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Introduction

The introduction of prostate-specific antigen (PSA) testing for use in the early detection of prostate cancer has led to controversy regarding the appropriateness of prostate cancer screening and any subsequent treatment. This controversy is due, in part, to the fact that the effect of early treatment of prostate cancer on mortality is not yet known. However, other cancer screening programs such as breast and cervical cancer were implemented without such knowledge. In fact, proof of the efficacy of these other screening programs was based on their widespread use in the community and not on controlled, randomized trials. One critical difference between these other cancer screening programs and prostate cancer screening is that prostate cancer screening became available when cost control was a dominant concern in the health-care system. The rising cost of health care has made payors (employers, insurance companies, and federal and state governments) less willing to approve new benefits for their members.

Cost-Control Issues

The etiology of the current cost consciousness in health care is well known. American companies are now forced to compete globally. The relatively high price of health care for American businesses has decreased productivity and hampered their ability to compete internationally. Rising costs of health care have also placed a burden on federal and state governments. Ever increasing budget deficits and the contribution of Medicaid and Medicare to these deficits have compelled governments to better control their health-care costs.

Regardless of the present healthcare environment, the cost of care must always be considered; very few interventions in medicine, however, offer actual cost savings. Most add cost while hopefully providing a reasonable benefit to patients. Supplying endless cost-effective interventions could conceivably bankrupt our government and businesses.

Patients, whether they are young or old, curable or incurable, afflicted with cancer or benign disease, have always competed for health-care resources. In today’s health-care environment, they are competing for more limited resources as cost control efforts intensify. Currently, proof of efficacy and cost-effectiveness are central requirements for the implementation of new medical interventions. Practitioners must decide whether the dollars spent on a new intervention, such as prostate cancer screening, are worth the benefits (defined in terms of years of life saved, improved quality of life, or discomfort avoided) compared to alternative uses of the same dollars on more established interventions. The costs and benefits of prostate cancer screening and subsequent treatment can be definitively determined only by controlled, randomized trials with long-term follow up. Until such studies become available, doctors and patients must make decisions regarding the appropriateness of prostate cancer screening based on the currently available evidence.

Effect of PSA Screening on Costs of Prostate Cancer Treatment

From strictly a financial perspective, the most cost-effective method of treating prostate cancer is probably not to treat it at all. Treatment of a disease usually costs more than no treatment. However, to let men die of prostate cancer or even to let prostate cancer progress locally without intervention would be morally unacceptable in this country. While the United States is certainly willing to commit some portion of its health-care resources to the treatment of prostate cancer, the
level of such commitment is not known. The proportion of total health-care resources to be spent on treating prostate cancer is not merely an economic decision, but a social and ethical one as well. The controversy surrounding the expense of prostate cancer treatment is not due to the costs of treating prostate cancer detected by traditional methods (biopsy performed due to local symptoms, palpable nodule on digital rectal examination [DRE], or bone pain), but rather to the higher costs incurred from the widespread use of PSA screening. Society must decide whether this additional outlay of health-care resources is worthwhile. This decision will be based, in part, on the magnitude of these additional costs and the benefits they produce for patients.

Any discussion of the increased costs of prostate cancer due to PSA screening must address the issue of clinically insignificant prostate cancer. The incidence of prostate cancer has increased markedly with the introduction of PSA. If this increased incidence is due to the detection of a larger number of clinically insignificant prostate cancers, the cost of treatment will rise, with little benefit in terms of increased survival and with some increase in morbidity and mortality due to that treatment. This would not represent a wise use of health-care resources.

**Prevalence Cancers**

Several studies indicate that concern regarding increased incidental prostate cancer detection from PSA screening is unfounded.[1,2] By the strict pathologic criteria currently available, prostate cancer screening with PSA does not result in the diagnosis of a larger proportion of clinically insignificant cancers than were diagnosed by traditional methods of detection (biopsy performed due to local symptoms, abnormal DRE, or symptoms of metastatic disease). Much of the recent increase in the number of prostate cancer cases is due to the detection of prevalence cancers.[3] These are cancers that would have been diagnosed in later years by traditional methods, but are being caught earlier due to PSA screening. Once these prevalence cancers have been removed from the population by prostate cancer screening, the incidence of prostate cancer detection should return to approximate historical levels.[3]

Widespread use of PSA screening will certainly increase health-care costs. The cost of a serum PSA (with or without the cost of a DRE) will be incurred for all men screened. The use of PSA will also lead to a portion of screened men undergoing a transrectal ultrasound (TRUS) and prostate biopsy. These costs must also be attributed to screening. However, even without PSA screening, a significant number of these men would still undergo PSA testing and subsequent TRUS and prostate biopsy due to local symptoms or an abnormal DRE.

