

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.

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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

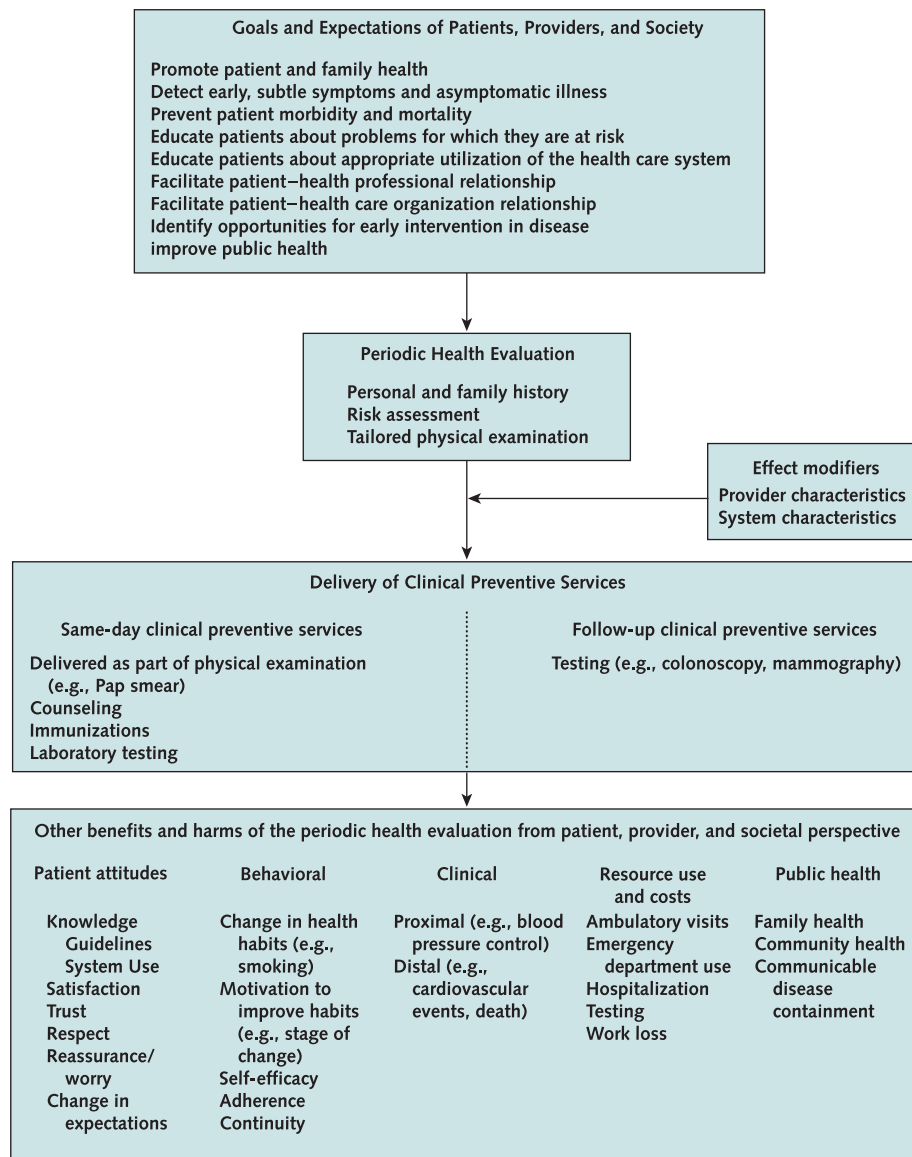
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Appendix Table

Conversion of figures and tables into slides

Figure 1. Conceptual framework developed to guide assessment of the value of the periodic health evaluation.



