Systematic Review: The Value of the Periodic Health Evaluation

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Background: The periodic health evaluation (PHE) has been a fundamental part of medical practice for decades despite a lack of consensus on its value.

Purpose: To synthesize the evidence on benefits and harms of the PHE.

Data Sources: Electronic searches of such databases as MEDLINE and the Cochrane Library, review of reference lists, and hand-searching of journals through September 2006.

Study Selection: Studies (English-language only) assessing the delivery of preventive services, clinical outcomes, and costs among patients receiving the PHE versus those receiving usual care.

Data Extraction: Study design and settings, descriptions of the PHE, and clinical outcomes associated with the PHE.

Data Synthesis: The best available evidence assessing benefits or harms of the PHE consisted of 21 studies published from 1973 to 2004. The PHE had a consistently beneficial association with patient receipt of gynecologic examinations and Papanicolaou smears, cholesterol screening, and fecal occult blood testing. The PHE also had a beneficial effect on patient “worry” in 1 randomized, controlled trial but had mixed effects on other clinical outcomes and costs.

Limitations: Descriptions of the PHE and outcomes were heterogeneous. Some trials were performed before U.S. Preventive Services Task Force guidelines were disseminated, limiting their applicability to modern practice.

Conclusions: Evidence suggests that the PHE improves delivery of some recommended preventive services and may lessen patient worry. Although additional research is needed to clarify the long-term benefits, harms, and costs of receiving the PHE, evidence of benefits in this study justifies implementation of the PHE in clinical practice.


For author affiliations, see end of text.

The periodic health evaluation (PHE) has been a fundamental part of medical practice for decades, despite a lack of consensus regarding its value in health promotion and disease prevention. The PHE consists of one or more visits with a health care provider to assess patients’ overall health and risk factors for preventable disease, and it results in the delivery of clinical preventive services that are tailored to a patient’s age, sex, and clinical risk factors and laboratory testing (1). By promoting prevention and enhancing the patient–provider relationship, the PHE may improve patient outcomes and the public’s health (2). However, it could also induce unnecessary costs and patient harms by promoting the use of nonrecommended services. Early studies of the PHE, performed before the adoption of current preventive services guidelines, were costly and demonstrated minimal improvement in clinical outcomes (3, 4). Because of resulting concern over the PHE’s value, some experts have advocated for episodic, targeted delivery of preventive services in the context of ongoing clinical care (5, 6). More recent clinical trials have reported some benefits of the PHE (7–11).

Private and public health insurance coverage for preventive services in the United States has gradually increased over time, although generally for one recommended service at a time rather than for a comprehensive set of preventive services (12). Recent legislation provides coverage for a “welcome to Medicare visit” for new enrollees, incorporating a range of diagnostic and screening tests (13). Despite this legislation and continued use of the PHE, there is a lack of clear evidence demonstrating that the PHE improves patient outcomes or reduces health care costs.

In light of conflicting opinions regarding the PHE’s impact on health and health care costs and nonuniformity on its implementation, we performed a systematic review of the evidence to ascertain the PHE’s benefits and harms with regard to patient outcomes and health care costs.

Methods

Study Design

We performed a systematic review for the Evidence-Based Practice Center Program of the Agency for Healthcare Research and Quality (AHRQ). A review of evidence identifying the value of the PHE was initially nominated to the AHRQ by the American College of Physicians. We developed a conceptual model to help define the PHE and its potential benefits and harms, identified relevant studies that assessed benefits and harms of the PHE, extracted data, assessed individual study quality, and synthesized the evidence.

Conceptualization of the PHE

In the absence of standard definitions of the PHE, we developed a conceptual framework to guide our assessment of the value of the PHE by 1) identifying the potential
Figure 1. Conceptual framework developed to guide assessment of the value of the periodic health evaluation.

