policy committee declined to implement the activity. “Partially implement” indicates that the food policy committee implemented some components of the activity but not all. “Delay” indicates that the food policy committee decided to delay implementation of the activity until project Year 2 or later.

Table 2. Sodium Reduction Intervention Activities Implemented by Schools and Community Meals Programs Participating in the Sodium Reduction in Communities Program, Northwest Arkansas, 2016–2017

Intervention Strategies and Activities	No. (%) at Follow-Up[a]
Schools (n = 30)	
Food service guidelines that discuss sodium	
Implemented comprehensive food service guidelines that include sodium reduction standards and practices	29 (96.7)
Procurement practices to reduce sodium content	
Implemented standardized purchasing lists with lower-sodium items	29 (96.7)
Focused USDA Foods commodity orders on low-sodium or no-sodium items	29 (96.7)
Identified and purchased lower-sodium alternatives for products and ingredients	29 (96.7)
Participated in taste-tests of lower sodium ingredients for program staff	29 (96.7)
Food preparation practices to reduce sodium content of menu items and meals	
Developed and served lower sodium recipes for higher sodium entrées	29 (96.7)
Modified the menu cycle to add new lower sodium entrées	29 (96.7)
Environmental strategies that encourage reductions in dietary sodium intake	
Placed posters featuring sodium reduction messages in food preparation areas	29 (96.7)
Received monthly newsletters of sodium reduction tips sent by UAMS staff	29 (96.7)
Implemented flavor stations in junior high and high school cafeterias	7 (23.3)
Community Meals Programs (n = 5)	
Food service guidelines that discuss sodium	
Implemented comprehensive food service guidelines that include sodium reduction standards and practices	3 (60.0)
Procurement practices to reduce sodium content	
Implemented standardized purchasing lists with lower sodium items	2 (40.0)
Participated in taste-tests of lower sodium ingredients for program staff	4 (80.0)
Food preparation practices to reduce sodium content of menu items and meals	
Implemented policy to eliminate “free salting”	3 (60.0)
Developed and served recipes for lower sodium menu items that incorporate restaurant-donated foods	3 (60.0)
Environmental strategies that encourage reductions in dietary sodium intake	
Placed posters featuring sodium reduction messages in food preparation areas	3 (60.0)
Placed multilingual educational signs and dining table tents that address sodium reduction in dining areas	3 (60.0)
Received monthly newsletters of sodium reduction tips sent by UAMS staff	5 (100.0)
Moved salt shakers away from dining tables to locations across the room	3 (60.0)

Abbreviations: USDA, US Department of Agriculture; UAMS, University of Arkansas for Medical Sciences.
[a] Data were collected at each venue immediately before intervention implementation and again 10 or 11 months later. In the school district, we collected baseline data during 2 consecutive weeks of meals in December 2016 and follow-up data during 2 consecutive weeks of meals in October 2017. In the community meals program, we collected baseline data during 4 consecutive weeks of meals in January 2017 and follow-up data during 2 consecutive weeks of meals in October 2017. At baseline, none of the activities had been implemented at any of the venues.

Table 3. Baseline and 1-Year Follow-Up Outcome Measures for Sodium Reduction Interventions at Schools and Community Meals Programs Participating in the Sodium Reduction in Communities Program, Northwest Arkansas, 2016–2017

Outcomes	Baseline	Follow-Up	Percentage Change
Schools (n = 30)[a]			
Sodium per entrée offered, mg	674	625	−7.3
Sodium per entrée served, mg	615	589	−4.2
Entrées offered with ≤480 mg of sodium, no. (%)	26 (24.3)	38 (32.8)	+46.2
Sodium served per lunch diner, mg	1,103	980	−11.2
Community meals programs (n = 5)			
Sodium per meal offered, mg	1,710	1,053	−38.4
Sodium per meal served, mg	1,509	1,258	−16.6
Sodium served per diner, mg	1,509	1,258	−16.6

[a] Calculations at baseline and follow-up are based on data from 28 and 29 schools, respectively. One school was excluded at baseline because of differences in menus, purchasing, and food preparation compared with other cafeterias in the district; at follow-up, the school had standardized its menus to match those of the other schools in the district and was included in calculations. A stand-alone prekindergarten site was excluded from both baseline and follow-up calculations because it did not have on-site lunch preparation.