CLINICAL GUIDELINE

ACP American College of Physicians
Leading Internal Medicine, Improving Lives

A Value Framework for Cancer Screening: Advice for High-Value Care From the American College of Physicians

Russell P. Harris, MD, MPH; Timothy J. Wilt, MD, MPH; and Amir Qaseem, MD, PhD, MHA, for the High Value Care Task Force of the American College of Physicians*

Experts, professional societies, and consumer groups often recommend different strategies for cancer screening. These strategies vary in the intensity of their search for asymptomatic lesions and in their value. This article outlines a framework for thinking about the value of varying intensities of cancer screening. The authors conclude that increasing intensity beyond an optimal level leads to low-value screening and speculate about pressures that encourage overly intensive, low-value screening.

Ann Intern Med. 2015;162:712-717. doi:10.7326/M14-2327 **www.annals.org**
For author affiliations, see end of text.

Screening for some types of cancer can reduce cancer deaths. Some screening strategies are more intensive than others in that they screen a larger population (for example, lower-risk or younger persons) at shorter intervals (for example, every year rather than every 2 years) and use more sensitive tests (such as magnetic resonance imaging rather than mammography). The motivation for high-intensity screening strategies is to detect every possible case, with the expectation that earlier detection leads to reduced morbidity and mortality.

Increasingly, however, the medical profession and the public are becoming aware of another side of intensive screening: the problems of greater harms and higher costs (1–3). This awareness has led to an alternative way of viewing the tradeoffs between benefits and harms and costs of different screening strategies–through the lens of value. High-value screening strategies provide a degree of benefit that clearly justifies the harms and costs; low-value strategies return disproportionately small health benefits for the harms and costs incurred. Value and intensity are not the same (2, 3). More intensive screening may provide greater benefit in lives extended than lower-intensity strategies but also often leads to increased harms and costs (1–5). Optimizing value requires finding the intermediate level of intensity that best balances benefits on the one hand with harms and costs on the other.

The American College of Physicians (ACP) has emphasized prioritization of high-value, cost-conscious care (2, 4–6). Because it can be difficult to determine the level of screening intensity that provides optimal value, the ACP initiated 2 articles to assist clinicians in determining the value of different cancer screening strategies. In this article, our goal was to develop a framework that can be used to understand how the value of screening strategies varies with their intensity. The second article uses this framework to assess the value of specific cancer screening strategies (7).

See also:

Related article 718
Summary for Patients I-14

A Framework for Thinking About the Intensity of Screening

How one thinks about cancer screening is important in deciding the optimal intensity to recommend to patients. One framework could be to maximize cancer detection. The lens of value, however, provides an alternative. The value framework seeks to balance the benefits of screening against its harms and costs by focusing on finding the strategy that optimizes these tradeoffs. This framework is depicted in Figure 1 for the implementation of a hypothetical new screening program. The tradeoffs between benefits versus harms and costs, which vary with intensity, determine the level of value. Low-intensity, low-value screening occurs when effective screening strategies are underused (far left side of the framework). As intensity increases, providing effective screening for underserved persons, benefits rapidly increase, leading to increasing value. As intensity increases beyond an optimal level, however, the increase in benefits slows while harms and costs increase rapidly (far right side of the framework), and value decreases.

Several lines of evidence support a value framework. First, trials with strong research designs have shown that some screening strategies for breast, colorectal, cervical, and lung cancer reduce cancer deaths to a degree that most people would believe justifies the harms and costs incurred (8–11). However, these

* This paper, written by Russell P. Harris, MD, MPH; Timothy J. Wilt, MD, MPH; and Amir Qaseem, MD, PhD, MHA, was developed for the High Value Care Task Force of the American College of Physicians. Individuals who served on the High Value Care Task Force from initiation of the project until its approval were Amir Qaseem, MD, PhD, MHA (*Chair*); John Biebelhausen, MD, MBA; Sanjay Desai, MD; Lawrence Feinberg, MD; Carrie A. Horwitch, MD, MPH; Linda L. Humphrey, MD, MPH; Robert M. McLean, MD; Tanveer P. Mir, MD; Darilyn V. Moyer, MD; Kelley M. Skeff, MD, PhD; Thomas G. Tape, MD; and Jeffrey Wiese, MD. Approved by the ACP Board of Regents on 15 November 2014.

trials do not tell us the optimal intensity of screening. Further research has shown that intensification of screening strategies often results in higher levels of false-positive results, diagnostic work-ups, overdiagnosis, and costs that most informed people would believe are not justified by the incremental increase in benefits (12–15). Another line of reasoning comes from modeling studies that have consistently found diminishing benefits but increasing costs and diagnostic work-ups as the intensity of cancer screening programs increases (16–19). Finally, there are theoretical reasons that more intensive screening not only is more costly but also necessarily leads to detection of more asymptomatic lesions that do not progress to fatal disease, leading to increasing harm (20–22).