**Cost Analysis**

Several investigators have developed models to calculate the additional costs to the health-care system due to screening. Optenberg and Thompson estimated that the cost resulting from the first year of screening men ages 50 to 70 years, would be $27.9 billion.[4] They compared this to the $255 million currently spent for prostate cancer treatment for men in this age range. Kramer et al estimated that the total cost of the first year of prostate cancer screening with PSA for men ages 50 to 74 would be $11.9 billion.[5] These estimates include the costs of screening, diagnosis, treatment, and complications resulting from such treatment. These types of analyses can potentially lead to a gross overestimation of the costs of screening. First, not all men 50 to 70 years old will be eligible for screening due to various comorbidities that will decrease their life expectancy to less than 10 to 15 years. Second, not all men will submit to the screening examination. Virtually every medical group recommends serial mammography for women over age 50 and this recommendation has received widespread publicity for many years. Yet, fewer than 50% of eligible women have a mammogram on a yearly basis.[6] Furthermore, one-third of men who volunteered for PSA screening as part of a research protocol and subsequently had a suspicious examination refused further evaluation.[1,7] It seems likely that only a minority of eligible men would undergo PSA screening, and then only a portion of those men would pursue further evaluation if indicated. Since the costs of screening and diagnosis represent only approximately 10% of the total costs resulting from prostate cancer screening (the remaining costs come from subsequent treatment of the prostate cancers detected)[8], it is unlikely that these increased costs alone will significantly increase overall health-care costs.

However, treatment resulting from prostate cancer screening with PSA will increase overall health-care costs. This increase will not be due to the detection of clinically insignificant prostate cancer. The majority of prostate cancers detected as a result of PSA screening are clinically significant, and therefore would have eventually required treatment (provided screening is done in men with more than 10 years of life expectancy).[1,7] Prostate-specific antigen screening will diagnose cancers earlier than traditional methods of prostate cancer detection, and this early detection will increase health-care costs by two factors: cost discounting and stage migration.
Effect of Cost Discounting
Since prostate cancers detected by PSA screening will be treated several years earlier than if PSA screening were not done, treatment costs will be paid in present dollars rather than future dollars. The present-value cost of treatment today is greater than the cost of that treatment at some point in the future, just as a dollar paid to someone today is worth more to that person than a dollar to be paid 1 year from today. The reason for the increased value today is that the recipient does not have to wait 1 year to obtain the money and therefore will have access to that dollar for investment, consumption, or spending.

Carter et al have estimated that PSA screening will detect a prostate cancer on average 2.6 to 11.2 years earlier than it would have been detected by traditional methods.[9] Table 1 demonstrates the increased costs, in present- value dollars, when radical prostatectomy is performed several years earlier. A cost of $14,000 is assumed for radical prostatectomy with discount rates of 6%, 8%, 10%, and 15%.

The concept of present value recognizes that money paid in the future is worth less than the same amount of money paid today. This difference in value occurs because the recipient of money in the future misses the advantages of a purchase or investment that would have been possible if that money were paid today. This difference in value can be quantitated using the following relationship:

\[
PV = \frac{C}{(1 + r)^t}
\]

where PV is present value, C is the amount of money paid, r is the risk-adjusted discount rate, and t is the time period when future money is to be paid.

The risk-adjusted discount rate (r) represents the opportunity cost of money for the individual or company in question. Both objective and subjective factors are used to estimate r. The risk-adjusted discount rate will vary based on the financial organization of a company. Because of the uncertainty regarding the appropriate risk-adjusted discount rate for a group as diverse as health-care payors, a range of possible r values was used to generate Table 1. The rationale for this range of values was that health insurance is a predictable business using actuarial analysis. Because of this predictability, an r of 15% is a reasonable high-end estimate. For a health care payor with at least some degree of business risk to have an r as low as 6%, the yield on long-term (20 to 30 years) federal treasury bonds, which are perceived to be risk-free, would probably have to fall below 4%. Given the range of interest and inflation rates over the past 30 years, this scenario appears to be unlikely and thus 6% is a good low-end r value.