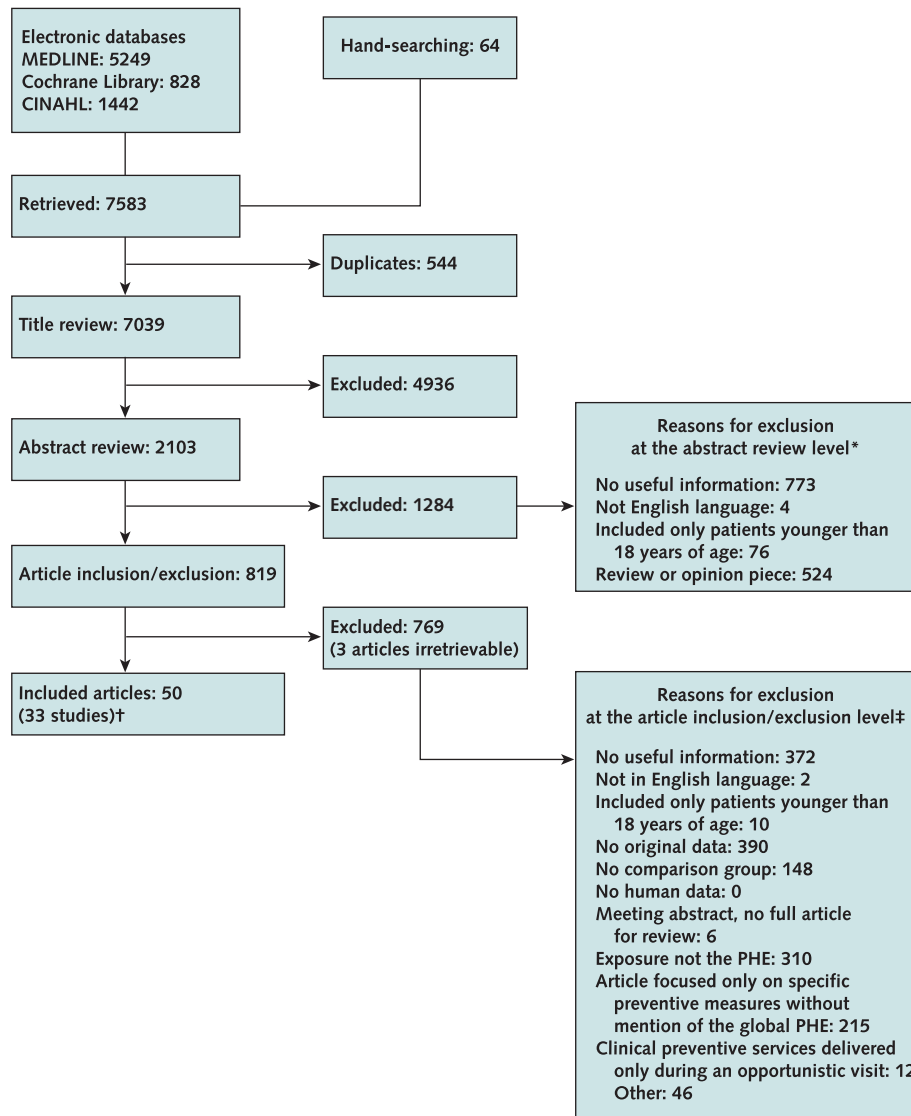
Pap Papanicolaou.

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

Figure 2. Summary of literature search and review process (number of articles).


*Total may exceed 1284; several reasons for exclusion at the abstract level were allowed. †A total of 50 articles were included in the data abstraction. These 50 articles represented 33 studies that reported multiple outcomes and multiple follow-ups. ‡Total may exceed 769; several reasons for exclusion at the article inclusion/exclusion review level were allowed. CINAHL Cumulative Index of Nursing and Alliance Health Literature; PHE periodic health evaluation.

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-

Table 1. Components of Risk Assessment Described as Part of Periodic Health Evaluation in 33 Studies Included in Literature Review

Component of Risk Assessed	Study, Year (Reference)							
	Observational Studies							
	Grimaldi, 1965 (22)	Roberts et al., 1969 (23)	Slesinger et al., 1976 (24)	Geiger et al., 1993 (25)	Nakanishi et al., 1996 (20)	Kottke et al., 1997 (26)	Sox et al., 1997 (27)	Bernacki et al., 1998 (28)
Diet							√	
Physical activity								
Substance abuse								
Injury prevention								
Safe sexual practice								
Tobacco smoking						√		
Calcium intake								
Folic acid								
Sun exposure								
Oral health								
Medications/polypharmacy								
Not otherwise specified	√	√	√	√	√			√

tients' 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)

Table 2. Components of Physical Examination Described as Part of Periodic Health Evaluation in 33 Studies Included in Literature Review

Component of Physical Examination	Study, Year (Reference)							
	Observational Studies							
	Grimaldi, 1965 (22)	Roberts et al., 1969 (23)	Slesinger et al., 1976 (24)	Geiger et al., 1993 (25)	Nakanishi et al., 1996 (20)	Kottke et al., 1997 (26)	Sox et al., 1997 (27)	Bernacki et al., 1998 (28)
Blood pressure			√		√	√		
Height								
Weight								
Pulse								
Cardiovascular								
Pulmonary								
Abdominal								
Neurologic								
Breast					√	√	√	
Gynecologic					√	√	√	
Rectal								
Prostate	√							
Foot								
Funduscopy								
"Examination," not otherwise specified	√	√	√	√	√			√
Other*				√				

* For example, vision testing, tonometry, and audiometry.