To better understand the value framework, the following 5 general concepts may be helpful.

Concept 1: Screening Is a Cascade of Events Rather Than a Single Test

Screening sets off a chain of events—a cascade—that can lead to benefit (such as longer life) or harm. When one is assessing the value of screening, it is important to count the benefits versus the harms and costs from the entire cascade. Benefit accrues only to a subset of persons with true-positive results (Figure 2). At optimal intensity, screening detects many of the cancer cases that could benefit from earlier treatment, leaving fewer additional cases to detect. When intensity is further increased to detect these few remaining cases, screening tests, diagnostic work-ups, and detection of cancer that would not benefit from earlier treatment are disproportionately increased, resulting in rapidly increasing harms and costs.

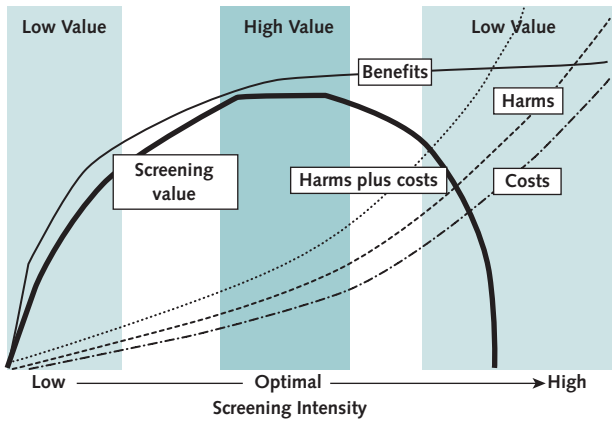
Concept 2: Cancer Cases Are Heterogeneous

Optimal-intensity screening strategies seek to find the subset of abnormalities that have the greatest probability of eventually causing health problems and that are more treatable at an early, asymptomatic stage. One can think of many cancer cases as having 3 general rates of progression from asymptomatic to fatal disease (Figure 3): rapid (often difficult to treat [patient 1]), intermediate (more amenable to treatment if found before symptoms [patient 2]), or slow (treatment not needed because the cancer will never cause symptoms [patient 3]). Detection of this third type of cancer constitutes overdiagnosis (detection of cancer that will not progress to symptoms during the patient's lifetime). Screening preferentially detects these slowly progressive cancer cases (and precancer cases) because they spend more time in the "detectable but not symptomatic" zone; higher-intensity screening increases this tendency. This is one of the factors that explains the steeper slope of the harms and costs curves with increasingly intensive screening (Figure 1). Screening confers benefit only when it detects cancer with intermediate progression.