Goals and Expectations of Patients, Providers, and Society
- Promote patient and family health
- Detect early, subtle symptoms and asymptomatic illness
- Prevent patient morbidity and mortality
- Educate patients about problems for which they are at risk
- Educate patients about appropriate utilization of the health care system
- Facilitate patient—health professional relationship
- Facilitate patient—health care organization relationship
- Identify opportunities for early intervention in disease
- Improve public health

Periodic Health Evaluation
- Personal and family history
- Risk assessment
- Tailored physical examination

Delivery of Clinical Preventive Services
- Same-day clinical preventive services
  - Delivered as part of physical examination
  - (e.g., Pap smear)
  - Counseling
  - Immunizations
  - Laboratory testing
- Follow-up clinical preventive services
  - Testing (e.g., colonoscopy, mammography)

Effect modifiers
- Provider characteristics
- System characteristics

Other benefits and harms of the periodic health evaluation from patient, provider, and societal perspective
- Patient attitudes
  - Knowledge
  - Guidelines
  - System Use
  - Satisfaction
- Behavioral
  - Change in health habits (e.g., smoking)
  - Motivation to improve habits (e.g., stage of change)
  - Self-efficacy
- Clinical
  - Proximal (e.g., blood pressure control)
  - Distal (e.g., cardiovascular events, death)
- Resource use and costs
  - Ambulatory visits
  - Emergency department use
  - Hospitalization
- Public health
  - Family health
  - Communicable disease containment

Pap = Papanicolaou.

goals, benefits, and harms of the PHE and 2) clarifying how the PHE might be consistently identified in the published literature. In this framework, patient, provider, and societal goals of the PHE could include the promotion of personal and family health, patient education, and improvement of public health. The PHE itself could lead to the delivery of appropriate (potential benefit) or inappropriate (potential harm) clinical preventive services and could lead to other potential benefits and harms, such as changes in patient attitudes and behaviors, improvement or worsening of clinical outcomes, decreases or increases in health system resource use and costs, and improvements or decrements in public health. Both health care provider and health system characteristics could modify the effect of PHE on outcomes (Figure 1).

Definition of the PHE and Usual Care

Because the PHE is tailored to individual patients and is thus delivered in a highly heterogeneous fashion on the basis of clinical resources available to different health care providers, we sought to develop a definition that could be widely applied to a majority of clinical practice environments, regardless of patient populations, health care delivery settings, or resource constraints. We also used a preliminary review of representative studies to help define the PHE in a manner that would allow us to identify the
broadest selection of studies assessing its value. We defined the PHE as one or more visits with a health care provider for the primary purpose of assessing patients’ overall health and risk factors for disease that may be prevented by early intervention. Our definition specified the PHE as consisting only of the history, risk assessment, and a tailored physical examination that could lead to the delivery of preventive services. According to our definition, the PHE did not include the delivery of clinical preventive services that patients could receive during or after their visit for the PHE and that we considered an outcome of the PHE. For instance, a 50-year-old woman receiving a PHE would undergo a detailed history, risk assessment, and physical examination (which could include a gynecologic examination). Under our definition, the delivery of clinical preventive services provided both during that visit (such as counseling to stop smoking and a Papanicolaou [Pap] smear) and outside of the visit (such as mammography or colonoscopy) were considered to be a result of the PHE (history, risk assessment, and physical examination) and not part of the PHE.

We defined “usual care” as the delivery of clinical preventive services in the absence of a health care provider visit designated for the primary purpose of assessing pa-
patients’ health and risk factors for disease. Under this definition, preventive services were considered to have been delivered opportunistically (that is, in the setting of a health care provider visit designated for the ongoing care of chronic illnesses or other acute illnesses).