Table 1—Continued

Study, Year (Reference)									
Observational Studies									
Williams et al., 1998 (29)	Hahn, 1999 (30)	Freedman et al., 2000 (31)	Stange et al., 2000 (32)	Hama et al., 2001 (33)	Nutting et al., 2001 (34)	Parchman and Byrd, 2001 (35)	Tao et al., 2001 (36)	Burton et al., 2002 (37)	Chiou and Chang, 2002 (38)
		√	√					√	
		√						√	
		√	√					√	
		√	√					√	
		√	√					√	
		√						√	
			√					√	
			√					√	
								√	√
√	√			√	√	√	√	√	

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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 recom-

mended 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

Table 2—Continued

Study, Year (Reference)									
Observational Studies									
Williams et al., 1998 (29)	Hahn, 1999 (30)	Freedman et al., 2000 (31)	Stange et al., 2000 (32)	Hama et al., 2001 (33)	Nutting et al., 2001 (34)	Parchman and Byrd, 2001 (35)	Tao et al., 2001 (36)	Burton et al., 2002 (37)	Chiou and Chang, 2002 (38)
		√	√	√		√	√	√	√
			√	√				√	√
			√	√				√	√
								√	√
				√				√	√
								√	√
√			√				√	√	√
√							√	√	√
							√	√	√
							√	√	√
√	√				√	√		√	√
		√	√	√			√	√	√

Continued on following page

Table 1—Continued

Study, Year (Reference)									
Observational Studies					Trials				
Finkelstein, 2002 (39)	Schneider et al., 2003 (40)	Flocke and Stange, 2004 (41)	Lin et al., 2004 (42)	Somkin et al., 2004 (43)	Cutler et al., 1973 (6)	Fletcher et al., 1977 (18)	Stone et al., 1981 (5)	Belcher, 1990 (19)	Burton et al., 1995 (10)
	√	√							√
		√							√
	√	√						√	√
	√	√							√
	√	√						√	√
		√							√
									√
									√
√			√	√	√	√	√		√

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

Table 2—Continued

Study, Year (Reference)									
Observational Studies					Trials				
Finkelstein, 2002 (39)	Schneider et al., 2003 (40)	Flocke and Stange, 2004 (41)	Lin et al., 2004 (42)	Somkin et al., 2004 (43)	Cutler et al., 1973 (6)	Fletcher et al., 1977 (18)	Stone et al., 1981 (5)	Belcher, 1990 (19)	Burton et al., 1995 (10)
						√	√	√	√
						√	√		√
	√					√	√		√
									√
							√		√
								√	√
						√	√		√
						√	√		√
									√
									√
									√
									√
√	√	√	√	√	√				√
						√	√	√	√

Table 1—Continued

Study, Year (Reference)				
Trials				
Elder et al., 1995 (8)	Morrissey et al., 1995 (9)	Nakanishi, 1996 (20)	Theobald, 1998 (21)	Patrick, 1999 (7)
√				√
√	√			√
√	√			√
√				√
√	√			√
	√			
		√	√	√

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

Table 2—Continued

Study, Year (Reference)				
Trials				
Elder et al., 1995 (8)	Morrissey et al., 1995 (9)	Nakanishi, 1996 (20)	Theobald, 1998 (21)	Patrick, 1999 (7)
	√	√		
	√			
	√			
	√			
	√	√		
	√	√		
	√			
	√		√	
√		√	√	√
	√		√	

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 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.