Concept 3: Patients Are Heterogeneous

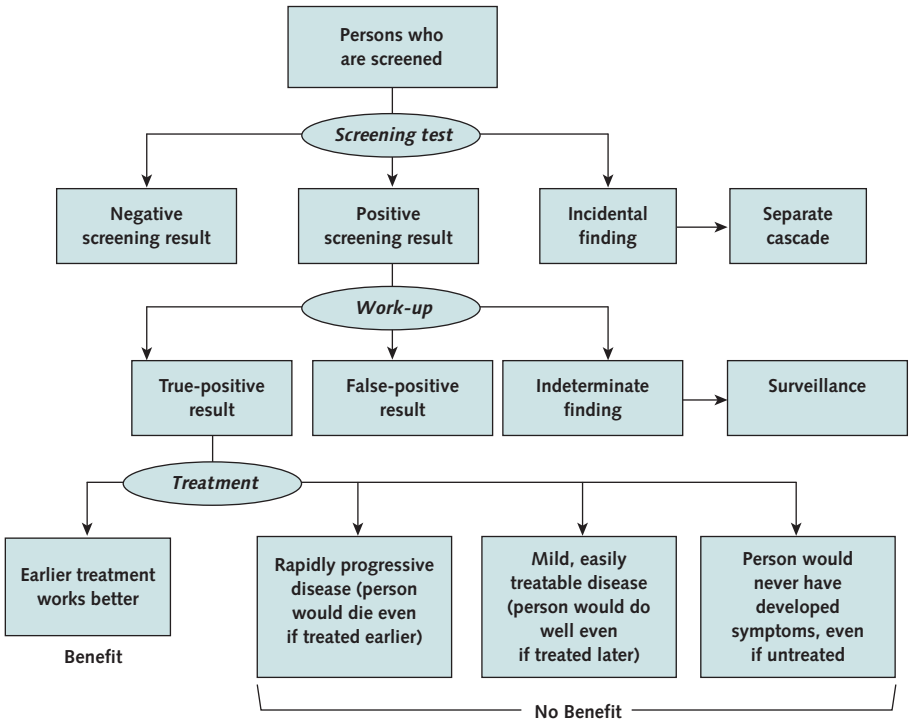
Optimal-intensity screening strategies focus on persons with sufficient risk for potentially fatal cancer who also have low competing health risks from other causes. Overdiagnosis is due to detection of not only slowly progressive cancer (Figure 3, *patient 3*) but also *any* type of cancer in patients with serious noncancer health risks that will end their life before the cancer becomes symptomatic (Figure 3, *patient 4*). An example is a hypothetical woman whose breast cancer is detected as a palpable lump (that is, by symptoms) at age 55 years and who would die of the cancer at age 65 years. With detection by screening at age 52 years and effective treatment, she would instead live until age 80 years and die of another cause, such as a stroke. Thus, her benefit (living 15 years beyond age 65 years) would come 13 years after she is screened at age 52 years. However, if this woman has severe congestive heart failure that would end her life at age 70 years, her benefit from breast cancer screening would be reduced from 15 years to 5 years. If her noncancer risk is even more serious (for example, if she has severe diabetes, end-stage renal disease, and cirrhosis), her life span may be decreased such that there is no benefit from breast cancer screening (Figure 3, *patient 4*). In fact, there may be unintentional harm if anxiety from and treatment of breast cancer reduce the quality and length of her life. This is another reason for the decrease in the slope of the benefit curve and the increase in the slope of the harms and costs curves with increasing screening intensity (Figure 1): The screening

Figure 1. The value framework.



The value of cancer screening strategies is linked to screening intensity (population screened, frequency, and sensitivity of test used) and is determined by the balance among benefits (e.g., cancer mortality reduction), harms (e.g., anxiety from false-positive test results, harms of diagnostic procedures, labeling, and overdiagnosis leading to overtreatment), and costs. Low-value care can result from either low benefits or high harms and costs. Low-intensity strategies are initially low-value due to low benefits (*left*). As intensity increases, benefits increase rapidly with acceptable levels of harms and costs, and value follows an upward trend. Screening strategies provide optimal value when the informed patient or public believes that the balance between benefits and harms or costs is optimal (*middle*). The top of the value curve is flat because different patients or groups may view different intensities as providing the best balance. Further increases in screening intensity beyond the optimal level lead to slower increases in benefits, with disproportionately rapid increases in harms and costs. Thus, value decreases; higher-intensity screening becomes low-value screening (*right*).

Figure 2. The screening cascade.



Screening is not a single test but a cascade of events that can lead to either benefit or harm. The screening test may yield a positive result, a negative result, or an incidental finding (negative for the target condition but with some other abnormality). Patients with an incidental finding are referred for an appropriate work-up. Patients with a positive result for the target condition are referred for further diagnostic testing (work-up). This leads to a diagnosis in some patients (true-positive result), who are then referred for treatment. However, diagnosis is not the same as benefit. Depending on the need for treatment and the relative effectiveness of earlier (screening detection) versus later (clinical detection) treatment, 4 possible outcomes may occur with treatment after a true-positive result (*bottom row, left to right*). Earlier treatment leads to benefit, with longer or higher-quality life. The other 3 scenarios provide no benefit, for various reasons. The patient could have rapidly progressive, untreatable disease and would not benefit from earlier detection. Alternatively, the patient could have mild, easily treatable disease and could be treated just as effectively even if the cancer is clinically detected later. Finally, the patient could have either nonprogressive (or slowly progressive) cancer or severe competing mortality risk from another condition and thus would never develop clinically important symptoms from the detected cancer (also known as "overdiagnosis"). Thus, in 3 of the 4 potential outcomes after screening detection and treatment, there is no benefit. Also, every step of the cascade has potential harms, which are immediate, whereas benefits occur only after diagnosis. (Adapted from Harris and colleagues [23].)

population is enlarged to include more persons with serious noncancer health risks.