Identification of Relevant Studies

We searched MEDLINE, the Cochrane Libraries, the Health Technology Assessment Database (HTA), the National Health System Economic Evaluation Database (NHS EED), and the Cumulative Index of Nursing and Allied Health Literature (CINAHL) for studies published through September 2006 that compared the PHE with usual care and assessed benefits and harms of the PHE. Examples of search terms included periodic physical examination, periodic health evaluation, annual physical examination, annual check up, multiphasic screening, multiphasic health testing, preventive screening, preventive services, and well care visits. To identify studies that our search strategy might have missed, we reviewed reference lists of relevant articles, and we hand-searched tables of contents of 24 periodicals in general medicine, preventive medicine, and public health. Titles and abstracts deemed potentially relevant were further reviewed if either of 2 reviewers did not exclude them. For articles promoted to abstract review, 2 investigators independently reviewed abstracts and excluded them if they 1) had no useful information applying to the benefits or harms of the PHE, 2)
were not written in English, 3) included participants 18 years or younger, 4) contained no original data, or 5) had no comparison group. We included observational studies as well as randomized, controlled trials (RCTs). Reviewers were paired randomly at all stages.

**Data Extraction**

Two reviewers sequentially abstracted data for each article, including information on the studies’ designs, locations and settings, dates of performance, follow-up length, enrollment, eligibility criteria, participant characteristics, components of the PHE, interventions, and outcomes. Data were abstracted to capture changes in the delivery (by health care providers) or receipt (by patients) of recommended preventive services as a result of the PHE, including the delivery of recommended aspects of the physical examination (such as blood pressure measurement and gynecologic examination), counseling (such as substance abuse counseling), immunizations (such as influenza vaccination), and screening tests (such as cholesterol testing). Data were also abstracted regarding changes in patient attitudes and perceptions as a result of the PHE (such as knowledge and satisfaction), patient behavioral outcomes (such as rates of tobacco cessation), proximal or intermediate clinical outcomes (such as cholesterol lowering and disease detection), distal clinical outcomes (such as death), economic outcomes (such as cost and

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health care utilization), and public health outcomes (such as containment of communicable disease).

**Study Quality Assessment**

Two reviewers independently judged each study’s quality on several aspects of external and internal validity, including descriptions of 1) inclusion and exclusion criteria for participants, 2) participants’ baseline characteristics, 3) nonenrollees, 4) handling of withdrawals, 5) the intervention, 6) adequacy of length of follow-up, 7) participant attrition, 8) outcomes, 9) relevancy and appropriateness of outcomes, 10) quality of outcomes assessment, 11) quality of randomization for RCTs, 12) quality of blinding for RCTs, 13) similarities and differences in the management of study groups for RCTs, 14) comparable characteristics of enrolled participants for control and treatment groups for RCTs, and 15) statistical analysis. For both experimental and observational studies, we applied a total quality score based on work by Chalmers and colleagues (14).

**Evidence Synthesis**

We synthesized findings from multiple studies by assessing the quantity, quality, and consistency of the “best available evidence” on the benefits and harms of the PHE. We adapted an evidence-grading scheme recommended by the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) Working Group (15). The GRADE classification scheme incorporates a systematic approach toward assessing the entire body of literature on specific outcomes in which “points” are assigned to (or...
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subtracted from) scores for each body of evidence, based on prespecified criteria, including assessments of individual study quality, evaluation of the consistency of the direction of results reported on specific outcomes, handling of plausible confounders across all studies evaluating an outcome, the strength of the associations between the PHE and outcomes, and the directness of evidence linking the PHE to outcomes across all studies. In assigning GRADE classifications, study members reviewed the evidence on each outcome as a group, and final GRADE classifications were arrived at by group consensus (16). We considered the best available evidence for each outcome to consist of at least 2 RCTs or at least 2 observational studies with designs least likely to present biased findings (cohort studies [considered best], followed by cross-sectional studies and studies with pre–post observational design [considered worst]). A GRADE classification of “high” signified that further research would be unlikely to alter our conclusions regarding the association of the PHE with outcomes, “medium” signified that further research could alter our conclusions, “low” signified that further research would be very likely to alter our conclusions, and “very low” signified that further research would alter our conclusions.