Effect of Stage Migration
The second reason for the higher costs resulting from PSA screening is due to the stage migration effect. More than 95% of prostate cancers detected by PSA screening will be clinically localized and therefore eligible for early treatment,[1,7] while prostate cancers detected by traditional methods are clinically localized in approximately 63% of cases.[10] Therefore, a larger proportion of men will be candidates for early treatment when PSA screening is widely practiced. This stage migration will increase costs because treatment of clinically localized disease (such as radical prostatectomy and external-beam radiation) is more costly than treatment of metastatic disease (androgen ablation).[11]

Although PSA screening detects clinically-localized disease in more than 95% of cases, only 65% to 75% of those cases will have pathologically organ-confined disease.[1,7] The percentage of extraprostatic cancers detected by screening is consistent with reports that 30% of men receive adjuvant therapy after radical prostatectomy. This adjuvant treatment will add more costs to the group of men detected by PSA screening. In contrast, while traditional methods of detection result in approximately 63% of cases being clinically localized, only half of those cases are pathologically organ-confined disease.[12] Therefore, an approximately equivalent number of men in both groups will be candidates for adjuvant therapy.

The timing of therapy (and subsequent cost discounting) will again be a factor, as the PSA-detected group of men will be candidates for adjuvant therapy several years earlier than those screened by traditional methods. Adjuvant treatment options for men who have undergone radical prostatectomy and are found to have residual cancer include radiation therapy or early or delayed androgen ablation. Both groups of men will probably be candidates for delayed hormonal therapy at similar times, negating the effect of discounting. No data exist to estimate the ratio of different adjuvant treatment modalities utilized in the PSA-detected and traditionally detected groups of men.

The costs of palliative treatment for local symptoms (medical therapy, TURP, androgen ablation) will be decreased by screening and subsequent early treatment since radical prostatectomy and radiation therapy lower the risk of local progression. This savings must be balanced by the increased spending needed to treat the complications of early treatment (incontinence, impotence, and
bladder neck contracture). Therefore, the net effect of these countering forces cannot be accurately calculated since no adequate control groups exist from which to estimate the need for and timing of palliative treatment for local symptoms in men who do not undergo PSA screening. Some have suggested that curative treatment of prostate cancer at an early stage by radical prostatectomy or radiation therapy will result in lower costs because the patient will be spared (and the payers will be saved the cost of) a death from metastatic prostate cancer. These costs would include palliative treatment of local disease (TURP, androgen ablation), palliative treatment of distant disease (radiation for bone pain, ureteral bypass for obstruction, pain control), and chemotherapy for hormone-refractory disease. However, one issue on which everyone can agree is that all men, with or without prostate cancer, will eventually die. No evidence exists that death from metastatic prostate cancer is either more or less costly than other causes of death.

Estimates of the Effectiveness of Prostate Cancer Screening

Two recent analyses by Krahn et al[11] and Fleming et al[13] of the effectiveness of the treatment of early-stage prostate cancer have found little or no clinical benefit from such treatment. These studies received widespread attention in the popular media and medical literature, resulting in an increased emphasis on watchful waiting for early-stage prostate cancer. Both studies employed the decision analysis (Markov) models. Markov models place patients in different disease states (e.g., no evidence of disease, local symptoms, metastatic disease, death) that may change over designated periods of time. Utility factors are assigned to patients who suffer complications of treatment (impotence, incontinence, bladder neck contracture). The outcomes calculated from decision analysis models are heavily dependent on the assumptions used to construct those models. Given the publicity that these studies have received and the controversy that they have generated, it is worthwhile to evaluate the validity of the assumptions on which these models are based.

Rate of Progression

The most important assumption in the models of the effectiveness of prostate cancer treatment is the rate of disease progression. Both analyses based their rate of progression for untreated patients on a Swedish cohort of men with clinically-localized prostate cancer who were said not to have received treatment.[14] Risk of progression was stratified by clinical stage in the Krahn study[11], and by grade in the Fleming study.[13] The yearly rate of metastatic progression in the Fleming study was 2.7 per 1,000 patients for men with well-differentiated tumors, 13 per 1000 patients for men with moderately differentiated tumors, and 42 per 1,000 patients for men with poorly differentiated tumors.