Concept 4: Screening Leads to Important Benefits for Some Cancer Types and Some Patients but Can Lead to Significant Harms for Many More

For some persons and some cancer screening strategies, screening can have important benefits by reducing cancer morbidity and mortality, although the number whose lives are extended by screening may be surprisingly small. For example, compared with no screening, annual screening mammography for 10 years prevents about 2 breast cancer deaths for every 1000 women aged 50 years (24). To achieve this benefit, however, there are real harms, and for many more patients than those whose lives are extended (23). A patient moving through the screening cascade (Figure 2) may encounter several types of harms, including physical harms (such as complications from the screening test or the diagnostic work-up), psychological harms (such as anxiety and sleepless nights while waiting for results from the screening test or work-up), opportunity costs (such as distraction from other meaningful life events), and financial strains (such as anticipated financial problems from positive screening or work-up results) (23). We briefly discuss 2 of the harms that have received attention: false-positive screening results and overdiagnosis.

False-positive screening results are common. For every 1000 women aged 50 years who are screened annually for breast cancer for 10 years, about 600 have at least 1 false-positive mammography result (24). Although anxiety from false-positive results is transient for many women, condition-specific worries and intrusive thoughts may persist for others, even after they are told that the positive result was not due to cancer (25, 26).

Overdiagnosis leads to different and more persistent harms. For every 1000 women aged 50 years who receive annual breast cancer screening with mammography for 10 years, about 7 are overdiagnosed with breast cancer that will never progress to being clinically important (24) (this estimate carries uncertainty but is probably the correct order of magnitude). In the psychological realm, the harm of overdiagnosis is

labeling–the woman's life changes suddenly after she is labeled as a patient with cancer (23). In the physical realm, she is subjected to the harms of unnecessary treatment.

Concept 5: Determining the Value of Screening Strategies Is Complex but Not Impossible

Determining value requires assessing the balance between all benefits versus all harms and costs in the screening cascade. This involves considering the number of persons receiving the benefit (or harm) and the type of benefit (or harm). The number of persons harmed in some way by screening is always larger than the number of cancer deaths prevented (21, 23), but the weight of a single person's benefit is often greater than a single person's harm when counted in cancer deaths prevented. Thus, the balance often comes down to many persons experiencing some degree of harm versus a few experiencing a greater degree of benefit.

The ultimate arbiter of this balance is the voice of the informed public, but how to include it is uncertain. One extreme position is that scientific experts can examine the tradeoffs and determine the most likely opinion of the informed public. The other extreme is that informed individual patients should decide the value of every strategy for themselves. A tenable middle ground is that experts (with adequate oversight) could determine value in situations that are reasonably clear. In less clear, close-call situations, public input from individual shared decision making or (for policy decisions) "deliberative democracy" methods (27) could determine value. This approach is reflected in the flat top of the value curve in Figure 1. The exact strategy that optimizes value may vary among individual patients and groups.

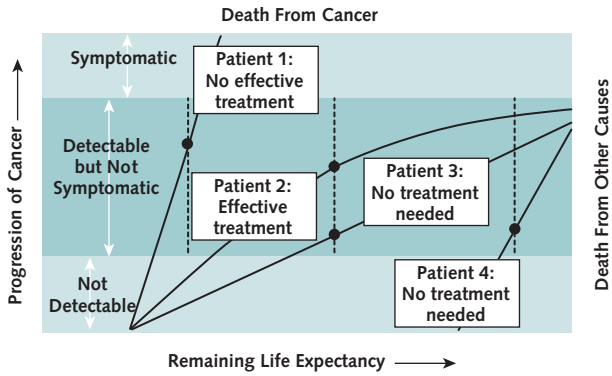
Although cost is an important factor in determining value, finding the best approach to include it in the balance of benefits versus harms and costs has been a problem in the United States. The use of cost-effectiveness analyses (especially those that include all benefits, harms, and costs with a societal perspective) and outcomes tables can provide information about the tradeoffs. Both economists and the informed public (through deliberative methods) could be involved in adding cost into the assessment of value.

Pressures to Use Overly Intensive, Low-Value Screening Strategies

Physicians and patients are under great pressure from many sources to use the "maximal cancer detection" framework rather than the value framework. Although we lack good evidence to understand the contribution of each source (28), several conceptual models have been proposed (3, 29–38). These models include factors that can be organized into 6 general categories (Table).

The relative importance of these factors in stimulating the use of overly intensive, low-value screening strategies is underinvestigated and largely unknown. However, many factors seem to encourage this practice, creating what has been described as a "perfect storm" of overuse (31).

Figure 3. Heterogeneity of cancer cases and patients.