Assessing the Magnitude of Effect of the PHE on Outcomes

To quantify the magnitude of the effect of the PHE on outcomes in a standard way among studies reporting a variety of heterogeneous outcomes (for example, percentage of persons receiving clinical preventive services in some studies vs. mean changes in clinical measures [such as blood pressure] in other studies), we calculated the Cohen’s d effect size estimate (95% CI) for mean differences and differences in proportions among all RCTs. We then classified effects as small, intermediate, or large effects by using standard criteria (Appendix Table, available at www.annals.org) (17). We considered evidence to show a clear beneficial effect of the PHE when the investigators reported that the PHE consistently resulted in greater benefits or a reduction in harms compared with usual care in all studies assessing that outcome. We considered evidence to show a clear harmful effect of the PHE when investigators reported that the PHE consistently resulted in fewer benefits, more harms, or a smaller reduction in harms compared with usual care in all studies assessing that outcome. We considered evidence to have no effect when findings were consistently neutral (that is, the 95% CI of the estimate of reported effects included 0). We considered evidence to show a mixed effect of the PHE when investigators of some studies assessing the PHE reported beneficial effects while others reported harmful or no effects.

Role of the Funding Source

Technical experts from the funding source (AHRQ) provided guidance regarding all aspects of the conduct of the review.

RESULTS

Yield of Literature Search and Identified Studies

We screened 7039 articles for eligibility at the title review level and reviewed 2103 at the abstract level. Of these, 50 articles were eligible for full review, representing 33 studies (10 RCTs [5–11, 18, 19, 21] and 23 observational studies [20, 22–43]) reporting on the benefits or harms of the PHE (Figure 2).

Definitions of the Adult PHE in Studies of Its Value

Definitions of the PHE were heterogeneous within studies. While central elements used to define the PHE in studies included the clinical history and risk assessment of patients as well as a physical examination, the specific composition of these central elements varied among studies.
The most frequently cited types of history and risk assessment performed were assessment of alcohol or substance abuse, tobacco smoking, and dietary risks; the least frequently cited types of risk assessment included assessment of calcium and folic acid intake (Table 1). Reports of almost two thirds of studies mentioned the physical examination element of the PHE but did not identify the components. In the remaining one third of studies, the most frequently cited components were assessment of blood pressure, weight, and height; breast examination; gynecologic examination; and rectal examination. The least frequently cited components included neurologic and foot examinations (Table 2). With the exception of studies reporting on the joint delivery of the gynecologic examination or Pap smear as part of the definition of the PHE, no studies included the delivery of clinical preventive services (for example, counseling, immunization, or preventive testing) as part of their description of the PHE.

**Design and Setting of Identified Studies**

Overall, the literature was characterized by complexity and heterogeneity in several dimensions. Among the 33 eligible studies, 10 were RCTs, 8 were cohort studies (2 retrospective), 12 were cross-sectional, and 3 featured pre–post comparisons of patients before and after undergoing a PHE. Studies were conducted over a period of several decades, with nearly one third performed before 1989. While more than two thirds of studies were performed in the United States, we also identified relevant studies from the United Kingdom, Canada, Taiwan, Japan, Denmark, and Sweden. Practice settings for the studies were diverse, with studies taking place in private offices, academic practices, hospital outpatient clinics, and other settings. Studies reflected a range of health care systems.

### Best Available Evidence of Benefits and Harms of PHE Compared with Care without a PHE

Ten RCTs, 2 cohort studies, and 9 cross-sectional studies constituted the best available evidence on benefits and harms of the PHE. These studies were published between 1973 and 2004 and reported on a wide range of outcomes, including delivery of preventive services, proximal clinical outcomes, and distal clinical outcomes. Studies not included among the best available evidence were observational studies (cohort studies, cross-sectional studies, and studies with pre–post designs) deemed to contribute more biased estimates than the best available evidence for...
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Review

Summary of Results from the Best Available Evidence on Benefits and Harms of the PHE