There are several reasons why this cohort of patients may not be a representative sample of men with clinically localized prostate cancer detected by screening. The average age of the men in the Swedish study was 72, which is older than the ages recommended for screening (men ages 50 to 70 years). Moderate or poorly differentiated disease was present in 34.2% of men with cancer in the Swedish study,[14] while 77.6% and 78.2% of the men diagnosed with cancer in large-scale United States screening trials had moderately or poorly differentiated disease, respectively.[1,7] In addition, a large proportion of the men were diagnosed by cytology, which can lead to the overdiagnosis of prostate cancer.[15] Not all of the men in the study went untreated since almost half of them had undergone hormonal therapy at some point during follow-up. Since the study took place prior to the PSA era, biochemical progression due to rising PSA could not be measured. Serum acid phosphatase, although available, was not measured. This cohort could be representative of a group of men destined not to progress. Although the death rate from prostate cancer in Sweden is among the highest in the world, the men in this study had a very low rate of progression. This low rate of progression may represent a reverse length time bias. Since these men were diagnosed by traditional methods of detection (resulting in late detection) and not by PSA (leading to earlier detection), by the time of diagnosis, the men who were destined to progress may already have been selected out of the cohort. There is no question that some men with clinically localized prostate cancer will not live long enough to progress. This group of men may simply represent a group with a large proportion of nonprogressers, and not a true spectrum of clinically localized prostate cancers.

The outcomes of decision-analysis models are heavily influenced by the assumptions used to construct the model, most importantly, the rate of progression. Although sensitivity analyses were performed in both studies using different treatment efficacies, no sensitivity analysis was performed using different estimates of the natural history of prostate cancer. A sophisticated computer model is...
not necessary to determine that men with a .0027 annual risk of progression do not need treatment! Beck et al performed a sensitivity analysis based on the Fleming Markov model but with more realistic progression rates.[16] In their sensitivity analysis, Beck et al used progression rates from a meta-analysis of recent watchful-waiting series[17] and from men treated with brachytherapy at the Scott Department of Urology (Table 2).[16] Results were calculated with and without the quality-of-life adjustments of the Fleming model and are shown in Table 3. By using these more realistic assumptions of the natural history of prostate cancer, the years of life saved by the treatment of early-stage prostate cancer increase by as much as 13 fold. Treatment of moderately differentiated disease results in 2.58 to 3.06 years of life saved, while treatment of poorly differentiated disease results in 2.34 to 2.78 years of life saved. The years of life saved, using these assumptions of the natural history of prostate cancer, compare very favorably to the years of life saved by other cancer screening programs.[18]

**Quality-of-Life Adjustment**
The decision analysis models also adjust for changes in the quality of life due to the side effects of treatment, such as impotence and incontinence. These complications are assigned utility values, which are incorporated into the health states (eg, no evidence of disease, local progression, metastatic disease) through which the patient progresses.

While not as important as the rate of progression, quality-of-life adjustments are critical in these models. Given the assumed low rate of progression of disease in these models, most men live for many years after treatment whether or not they are cured. Therefore, quality-of-life differences are multiplied by many years and will markedly affect the results. The quality-of-life adjustments assigned to complications of treatment were not based on standardized, validated questionnaires. In the Krahn study, the effects of complications on quality of life were based on estimates from a small group of urologists, radiologists, and oncologists.[10] In the Fleming study, utility values were assigned to each health outcome state based on a consensus of clinicians involved in outcomes research and treatment of prostate cancer. Patients with prostate cancer were not surveyed in either study.

In both decision-analysis models, patients with no evidence of disease were assigned a utility value of 1.0. No quality-of-life benefit was assigned to men who were cured of disease. Many urologists, familiar with the satisfaction that a patient who undergoes radical prostatectomy expresses when told his prostate cancer is pathologically organ-confined and his postoperative PSA is undetectable, may disagree with this assignment. In addition, no decrease in quality of life was given for men who did not receive treatment and were left with the knowledge that they have cancer and are at risk for progression.