Cases of the same type of cancer are heterogeneous in their natural history and response to treatment. Patients are also heterogeneous in their response to treatment and in the presence of serious noncancer health risks. The figure depicts the rate of disease progression for 4 hypothetical patients through 3 zones: not detectable, detectable but not symptomatic, and symptomatic. Screening episodes are represented by the vertical dashed lines, but screening detection (*solid circles*) occurs only in the second zone (detectable but not symptomatic). For patient 1, progression is rapid; the cancer may or may not be detected by screening because it spends little time in the detectable but not symptomatic zone. Patient 2 has cancer with an intermediate rate of progression, making it a good target for screening. This cancer has the potential to cause important clinical symptoms (*top*), and if treatment is more effective in the presymptomatic phase, the treatment bends the natural history curve and the patient benefits from earlier detection. Patient 3 has slowly growing cancer that will not cause symptoms during his or her lifetime. Patient 4 has serious noncancer health risks that decrease life expectancy and prevent benefit from detection of cancer. Because the cancer spends more time in the detectable but not symptomatic zone for patients 3 and 4, it is more likely to be detected by screening than patient 1's cancer; however, the earlier detection is not beneficial because these patients will die of another condition. Patients 3 and 4 are overdiagnosed and usually overtreated, both important harms of screening.

Discussion

In this article, we suggest a value framework for considering the tradeoffs between benefits on the one hand and harms and costs on the other in screening for cancer (as well as other screening programs). In contrast, a maximal cancer detection framework encourages high-intensity screening strategies and incurs a disproportionate level of harms and costs for the benefit attained. Although there are currently many pressures to adopt the maximal detection approach, we recommend moving to the value approach, for several reasons. First, by reducing harms relative to maximal detection, the value framework will improve the health of individual patients and the public. Second, by reducing screening costs, the value approach will allow for redirection of funds to increase the intensity of screening among disadvantaged groups, for whom screening intensity is less than optimal. Third, by reducing the time spent on low-value screening, a value framework will allow clinical practices to focus on higher-value services.

Table. Pressures to Use Low-Value Screening Strategies

Examples, Category
Knowledge, attitudes, and beliefs among patients and the public
Belief that "earlier is always better"; lack of knowledge of harms and overestimation of benefits
Habit
Fear of cancer; anticipated regret
Social norms
Belief that it is everyone's responsibility to be screened
Media messages about screening
Stories of "survivors"
Knowledge, attitudes, and beliefs among physicians
Lack of knowledge of principles of screening
Lack of evidence about what is high- vs. low-value; uncertainty about value
Lack of understanding of the harms of screening
Habit
Belief that patients want intensive screening
Physician professional norms
Belief that action is better than inaction
Medical education
Intolerance of uncertainty
Belief that other physicians practice intensive screening
Organizational, legal, and political
Performance measures
Malpractice concerns
Politicalization of medical care and coverage
Industry
Promotion of screening and treatment by pharmaceutical, biotechnology, and treatment companies

Countering the pressures to screen intensively will likely require multilevel interventions over time (35, 38), and finding what works is a research priority. Ultimately, the interventions will need to lead to adoption by both the medical profession and the public of a new, value-based framework for thinking about screening.

We have used cost as an important determinant of value throughout this article but have not given it equal space with benefits and harms. Yet, for many strategies, cost can be the determining factor in assessing value (39). Although groups developing guidelines for cancer screening rarely use cost in their recommendations, an assessment of value is not complete without inclusion of costs.

There is reason to believe that understanding of these concepts is increasing. Campaigns, such as the High Value Care (4), Choosing Wisely (40), and Do No Harm (41) campaigns, may increase professional and public awareness of overly intensive, low-value screening. An increasing number of articles and books in the medical and lay press are discussing harms and costs. High-visibility guideline groups, including the American Cancer Society, have recently recommended less intensive screening. The ultimate effect and longevity of these programs, however, is uncertain. Additional awareness raising and other steps will likely be needed over time.

As the nation comes to terms with the need to reduce the harms and costs of excessively intensive medical care, we hope that advice such as this from the ACP can contribute to the understanding that lower intensity may provide greater value.

From the Research Center for Excellence in Clinical Preventive Services, Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina; Minneapolis Veterans Affairs Center for Chronic Disease Outcomes Research, Minneapolis Veterans Affairs High Value Care Initiative, and University of Minnesota School of Medicine, Minneapolis, Minnesota; and American College of Physicians, Philadelphia, Pennsylvania.

Disclaimer: The authors of this article are responsible for its contents, including any clinical or treatment recommendations.