Table 3. Summary of Results from Best Available Evidence to Assess Each Outcome*

Outcome	Type of Evidence Considered (Studies, n)	GRADE Classification†	Effect (Range of Magnitude) of PHE on Outcome‡
Delivery of clinical preventive services			
Gynecologic examination/ Papanicolaou smear	RCTs (2)	High	Beneficial (small to large)
Counseling	RCTs (1) Observational (6)	Low	Mixed
Immunizations	RCTs (3)	Medium	Mixed
Cholesterol screening	RCTs (1) Observational (4)	Medium	Beneficial (small to large)
Colon cancer screening (fecal occult blood testing)	RCTs (2)	High	Beneficial (large)
Mammography	RCTs (1) Observational (1)	Low	Mixed
Proximal clinical outcomes			
Disease detection	RCTs (2)	Medium	Mixed
Health habits	RCTs (5)	Medium	Mixed
Patient attitudes (worry)	RCTs (1)	Medium	Beneficial§
Health status	RCTs (2)	Medium	Mixed§
Blood pressure	RCTs (2)	High	Mixed
Serum cholesterol	RCTs (1) Observational (1)	Low	Mixed
Body mass index	RCTs (3)	Medium	Mixed
Distal economic and clinical outcomes			
Costs	RCTs (4)	Medium	Mixed
Disability	RCTs (2)	Medium	Mixed
Hospitalization	RCTs (3)	High	Mixed
Mortality	RCTs (5)	Medium	Mixed

* GRADE Grading of Recommendations, Assessment, and Evaluation; Observational studies with observational design; PHE periodic health evaluation; RCT randomized, controlled trial.

† Adapted from the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) Working Group.

‡ 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 58th percentile of the untreated group. An effect size of 0.8 indicates that the mean of the treated group is at the 79th percentile of the untreated group.

§ Standardized effect size could not be calculated for the study or some studies assessing this outcome.

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

each outcome. The full evidence report (16) describes these studies in detail.

Overall, the strength and consistency of the evidence varied widely among outcomes, as did the magnitude and direction of results. Nearly half of studies reported on multiple outcomes: Twelve studies reported on 1 outcome; 9 studies reported on 2 or more outcomes. The full evidence report produced for AHRQ contains details of results from the 21 studies that provided the best available evidence, including scores for specific criteria and overall grades on the strength and consistency of the evidence (16). Data on effect size estimates can be viewed in the **Appendix Table** (available at www.annals.org).

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.

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References

1. Periodic health examination: a guide for designing individualized preventive health care in the asymptomatic patients. Medical Practice Committee, American College of Physicians. *Ann Intern Med.* 1981;95:729-32. [PMID: 7305155]
2. Merenstein D, Daumit GL, Powe NR. Use and costs of nonrecommended tests during routine preventive health exams. *Am J Prev Med.* 2006;30:521-7. [PMID: 16704947]
3. South-East London Screening Study Group. A controlled trial of multiphasic screening in middle-age: results of the South-East London Screening Study. 1977. *Int J Epidemiol.* 2001;30:935-40. [PMID: 11689496]
4. Friedman GD, Collen MF, Fireman BH. Multiphasic Health Checkup Evaluation: a 16-year follow-up. *J Chronic Dis.* 1986;39:453-63. [PMID: 3711252]
5. Stone DH, D’Souza MF. Multiphasic screening in middle age: results and