**Impotence**
The studies by Krahn et al and Fleming et al assume that the rate of impotence for radical prostatectomy is 31% to 65%. However, the baseline impotence rate is not discussed. Men who were impotent preoperatively should not have their quality of life adjusted downward due to preexisting impotence. In addition, a potent 60-year-old man who becomes impotent postoperatively will have his quality of life adjusted downward for the remainder of his life using these models. The models do not take into account the fact that a significant portion of men become impotent later in life whether or not they are treated for prostate cancer. Furthermore, in these models the quality-of-life adjustment remains steady for a given complication for the remainder of a patient's life. It is unlikely that the quality-of-life adjustment from impotence is the same for a man at age 50 as at age 70. This method of assigning quality-of-life changes has questionable validity, as would any large-scale standard. However, even if a large-scale standard was developed that had validity and reproducibility, its ability to measure quality-of-life changes for individual patients would remain suspect. It is likely that each patient will process the stated risk of complications according to his own unique values, motivations, and priorities. Only that individual can weigh the importance in his life of continence, potency, the risk of local progression, the risk of distant disease, and the risk of death. If a patient is given full, informed consent, he will select his treatment option, including watchful waiting, based on his own preferences and priorities. If he is willing to accept a risk of complications for the perceived benefit of aggressive treatment, his quality-of-life adjustment may be less than expected if a complication occurs because he accepted the risk of complications preoperatively.

**Discounting Future Years of Life**
The discounting of future years of life, similar to the way future costs are discounted, is a controversial issue. The decision to discount future life-years is especially important for screening or preventive programs, for which the costs are immediate but the health benefits are reaped in the future.
future. For screening programs, the cost-effectiveness relied heavily upon whether future benefits are discounted. This is particularly true for prostate cancer screening because of the lead time connected to PSA and the generally slow growth of prostate cancer. Present-value analysis is a widely accepted technique of weighting future dollars by a discount factor to make them comparable to present dollars. Some authors argue that for the sake of consistency, the same discount factor should be applied to future health benefits as well. The reason for discounting future years of life saved is not that life-years can be invested to yield more life-years in the same way that dollars can be invested to yield more dollars, but rather, that future years of life are being valued relative to dollars. If a dollar in the future is discounted relative to a present dollar, a year of life in the future should be discounted relative to a year life in the present. If a constant steady-state relationship between dollars and health benefits is assumed, then health benefits must be discounted as well as health costs. However, discounting future years of life assumes that life-years in the future are less valuable than life-years today, from both a financial and utilitarian perspective. The rate by which to discount future years of life is also a matter of uncertainty. The financial discount rate depends on many factors, including the interest rate. Interest rates reflect differences between the productive potential of investment capital and individual preferences vs future consumption of goods and services. Although historical trends are available to predict future interest rates, there is a large degree of uncertainty about these predictions. Medical knowledge and technology may improve in the future, which could make saving lives in the future less expensive, further discounting future years of life saved. Societal attitudes concerning willingness to pay for years of life saved are subject to change, which could increase or decrease the [value] of future years of life. The cost of health care may also change, becoming more or less expensive compared to the opportunity cost of money. In computer models, the discount rate applied is 5%. For this approach to achieve validity, extensive questioning of people of different ages over a multiyear time horizon determines whether a year of life is worth more to a 60-year-old man than to a 70-year-old man and, if so, whether 5% is the appropriate discount rate. Until such data are available, the validity of discounting the future value of human life remains questionable.