Delivery of Clinical Preventive Services

Four RCTs (7, 9, 19, 44) and 10 observational studies (26, 27, 29, 30, 32, 35, 36, 39, 41, 42) assessed delivery of clinical preventive services as a result of the PHE. The overall GRADE classification of the evidence assessing these outcomes ranged from low to high. Evidence on gynecologic examination or Pap smear and fecal occult blood screening received a high rating, evidence on immunizations and cholesterol screening received a medium rating, and evidence on counseling and mammography receiving a low rating. The PHE had a beneficial association with receipt of gynecologic examinations or Pap smears, cholesterol screening, and fecal occult blood testing (greater rates of delivery of these clinical preventive services in persons undergoing the PHE than in those not undergoing the PHE) and had mixed effects on other clinical preventive services (Table 3).

Proximal Clinical Outcomes

Six RCTs (3, 7, 8, 10, 11, 18, 44, 45) and 1 observational study (33) assessed the association of the PHE with proximal clinical outcomes. Outcomes ranged from disease detection to changes in patient health habits, attitudes, and clinical measures (including blood pressure, serum cholesterol, and body mass index) as a result of the PHE. The overall GRADE classification of the evidence assessing these outcomes ranged from low to high. Evidence on serum cholesterol received a low rating; evidence on disease detection, health habits, patient attitudes, health status, and body mass index received a medium rating; and evidence on blood pressure received a high rating. The PHE had a beneficial effect on patient worry in 1 RCT (7) (less increase in patient worry over time among persons undergoing the PHE than in those not undergoing the PHE), but associations between the PHE and other proximal clinical outcomes were mixed (Table 3).

Distal Economic and Clinical Outcomes

Five RCTs (3, 4, 9, 10, 21, 46–48) assessed distal economic and clinical outcomes resulting from the PHE. Outcomes included costs, disability, hospitalization, and mortality. The overall GRADE classification of the evidence assessing these outcomes ranged from medium to high. Evidence on costs, disability, and mortality received a medium rating, while evidence on hospitalization received a high rating. The PHE was found to have mixed effects on all distal economic and clinical outcomes (Table 3).

Discussion

The best available evidence suggests that patients benefit from the PHE through its association with improved delivery of some recommended clinical preventive services and through reduction of patient worry. The available evidence does not reveal harms associated with the PHE. Given that short- and long-term studies have shown that appropriate implementation of currently recommended preventive services improves health in short and long-term studies (49) and that elimination of worry or concern regarding illness may represent a powerful motivator for action on the part of patients (50–56), our findings provide health care providers and payers with justification for the continued implementation of the PHE.

Mechanisms through which improvements in care attributed to the PHE occur are unclear, as studies were highly heterogeneous in terms of content of the PHE and their institution of additional interventions to enhance delivery of the PHE. Regardless of the specific components included, the PHE may provide clinicians time to consider preventive care more fully, thus leading to their instituting preventive measures more frequently (57). It is possible that the PHE has a stronger effect on improving the delivery of preventive services that are performed by clinicians at the time of the office visit (such as gynecologic examinations and Pap smears) than on preventive services that require patients to schedule appointments outside of the initial office visit for the PHE, which might also be affected by patient adherence or system failures (58). By providing an opportunity for both patients and physicians to contemplate and discuss potential risks, the PHE could also provide a vehicle through which patient worries can be more fully elucidated from patients and addressed. Findings of clear benefits of the PHE despite great study heterogeneity could provide clinicians with confidence that the PHE may confer benefits in their own practices. Nevertheless, clinicians should use individual judgment regarding the optimal way in which the PHE is implemented given the logistics in their practices and resource constraints.