- implications of a controlled trial in British general practice. *Isr J Med Sci.* 1981; 17:215-21. [PMID: 7228648]
6. Cutler JL, Ramcharan S, Feldman R, Siegelau AB, Campbell B, Friedman GD, et al. Multiphasic checkup evaluation study. 1. Methods and population. *Prev Med.* 1973;2:197-206. [PMID: 4723635]
 7. Patrick DL, Grembowski D, Durham M, Beresford SA, Diehr P, Ehreth J, et al. Cost and outcomes of Medicare reimbursement for HMO preventive services. *Health Care Financ Rev.* 1999;20:25-43. [PMID: 11482123]
 8. Elder JP, Williams SJ, Drew JA, Wright BL, Boulan TE. Longitudinal effects of preventive services on health behaviors among an elderly cohort. *Am J Prev Med.* 1995;11:354-9. [PMID: 8775655]
 9. Morrissey JP, Harris RP, Kincade-Norburn J, McLaughlin C, Garrett JM, Jackman AM, et al. Medicare reimbursement for preventive care. Changes in performance of services, quality of life, and health care costs. *Med Care.* 1995; 33:315-31. [PMID: 7731275]
 10. Burton LC, Steinwachs DM, German PS, Shapiro S, Brant LJ, Richards TM, et al. Preventive services for the elderly: would coverage affect utilization and costs under Medicare? *Am J Public Health.* 1995;85:387-91. [PMID: 7892924]
 11. Effectiveness of health checks conducted by nurses in primary care: final results of the OXCHECK study. Imperial Cancer Research Fund OXCHECK Study Group. *BMJ.* 1995;310:1099-104. [PMID: 7742676]
 12. Faulkner LA, Schaffner HH. The effect of health insurance coverage on the appropriate use of recommended clinical preventive services. *Am J Prev Med.* 1997;13:453-8. [PMID: 9415792]
 13. U.S. Department of Health and Human Services. Prevention Makes Common "Cents." Accessed at <http://aspe.hhs.gov/health/prevention/> on 22 September 2006.
 14. Chalmers TC, Smith H Jr, Blackburn B, Silverman B, Schroeder B, Reitman D, et al. A method for assessing the quality of a randomized control trial. *Control Clin Trials.* 1981;2:31-49. [PMID: 7261638]
 15. GRADE Working Group. Grading quality of evidence and strength of recommendations. *BMJ.* 2004;328:1490. [PMID: 15205295]
 16. Boulware LE, Barnes GJ, Wilson RF, Phillips K, Maynor K, Hwang C, et al. Value of the periodic health evaluation (Evidence Report/Technology Assessment No. 136, prepared by Johns Hopkins Evidence-based Practice Center under contract no. 290-02-0018). Rockville, MD: Agency for Healthcare Research and Quality, U.S. Department of Health and Human Services; 2006. AHRQ publication no. 06-E011.
 17. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, NJ: L. Erlbaum Associates; 1988.
 18. Fletcher SW, Sourkes M, Rabzel M, Fletcher RH. Multiphasic screening. Case-finding tool in a Teaching Hospital Medical Clinic. *JAMA.* 1977;237:887-91. [PMID: 576328]
 19. Belcher DW. Implementing preventive services. Success and failure in an outpatient trial. *Arch Intern Med.* 1990;150:2533-41. [PMID: 2244769]
 20. Nakanishi N, Tataru K, Fujiwara H. Do preventive health services reduce eventual demand for medical care? *Soc Sci Med.* 1996;43:999-1005. [PMID: 8888469]
 21. Theobald H, Bygren LO, Carstensen J, Hauffman M, Engfeldt P. Effects of an assessment of needs for medical and social services on long-term mortality: a randomized controlled study. *Int J Epidemiol.* 1998;27:194-8. [PMID: 9602398]
 22. Grimaldi JV. The worth of occupational health programs: a new evaluation of periodic physical examinations. *J Gnatol.* 1965;56:365-74. [PMID: 14321467]
 23. Roberts NJ, Ipsen J, Elsom KO, Clark TW, Yanagawa H. Mortality among males in periodic-health-examination programs. *N Engl J Med.* 1969;281:20-4. [PMID: 5785733]
 24. Slesinger DP, Tessler RC, Mechanic D. The effects of social characteristics on the utilization of preventive medical services in contrasting health care programs. *Med Care.* 1976;14:392-404. [PMID: 1271880]
 25. Geiger WJ, Neuberger MJ, Bell GC. Implementing the US preventive services guidelines in a family practice residency. *Fam Med.* 1993;25:447-51. [PMID: 8375602]
 26. Kottke TE, Solberg LI, Brekke ML, Cabrera A, Marquez MA. Delivery rates for preventive services in 44 midwestern clinics. *Mayo Clin Proc.* 1997;72: 515-23. [PMID: 9179135]
 27. Sox CH, Dietrich AJ, Tosteson TD, Winchell CW, Labaree CE. Periodic health examinations and the provision of cancer prevention services. *Arch Fam Med.* 1997;6:223-30. [PMID: 9161346]
 28. Bernacki EJ, Tsai SP, Malone RD. Participation in a periodic physical examination program and group health care utilization and costs. *J Occup Med.* 1988;30:949-52. [PMID: 3230446]