Financial Support: Financial support for the development of this guideline comes exclusively from the ACP operating budget.

Disclosures: Authors followed the policy regarding conflicts of interest described at www.annals.org/article.aspx?articleid=745942. Disclosures can be viewed at www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M14-2327. A record of conflicts of interest is kept for each High Value Care Task Force meeting and conference call and can be viewed at http://hvc.acponline.org/clinrec.html.

Requests for Single Reprints: Amir Qaseem, MD, PhD, MHA, American College of Physicians, 190 N. Independence Mall West, Philadelphia, PA 19106; e-mail, aqaseem@acponline.org.

Current author addresses and author contributions are available at www.annals.org.

References

1. **Woolf SH, Harris R.** The harms of screening: new attention to an old concern. JAMA. 2012;307:565-6. [PMID: 22318274] doi:10.1001/jama.2012.100

2. **Owens DK, Qaseem A, Chou R, Shekelle P; Clinical Guidelines Committee of the American College of Physicians.** High-value, cost-conscious health care: concepts for clinicians to evaluate the benefits, harms, and costs of medical interventions. Ann Intern Med. 2011;154:174-80. [PMID: 21282697] doi:10.7326/0003-4819-154-3-201102010-00007

3. **Fisher ES, Welch HG.** Avoiding the unintended consequences of growth in medical care: how might more be worse? JAMA. 1999;281:446-53. [PMID: 9952205]

4. **Qaseem A, Alguire P, Dallas P, Feinberg LE, Fitzgerald FT, Horwitch C, et al.** Appropriate use of screening and diagnostic tests to foster high-value, cost-conscious care. Ann Intern Med. 2012;156:147-9. [PMID: 22250146] doi:10.7326/0003-4819-156-2-201201170-00011

5. **Baker DW, Qaseem A, Reynolds PP, Gardner LA, Schneider EC; American College of Physicians Performance Measurement Committee.** Design and use of performance measures to decrease low-value services and achieve cost-conscious care. Ann Intern Med. 2013;158:55-9. [PMID: 23108285] doi:10.7326/0003-4819-158-1-201301010-00560

6. **Snyder L; American College of Physicians Ethics, Professionalism, and Human Rights Committee.** American College of Physicians Ethics Manual: sixth edition. Ann Intern Med. 2012;156:73-104. [PMID: 22213573] doi:10.7326/0003-4819-156-1-201201031-00001