Several gaps in the identified literature are notable and lay the foundation for future research aimed at further elucidating the value of the PHE. The PHE was delivered heterogeneously and with varying levels of intensity in studies. Such heterogeneity prohibited any determination of what might constitute an adequate PHE to achieve benefits. Randomized trials comparing the effect of different characteristics of the PHE on clinical outcomes, including...
variations in the frequency and intensity of specific components of the PHE, are needed. Studies comparing the effect of the PHE in varying patient populations and systems of care are also needed to elucidate who will best benefit from the PHE. Evidence was mixed with regard to most short- and long-term clinical outcomes reported in the literature. Well-performed, long-term clinical trials are needed to identify whether the PHE can consistently improve intermediate (for example, patient attitudes, health status serum cholesterol, blood pressure) and long-term clinical outcomes (for example, hospitalization, costs, or death) in contemporary medical settings, to characterize the effect of the PHE on the patient–physician relationship, and to assess the effect of the PHE on broad societal outcomes, such as disease containment in populations. Large-scale trials could be costly and potentially unable to capture long-term effects of the PHE on such outcomes as costs and mortality because of multiple competing factors affecting these outcomes (for example, changes in medical technologies and their demonstrated benefits over time); however, the development of computerized models to simulate trajectories of quality of life, the development of morbidity and mortality, and impacts on direct and indirect costs as a result of the PHE are needed.

Limitations of this synthesis and the literature deserve mention. First, although we based our definition of the PHE on a conceptual model that provided context for assessing its value to patients, providers, and society, our definition was also based partially on our desire to broadly identify studies assessing the value of the PHE. Thus, our definition could be construed as allowing so much heterogeneity in the PHE among identified studies as to obscure definitions that might be commonly used among clinicians. For instance, many health care providers may consider the delivery of clinical preventive services to be part of—and not a result of—the PHE. Clinicians believing this to be the case might perceive that this review “misses the point” of the PHE, by parsing out important parts of the evaluation itself. While this is a valid and important consideration, the heterogeneity in studies we reviewed reflects considerable disagreement within the medical community about what elements should be considered essential to the PHE. In addition, a majority of studies identified receipt of preventive health services as an outcome of the PHE and not a part of the PHE. Furthermore, our definition of the PHE facilitated a comprehensive identification of studies assessing its value and provided for a broad assessment of many potential benefits and harms resulting from the PHE. It is possible, however, that heterogeneity in the PHE among studies could limit inferences regarding which aspects of the PHE are most influential on some outcomes.

Second, some of the largest trials assessing the PHE were performed among select populations before publication of USPSTF guidelines in 1989, which may limit their generalizability to current clinical practice. Heterogeneity among studies’ reported outcomes prevented a systematic analysis of any potential time trends.

Third, the feasibility of isolating the effect of the PHE on long-term outcomes is unclear given the periodic (or one-time) delivery of the PHE in studies and given multiple other episodes of patient care that typically occur outside of the PHE. In one study, follow-up was as long as 20 years, with minimal analysis of potential competing causes of long-term outcomes, limiting the ability to identify a durable effect of the PHE (59).

Notwithstanding these limitations, our review provides a systematic appraisal of the literature identifying the value of the PHE to date, which could serve as an important foundation for clinical practice policies and future research in this area.

In summary, this systematic review demonstrated that the PHE has a beneficial effect on the delivery of some clinical preventive services and may have a beneficial effect on patient worry, providing justification for its continued implementation in clinical practice. Further research is needed to clarify the long-term benefits, harms, and costs of undergoing the PHE and to weigh the value of receiving clinical preventive services and worry relief in the absence of evidence demonstrating such long-term clinical benefits. Notwithstanding this, current evidence demonstrating clear benefits of the PHE despite heterogeneity in the literature could provide clinicians with confidence that the PHE may confer similar benefits in their own practices while they use individual judgment regarding the optimal way to implement the PHE.

From the Welch Center for Prevention, Epidemiology and Clinical Research, Johns Hopkins School of Medicine, and Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland.