 29. Williams RB, Boles M, Johnson RE. A patient-initiated system for preventive health care. A randomized trial in community-based primary care practices. *Arch Fam Med.* 1998;7:338-45. [PMID: 9682687]
 30. Hahn DL. The delivery of clinical preventive services: acute care intervention. *J Fam Pract.* 1999;48:785-9. [PMID: 12224676]
 31. Freedman A, Pimlott N, Naglie G. Preventive care for the elderly. Do family physicians comply with recommendations of the Canadian Task Force on Preventive Health Care? *Can Fam Physician.* 2000;46:350-7. [PMID: 10690491]
 32. Stange KC, Flocke SA, Goodwin MA, Kelly RB, Zyzanski SJ. Direct observation of rates of preventive service delivery in community family practice. *Prev Med.* 2000;31:167-76. [PMID: 10938218]
 33. Hama Y, Masumori K, Tagami H, Fujiwara K, Kusano S. Preassignment examination for personnel on Iwo Jima. *Mil Med.* 2001;166:721-4. [PMID: 11515325]
 34. Nutting PA, Baier M, Werner JJ, Cutter G, Conry C, Stewart L. Competing demands in the office visit: what influences mammography recommendations? *J Am Board Fam Pract.* 2001;14:352-61. [PMID: 11572540]
 35. Parchman M, Byrd T. Access to and use of ambulatory health care by a vulnerable Mexican American population on the U.S.-Mexico border. *J Health Care Poor Underserved.* 2001;12:404-14. [PMID: 11688192]
 36. Tao G, Zhang P, Li Q. Services provided to nonpregnant women during general medical and gynecologic examinations in the United States. *Am J Prev Med.* 2001;21:291-7. [PMID: 11701300]
 37. Burton WN, Chen CY, Conti DJ, Schultz AB, Edington DW. The value of the periodic executive health examination: experience at Bank One and summary of the literature. *J Occup Environ Med.* 2002;44:737-44. [PMID: 12185794]
 38. Chiou CJ, Chang HY. Do the elderly benefit from annual physical examination? An example from Kaohsiung City, Taiwan. *Prev Med.* 2002;35:264-70. [PMID: 12202069]
 39. Finkelstein MM. Preventive screening. What factors influence testing? *Can Fam Physician.* 2002;48:1494-501. [PMID: 12371308]
 40. Schneider GW, DeHaven M, Snell LM. Fostering a culture of prevention in a residency program through a continuous quality improvement project. *Am J Med Qual.* 2003;18:82-9. [PMID: 12710557]
 41. Flocke SA, Stange KC. Direct observation and patient recall of health behavior advice. *Prev Med.* 2004;38:343-9. [PMID: 14766118]
 42. Lin SX, Gebbie KM, Fullilove RE, Arons RR. Do nurse practitioners make a difference in provision of health counseling in hospital outpatient departments? *J Am Acad Nurse Pract.* 2004;16:462-6. [PMID: 15543924]
 43. Somkin CP, McPhee SJ, Nguyen T, Stewart S, Shema SJ, Nguyen B, et al. The effect of access and satisfaction on regular mammogram and Papanicolaou test screening in a multiethnic population. *Med Care.* 2004;42:914-26. [PMID: 15319618]
 44. Burton LC, German PS, Shapiro S. A preventive services demonstration. Health status, health behaviors, and cost outcomes 2 years after intervention. The Johns Hopkins Medicare Preventive Services Demonstration Team. *Med Care.* 1997;35:1149-57. [PMID: 9366893]
 45. Burton LC, Paglia MJ, German PS, Shapiro S, Damiano AM. The effect among older persons of a general preventive visit on three health behaviors: smoking, excessive alcohol drinking, and sedentary lifestyle. The Medicare Preventive Services Research Team. *Prev Med.* 1995;24:492-7. [PMID: 8524724]
 46. Collen MF, Dales LG, Friedman GD, Flagle CD, Feldman R, Siegelau AB. Multiphasic checkup evaluation study. 4. Preliminary cost benefit analysis for middle-aged men. *Prev Med.* 1973;2:236-46. [PMID: 4723639]
 47. Patrick DL, Grembowski D, Durham M, Beresford SA, Diehr P, Ehreth J, et al. Cost and outcomes of Medicare reimbursement for HMO preventive services. *Health Care Financ Rev.* 1999;20:25-43. [PMID: 11482123]
 48. Dales LG, Friedman GD, Collen MF. Evaluating periodic multiphasic health checkups: a controlled trial. *J Chronic Dis.* 1979;32:385-404. [PMID: 109452]
 49. Sheridan S, Pignone M, Donahue K. Screening for high blood pressure: a review of the evidence for the U.S. Preventive Services Task Force. *Am J Prev Med.* 2003;25:151-8. [PMID: 12880884]
 50. Dijkstra A, Brosschot J. Worry about health in smoking behaviour change. *Behav Res Ther.* 2003;41:1081-92. [PMID: 12914809]
 51. Hvas L, Reventlow S, Jensen HL, Malterud K. Awareness of risk of osteoporosis may cause uncertainty and worry in menopausal women. *Scand J Public*