7. **Wilt TJ, Harris RP, Qaseem A; High Value Care Task Force of the American College of Physicians.** Screening for cancer: advice for high-value care from the American College of Physicians. Ann Intern Med. 2015;162:718-25. doi:10.7326/M14-2326
8. **Nelson HD, Tyne K, Naik A, Bougatsos C, Chan BK, Humphrey L; U.S. Preventive Services Task Force.** Screening for breast cancer: an update for the U.S. Preventive Services Task Force. Ann Intern Med. 2009;151:727-37. [PMID: 19920273] doi:10.7326/0003-4819-151-10-200911170-00009
9. **Whitlock EP, Lin JS, Liles E, Beil TL, Fu R.** Screening for colorectal cancer: a targeted, updated systematic review for the U.S. Preventive Services Task Force. Ann Intern Med. 2008;149:638-58. [PMID: 18838718] doi:10.7326/0003-4819-149-9-200811040-00245
10. **Whitlock EP, Vesco KK, Eder M, Lin JS, Senger CA, Burda BU.** Liquid-based cytology and human papillomavirus testing to screen for cervical cancer: a systematic review for the U.S. Preventive Services Task Force. Ann Intern Med. 2011;155:687-97. [PMID: 22006930] doi:10.7326/0003-4819-155-10-201111150-00376
11. **Humphrey LL, Deffebach M, Pappas M, Baumann C, Artis K, Mitchell JP, et al.** Screening for lung cancer with low-dose computed tomography: a systematic review to update the US Preventive Services Task Force recommendation. Ann Intern Med. 2013;159:411-20. [PMID: 23897166] doi:10.7326/0003-4819-159-6-201309170-00690
12. **Kovalchik SA, Tammemagi M, Berg CD, Caporaso NE, Riley TL, Korch M, et al.** Targeting of low-dose CT screening according to the risk of lung-cancer death. N Engl J Med. 2013;369:245-54. [PMID: 23863051] doi:10.1056/NEJMoa1301851
13. **Hubbard RA, Kerlikowske K, Flowers CI, Yankaskas BC, Zhu W, Miglioretti DL.** Cumulative probability of false-positive recall or biopsy recommendation after 10 years of screening mammography: a cohort study. Ann Intern Med. 2011;155:481-92. [PMID: 22007042] doi:10.7326/0003-4819-155-8-201110180-00004
14. **Morioka-Douglas N, Hillard PJ.** No Papanicolaou tests in women younger than 21 years or after hysterectomy for benign disease. JAMA Intern Med. 2013;173:855-6. [PMID: 23568165] doi:10.1001/jamainternmed.2013.316
15. **Robertson DJ, Burke CA, Welch HG, Haile RW, Sandler RS, Greenberg ER, et al.** Using the results of a baseline and a surveillance colonoscopy to predict recurrent adenomas with high-risk characteristics. Ann Intern Med. 2009;151:103-9. [PMID: 19620162] doi:10.7326/0003-4819-151-2-200907210-00007
16. **Mandelblatt JS, Cronin KA, Bailey S, Berry DA, de Koning HJ, Draisma G, et al; Breast Cancer Working Group of the Cancer Intervention and Surveillance Modeling Network.** Effects of mammography screening under different screening schedules: model estimates of potential benefits and harms. Ann Intern Med. 2009;151:738-47. [PMID: 19920274] doi:10.7326/0003-4819-151-10-200911170-00010
17. **Zauber AG, Lansdorp-Vogelaar I, Knudsen AB, Wilschut J, van Ballegooijen M, Kuntz KM.** Evaluating test strategies for colorectal cancer screening: a decision analysis for the U.S. Preventive Services Task Force. Ann Intern Med. 2008;149:659-69. [PMID: 18838717] doi:10.7326/0003-4819-149-9-200811040-00244
18. **Kulasingam SL, Havrilesky L, Ghebre R, Myers ER.** Screening for cervical cancer: a decision analysis for the U.S. Preventive Services Task Force. AHRQ Publication No. 11-05157-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; 2011.
19. **de Koning HJ, Meza R, Plevritis SK, ten Haaf K, Munshi VN, Jeon J, et al.** Benefits and harms of computed tomography lung cancer screening strategies: a comparative modeling study for the U.S. Preventive Services Task Force. Ann Intern Med. 2014;160:311-20. [PMID: 24379002] doi:10.7326/M13-2316
20. **Harris R.** Overview of screening: where we are and where we may be headed. Epidemiol Rev. 2011;33:1-6. [PMID: 21709142] doi:10.1093/epirev/mxr006
21. **Welch HG, Black WC.** Overdiagnosis in cancer. J Natl Cancer Inst. 2010;102:605-13. [PMID: 20413742] doi:10.1093/jnci/djq099
22. **Harris R, Sawaya GF, Moyer VA, Calonge N.** Reconsidering the criteria for evaluating proposed screening programs: reflections from 4 current and former members of the U.S. Preventive Services Task Force. Epidemiol Rev. 2011;33:20-35. [PMID: 21666224] doi:10.1093/epirev/mxr005
23. **Harris RP, Sheridan SL, Lewis CL, Barclay C, Vu MB, Kistler CE, et al.** The harms of screening: a proposed taxonomy and application to lung cancer screening. JAMA Intern Med. 2014;174:281-5. [PMID: 24322781] doi:10.1001/jamainternmed.2013.12745
24. **Welch HG, Passow HJ.** Quantifying the benefits and harms of screening mammography. JAMA Intern Med. 2014;174:448-54. [PMID: 24380095] doi:10.1001/jamainternmed.2013.13635
25. **Brewer NT, Salz T, Lillie SE.** Systematic review: the long-term effects of false-positive mammograms. Ann Intern Med. 2007;146:502-10. [PMID: 17404352] doi:10.7326/0003-4819-146-7-200704030-00006
26. **Brodersen J, Siersma VD.** Long-term psychosocial consequences of false-positive screening mammography. Ann Fam Med. 2013;11:106-15. [PMID: 23508596] doi:10.1370/afm.1466
27. **Rychetnik L, Carter SM, Abelson J, Thornton H, Barratt A, Entwistle VA, et al.** Enhancing citizen engagement in cancer screening through deliberative democracy. J Natl Cancer Inst. 2013;105:380-6. [PMID: 23378639] doi:10.1093/jnci/djs649
28. **Korenstein D, Falk R, Howell EA, Bishop T, Keyhani S.** Overuse of health care services in the United States: an understudied problem. Arch Intern Med. 2012;172:171-8. [PMID: 22271125] doi:10.1001/archinternmed.2011.772
29. **Ransohoff DF, McNaughton Collins M, Fowler FJ.** Why is prostate cancer screening so common when the evidence is so uncertain? A system without negative feedback. Am J Med. 2002;113:663-7. [PMID: 12505117]
30. **Schwartz LM, Woloshin S, Fowler FJ Jr, Welch HG.** Enthusiasm for cancer screening in the United States. JAMA. 2004;291:71-8. [PMID: 14709578]
31. **Emanuel EJ, Fuchs VR.** The perfect storm of overutilization. JAMA. 2008;299:2789-91. [PMID: 18560006] doi:10.1001/jama.299.23.2789
32. **Moyer VA.** What we don't know can hurt our patients: physician innumeracy and overuse of screening tests [Editorial]. Ann Intern Med. 2012;156:392-3. [PMID: 22393136] doi:10.7326/0003-4819-156-5-201203060-00015
33. **Sirovich BE, Woloshin S, Schwartz LM.** Too little? Too much? Primary care physicians' views on US health care: a brief report. Arch Intern Med. 2011;171:1582-5. [PMID: 21949169] doi:10.1001/archinternmed.2011.437
34. **Herndon MB, Schwartz LM, Woloshin S, Anthony D, Gallagher P, Fowler FJ, et al.** Older patients perceptions of "unnecessary" tests and referrals: a national survey of Medicare beneficiaries. J Gen Intern Med. 2008;23:1547-54. [PMID: 18592324] doi:10.1007/s11606-008-0626-9
35. **Colla CH.** Swimming against the current–what might work to reduce low-value care? N Engl J Med. 2014;371:1280-3. [PMID: 25271601] doi:10.1056/NEJMp1404503
36. **LeFevre ML.** Swimming upstream: doing less in health care is hard: comment on "No Papanicolaou tests in women younger than 21 years or after hysterectomy for benign disease" and "Cervical cancer screening intervals, 2006 to 2009". JAMA Intern Med. 2013;173:856-8. [PMID: 23568453] doi:10.1001/jamainternmed.2013.535
37. **Hoffmann TC, Del Mar C.** Patients' expectations of the benefits and harms of treatments, screening, and tests: a systematic review. JAMA Intern Med. 2015;175:274-86. [PMID: 25531451] doi:10.1001/jamainternmed.2014.6016
38. **Gawande AA, Colla CH, Halpern SD, Landon BE.** Avoiding low-value care. N Engl J Med. 2014;370:e21. [PMID: 24693918] doi:10.1056/NEJMp1401245
39. **Garber AM.** A menu without prices [Editorial]. Ann Intern Med. 2008;148:964-6. [PMID: 18483127] doi:10.7326/0003-4819-148-12-200806170-00223
40. Choosing Wisely Web site. Philadelphia: ABIM Foundation; 2015. Accessed at www.choosingwisely.org on 8 January 2015.
41. **Caverly TJ, Combs BP, Moriates C, Shah N, Grady D.** Too much medicine happens too often: the teachable moment and a call for manuscripts from clinical trainees [Editorial]. JAMA Intern Med. 2014;174:8-9. [PMID: 24080955] doi:10.1001/jamainternmed.2013.9967