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Appendix Table. Effect Sizes in Randomized, Controlled Trials by Outcome Assessed*

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<th>Outcomes</th>
<th>In Studies with Positive Effect of PHE**</th>
<th>In Studies with Negative Effect of PHE**</th>
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<th>Reference for Which Effect Size Could Not Be Calculated§</th>
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<td>Receipt of Papancocoalou smear</td>
<td>1.71 (1.69 to 1.73) (9)</td>
<td>0.07 (0.07 to 0.07) (44)</td>
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<td>Preventive counseling</td>
<td>1.09 (1.08 to 1.11) (19)**</td>
<td>1.19 (1.17 to 1.21) (19)**</td>
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<td>Immunizations</td>
<td>0.35 (0.33 to 0.36) (9)c</td>
<td>0.10 (0.10 to 0.10) (7)d</td>
<td>−0.22 (−0.24 to −0.20) (19)e</td>
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<td>Cholesterol screening</td>
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<td>Colon cancer screening</td>
<td>1.19 (1.17 to 1.21) (9)</td>
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<td>Mamnography</td>
<td>0.14 (0.12 to 0.16) (9)</td>
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<td>Disease detection</td>
<td>0.03 (0.02 to 0.03) (3)†</td>
<td>0.96 (0.84 to 1.08) (18)†</td>
<td>−0.01 (−0.01 to −0.01) (3)†</td>
<td>−0.01 (−0.01 to 0.00) (3)k</td>
</tr>
<tr>
<td>Health habits</td>
<td>0.28 (0.14 to 0.42) (8)†</td>
<td>0.120 (0.117 to 0.123) (7)m</td>
<td>−0.040 (−0.043 to −0.037) (7)n</td>
<td>0.000 (−0.14 to 0.14) (8)hb</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>0.13 (0.06 to 0.19) (11)†</td>
<td>0.040 (0.037 to 0.043) (7)n</td>
<td>−0.014 (−0.016 to −0.012) (3)†</td>
<td>0.01 (−0.13 to 0.15) (8)ec</td>
</tr>
<tr>
<td>Changes in serum cholesterol levels</td>
<td>0.345 (0.342 to 0.348) (7)n</td>
<td>0.080 (0.077 to 0.083) (7)p</td>
<td>−0.02 (−0.03 to −0.02) (45)mm</td>
<td>0.02 (−0.12 to 0.16) (8)ed</td>
</tr>
<tr>
<td>Body mass index</td>
<td>0.020 (0.017 to 0.023) (7)n</td>
<td>0.100 (0.098 to 0.102) (11)j</td>
<td></td>
<td>0.05 (−0.09 to 0.19) (8)es</td>
</tr>
<tr>
<td>Reduction in health care costs</td>
<td>0.020 (0.017 to 0.023) (7)n</td>
<td>0.032 (0.030 to 0.034) (11)j</td>
<td></td>
<td>0.01 (−0.13 to 0.15) (8)fh</td>
</tr>
<tr>
<td>Patient attitudes</td>
<td>0.988 (0.886 to 0.990) (11)a</td>
<td>0.244 (0.242 to 0.246) (11)h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood pressure</td>
<td>0.13 (0.11 to 0.14) (45)§</td>
<td>0.250 (0.248 to 0.252) (11)j**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health status</td>
<td>0.03 (0.02 to 0.21) (8)ife</td>
<td>0.11 (0.04 to 0.16) (11)ife</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changes in serum cholesterol levels</td>
<td>0.13 (0.06 to 0.19) (11)ife</td>
<td>0.022 (0.019 to 0.024) (11)ife</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body mass index</td>
<td>0.087 (0.022 to 0.153) (11)ife</td>
<td>0.032 (0.030 to 0.034) (11)ife</td>
<td>−0.020 (−0.023 to −0.017) (7)ife</td>
<td>0.031 (−0.170 to 0.108) (8)ife</td>
</tr>
<tr>
<td>Reduction in health care costs</td>
<td>0.09 (0.09 to 0.10) (11)ime</td>
<td>0.05 (0.04 to 0.06) (11)ime</td>
<td>−0.03 (−0.03 to 0.03) (8)ime</td>
<td>0.036 (−0.174 to 0.103) (8)ime</td>
</tr>
<tr>
<td>Reduction in disability</td>
<td>0.02 (0.00 to 0.01) (3)irv</td>
<td>0.01 (0.00 to 0.01) (3)irv</td>
<td>−0.014 (−0.016 to −0.012) (3)irv</td>
<td>0.02 (−0.07 to 0.11) (9)irv</td>
</tr>
<tr>
<td>Reduction in hospitalizations</td>
<td>0.06 (0.05 to 0.06) (10)irc</td>
<td>0.04 (0.004 to 0.005) (4)ircc</td>
<td>−0.03 (−0.04 to −0.03) (7)ircc</td>
<td>−0.04 (−0.13 to 0.05) (9)ircc</td>
</tr>
<tr>
<td>Reduction in all-cause mortality</td>
<td>0.004 (0.004 to 0.005) (4)irddd</td>
<td>−0.002 (−0.003 to −0.003) (3)irddd</td>
<td>Rate ratio</td>
<td>1.03 (0.94 to 1.14) (21)</td>
</tr>
</tbody>
</table>