Health. 2005;33:203-7. [PMID: 16040461]

52. Wilcox S, Ainsworth BE, LaMonte MJ, DuBose KD. Worry regarding major diseases among older African-American, Native-American, and Caucasian women. *Women Health*. 2002;36:83-99. [PMID: 12539794]

53. McCaul KD, Schroeder DM, Reid PA. Breast cancer worry and screening: some prospective data. *Health Psychol*. 1996;15:430-3. [PMID: 8973922]

54. Harris R, Donahue K, Rathore SS, Frame P, Woolf SH, Lohr KN. Screening adults for type 2 diabetes: a review of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2003;138:215-29. [PMID: 12558362]

55. Pignone M, Rich M, Teutsch SM, Berg AO, Lohr KN. Screening for colorectal cancer in adults at average risk: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2002;137:132-41. [PMID: 12118972]

56. Humphrey LL, Helfand M, Chan BK, Woolf SH. Breast cancer screening: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2002;137:347-60. [PMID: 12204020]

57. Yarnall KS, Pollak KI, Østbye T, Krause KM, Michener JL. Primary care: is there enough time for prevention? *Am J Public Health*. 2003;93:635-41. [PMID: 12660210]

58. McCarthy BD, Yood MU, MacWilliam CH, Lee MJ. Screening mammography use: the importance of a population perspective. *Am J Prev Med*. 1996;12:91-5. [PMID: 8777073]

59. A controlled trial of multiphasic screening in middle-age: results of the South-East London Screening Study. The South-East London Screening Study Group. *Int J Epidemiol*. 1977;6:357-63. [PMID: 608798]

AD LIBITUM

"For when his youth with gift of light heart
has come and gone, what grievous stroke
is spared to a man, what agony
is he without?"

Sophocles, *Oedipus at Colonus* (lines 1414-1417),
transl., Grene and Lattimore

The Old Poet

Grizzled and frail, he fingers tenderly
The book in which his first poem was printed—
The page still crisp, the thought still fresh and free
As a dollar bill that's newly minted;
But what's the worth of precious words encased
And leather bound, creatures of precision—
These words that as a youth he once embraced
Like an old cellist with extended bow,
Teasing his strings to one last melody,
Who elicits a sound plaintive and low—
First brief notes of a dirge or threnody—
He fashions a late sonnet in his mind
Composed of thoughts lost, languished or left
behind.

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"Everything, in my humble opinion, is a joking
matter."

— *Rumpole for the Prosecution*, John Mortimer

The Funnies

Called "the Funnies" (but they weren't very)—
We read them every Sunday front to back
And waited for them every week—"Terry
And the Pirates," Dick Tracy," "Smilin' Jack."
Weird characters, like the "Dragon Lady"
Stirred our appetite for exotic lands;
Tracy's villains, sinister and shady,
Kept unearthing diabolic plans.
Now, living in a deeply worried age
Those youthful fantasies have fled too soon—
We need not scurry to "the Funnies" page
To see our planet as a big cartoon.
Global warming, terrorism unfurled—
We're living through a not-so-funny world.