Current Author Addresses: Dr. Harris: Research Center for Excellence in Clinical Preventive Services, Cecil B. Sheps Center for Health Services Research, University of North Carolina, 725 Martin Luther King Jr. Boulevard, CB 7590, Chapel Hill, NC 27599.
Dr. Wilt: Minneapolis Veterans Affairs Health Care System and the Center for Chronic Disease Outcomes Research, 1 Veterans Drive (111-0), Minneapolis, MN 55417.
Dr. Qaseem: American College of Physicians, 190 N. Independence Mall West, Philadelphia, PA 19106.

Author Contributions: Conception and design: R.P. Harris, T.J. Wilt, A. Qaseem.
Analysis and interpretation of the data: R.P. Harris, T.J. Wilt, A. Qaseem.
Drafting of the article: R.P. Harris, A. Qaseem.
Critical revision of the article for important intellectual content: R.P. Harris, T.J. Wilt, A. Qaseem.
Final approval of the article: R.P. Harris, T.J. Wilt, A. Qaseem.
Statistical expertise: R.P. Harris, A. Qaseem.
Obtaining of funding: T.J. Wilt, A. Qaseem.
Administrative, technical, or logistic support: R.P. Harris, T.J. Wilt, A. Qaseem.
Collection and assembly of data: R.P. Harris, T.J. Wilt.