* PHE = periodic health evaluation.
† Magnitude and direction of effect of receipt of PHE on outcome, based on standardized effect sizes calculated by using the Cohen d statistic. We considered effect sizes ranging from 0 to 0.25 to represent small effects, those ranging from 0.26 to 0.8 to represent intermediate effects, and those greater than 0.8 to represent large effects. Effect sizes can be thought of as the average percentile standing of the average treated (or experimental) participant relative to the average untreated (or control) participant. An effect size of 0.0 indicates that the mean of the treated group is at the 50th percentile of the untreated group. An effect size of 0.25 indicates that the mean of the treated group is at the 75th percentile of the untreated group.
‡ The same studies reported on multiple outcomes. Where a letter superscript is indicated next to a citation, additional information regarding the reported outcome is listed here: a: smoking cessation; b: alcohol abuse; e: influenza vaccination; d: influenza vaccination; c: influenza vaccination; f: ischemia on electrocardiogram; g: detection of “all problems” before and after intervention; h: disease detection of “important problems” before and after intervention; i: angina; j: bronchitis symptoms; k: high diastolic blood pressure; l: fiber servings per day; m: physical activity; n: diet (fat and fiber); o: advance directives; p: breast self-examination; q: smoking; r: alcohol use; s: smoking; t: alcohol use; u: exercise less than once per month; v: use full-cream milk; w: use butter or hard margarine; x: smoking; y: seat belt use; z: percentage still smoking; aa: problem alcohol drinking; bb: fat servings per week; cc: salt use; dd: caffeine drinks per day; ee: stretching minutes per week; ff: consumption of cruciferous foods; gg: mean systolic blood pressure at 12 months’ follow-up; hh: systolic blood pressure at 3 years’ follow-up; ii: diastolic blood pressure at 3 years’ follow-up; jj: proportion of high-risk diastolic pressure (≥100 mm Hg) at 3 years’ follow-up; kk: mean diastolic blood pressure at 12 months’ follow-up; ll: mean total cholesterol at 3 years’ follow-up; mm: proportion with “high risk” cholesterol level (≥8 mmol/L) at 3 years’ follow-up; nn: mean body mass at 3 years’ follow-up; oo: proportion of participants with body mass index ≥30 kg/m²; pp: at risk for obesity at 24 months’ follow-up; qq: mean body mass index at 24 months’ follow-up; rr: mean body mass index at 48 months’ follow-up; ss: 3-year postintervention cumulative Medicare reimbursements; uu: disability at 11 years’ follow-up; vv: hospitalizations; ww: hospital days per enrollee; xx: admissions per enrollee; yy: mean inpatient days for the intervention and control groups who had a hospital discharge in that year (year 1); zz: mean inpatient days (year 2); aa: hospital discharges per 1000 (year 1); bb: hospital discharges per 1000 (year 2); cc: deaths; dd: deaths, rate per 1000 persons at 16 years; ee: mortality at 48 months’ follow-up; ff: mortality rate per 1000 person-years at risk.
§ Standardized effect size could not be calculated for the study or some studies assessing this outcome.