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

Outcomes	Effect Size (95% CI)† (Reference)			Reference for Which Effect Size Could Not Be Calculated§
	In Studies with Positive Effect of PHE‡	In Studies with Negative Effect of PHE	Confidence Interval Crosses 0	
Receipt of Papanicolaou smear	1.71 (1.69 to 1.73) (9) 0.07 (0.07 to 0.07) (44)			
Preventive counseling	1.09 (1.08 to 1.11) (19) ^a 1.19 (1.17 to 1.21) (19) ^b			
Immunizations	0.35 (0.33 to 0.36) (9) ^c 0.10 (0.10 to 0.10) (7) ^d	-0.22 (-0.24 to -0.20) (19) ^e		
Cholesterol screening	0.02 (0.00 to 0.04) (9)			
Colon cancer screening (fecal occult blood testing)	1.19 (1.17 to 1.21) (9) 1.07 (1.05 to 1.08) (19)			
Mammography	0.14 (0.12 to 0.16) (9)			
Disease detection	0.03 (0.02 to 0.03) (3) ^f 0.96 (0.84 to 1.08) (18) ^g 0.53 (0.41 to 0.64) (18) ^h	-0.01 (-0.01 to -0.01) (3) ⁱ -0.03 (-0.03 to -0.03) (3) ^j	-0.01 (-0.01 to 0.00) (3) ^k	
Health habits	0.28 (0.14 to 0.42) (8) ^l 0.120 (0.117 to 0.123) (7) ^m 0.040 (0.037 to 0.043) (7) ⁿ 0.345 (0.342 to 0.348) (7) ^o 0.080 (0.077 to 0.083) (7) ^p 0.020 (0.017 to 0.023) (7) ^q 0.020 (0.017 to 0.023) (7) ^r 0.100 (0.098 to 0.102) (11) ^s 0.032 (0.030 to 0.034) (11) ^t 0.088 (0.086 to 0.090) (11) ^u 0.244 (0.242 to 0.246) (11) ^v 0.250 (0.248 to 0.252) (11) ^w 0.13 (0.11 to 0.14) (45) ^x	-0.040 (-0.043 to -0.037) (7) ^y -0.014 (-0.016 to -0.012) (3) ^z -.02 (-.03 to -.02) (45) ^{aa}	0.000 (-0.14 to 0.14) (8) ^{bb} 0.01 (-0.13 to 0.15) (8) ^{cc} 0.02 (-0.12 to 0.16) (8) ^{dd} 0.05 (-0.09 to 0.19) (8) ^{ee} 0.01 (-0.13 to 0.15) (8) ^{ff}	
Patient attitudes				7
Health status				10
Blood pressure	0.12 (0.02 to 0.21) (8) ^{gg} 0.11 (0.04 to 0.18) (11) ^{hh} 0.13 (0.06 to 0.19) (11) ⁱⁱ 0.022 (0.019 to 0.024) (11) ^{jj}		0.03 (-0.06 to 0.13) (8) ^{kk}	
Changes in serum cholesterol levels	0.22 (0.16 to 0.29) (11) ^{ll} 0.09 (0.09 to 0.10) (11) ^{mm}			
Body mass index	0.087 (0.022 to 0.153) (11) ⁿⁿ 0.032 (0.030 to 0.034) (11) ^{oo}	-0.020 (-0.023 to -0.017) (7) ^{pp}	-0.031 (-0.170 to 0.108) (8) ^{qq} -0.036 (-0.174 to 0.103) (8) ^{rr}	
Reduction in health care costs			0.06 (-0.03 to 0.15) (9) ^{ss} 0.05 (-0.04 to 0.14) (9) ^{tt}	7, 10, 46
Reduction in disability	0.060 (0.054 to 0.066) (48) ^{uu}	-0.014 (-0.016 to -0.012) (3)		
Reduction in hospitalizations	0.01 (0.00 to 0.01) (3) ^{vv}		0.02 (-0.07 to 0.11) (9) ^{ww} -0.04 (-0.13 to 0.05) (9) ^{xx}	10 ^{yy,zz,aaa,bbb}
Reduction in all-cause mortality	0.06 (0.05 to 0.06) (10) ^{ccc} 0.004 (0.004 to 0.005) (4) ^{ddd}	-0.03 (-0.04 to -0.03) (7) ^{eee} -0.002 (-0.003 to -0.0003) (3) ^{fff}	Rate ratio: 1.03 (0.94 to 1.14) (21)	

* 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 58th percentile of the untreated group. An effect size of 0.8 indicates that the mean of the treated group is at the 79th 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; c: influenza vaccination; d: influenza vaccination; e: 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 charges; tt: 3-year postintervention cumulative Medicare reimbursement; 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); aaa: hospital discharges per 1000 (year 1); bbb: hospital discharges per 1000 (year 2); ccc: death; ddd: deaths, rate per 1000 persons at 16 years; eee: mortality at 48 months' follow-up; fff: mortality rate per 1000 person-years at risk.

§ Standardized effect size could not be calculated for the study or some studies assessing this outcome.