**Cost-Effectiveness of Prostate Cancer Screening and Treatment**

Benoit and Naslund have estimated the cost-effectiveness of prostate cancer screening in terms of cost per year of life saved. In this study, no attempt was made to estimate the rate of progression of untreated, clinically localized prostate cancer diagnosed by screening. Although no randomized, controlled study of the effectiveness of prostate cancer screening has been performed, several studies have demonstrated that men with pathologically organ-confined prostate cancer treated with radical prostatectomy have the same life expectancy as age-matched men without prostate cancer. However, there are no available data that show how many years of life would have been lost in this cohort if they were not treated for their prostate cancer. A study by Grönberg et al, which compared the survival rate of men with prostate cancer to the survival rate of men in the national standard population, was utilized to estimate this important information. These men with prostate cancer were treated by noncurative methods only (watchful waiting, radiation therapy, androgen ablation) and were not treated with radical prostatectomy. The difference in survival rates between the men with cancer and the overall population of men were the years of life lost due to prostate cancer. These results are similar to the years of life lost due to prostate cancer in American men as calculated by Albertsen et al. The rate by which to discount future years of life is also a matter of uncertainty. The financial discount rate depends on many factors, including the interest rate. Interest rates reflect differences between the productive potential of investment capital and individual preferences vs future consumption of goods and services. Although historical trends are available to predict future interest rates, there is a large degree of uncertainty about these predictions. Medical knowledge and technology may improve in the future, which could make saving lives in the future less expensive, further discounting future years of life saved. Societal attitudes concerning willingness to pay for years of life saved are subject to change, which could increase or decrease the [value] of future years of life. The cost of health care may also change, becoming more or less expensive compared to the opportunity cost of money. In computer models, the discount rate applied is 5%. For this approach to achieve validity, extensive questioning of people of different ages over a multiyear time horizon determines whether a year of life is worth more to a 60-year-old man than to a 70-year-old man and, if so, whether 5% is the appropriate discount rate. Until such data are available, the validity of discounting the future value of human life remains questionable.

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Accuracy of Cost-Effectiveness Analyses

Society’s objective in the expenditure of health-care resources is to maximize health benefits for the dollars spent. To facilitate these allocation decisions, the best information on both the efficacy of medical practices and their costs must be made available to decision-makers. If this information is not available, society (or the decision-makers society has appointed) cannot make valid comparisons of alternative uses for the available resources.

Lack of Data

The costs of prostate cancer screening, diagnosis, and treatment that would result if PSA screening were implemented nationally are unknown. This lack of information is due to several factors. The number of men who would undergo screening, subsequent diagnosis, and treatment is difficult to predict. National cost data for radical prostatectomy or external-beam radiotherapy are not available. Likewise, longitudinal cost data that demonstrate the short- and long-term costs associated with routine follow-up care and the care of complications resulting from treatment of prostate cancer have not been published.

Less information is available on the efficacy of prostate cancer treatment. The evolving techniques of several treatment options for clinically localized prostate cancer (radical prostatectomy, external-beam radiotherapy, cryosurgical ablation of the prostate, and interstitial radiotherapy), as well as the long follow-up needed to determine the efficacy of prostate cancer treatment, leave little solid data on the long-term results of current treatments for clinically localized prostate cancer. Given the paucity of data regarding the cost and efficacy of prostate cancer screening and treatment, a cost-effectiveness analysis cannot accurately predict the benefit (or lack of benefit) of prostate cancer screening. A cost-effectiveness analysis must limit uncertainties and intangibles to achieve accuracy. The lack of solid data results in these uncertainties dominating any analysis.

Several studies have evaluated the effectiveness and cost-effectiveness of prostate cancer screening and treatment. Despite the inaccuracies inherent in these analyses, the studies have received widespread attention and have been used to justify the denial of prostate cancer screening.

Objectives of Cost Analysts

The particular objective of the cost-effectiveness analyst must also be considered. Patients, physicians, and payors all have an interest in the outcome of these studies. Patients in a third-party payor system are interested only in the benefits of screening and treatment and are not concerned about the costs involved. Physicians are certainly not disinterested participants in this controversy. Urologic surgeons stand to benefit both financially and in terms of prestige. Other specialists also have a stake in this issue since resources spent on prostate cancer screening and treatment will reduce the dollars available for the treatment of other diseases.

The payors of health care seek to limit expenditures while maintaining client satisfaction. Prostate-specific antigen screening will increase the resources expended to treat prostate cancer because of the lead time and stage migration associated with the early detection of prostate cancer. Additionally, private insurers generally cover their clients until the age of 65, at which time Medicare assumes coverage. The lead time associated with PSA screening will result in a substantial proportion of men being diagnosed with prostate cancer prior to rather than after age 65, therefore transferring costs from Medicare to private insurers. Studies that demonstrate the lack of effectiveness or cost-effectiveness of prostate cancer screening and treatment allow health-care payors to deny these benefits without resulting in client discontent.

Conclusions

Widespread PSA screening will increase overall health-care costs. This increase will not result from the detection of clinically insignificant prostate cancer, but rather, from the stage migration caused by prostate cancer screening. This stage migration will result in a larger percentage of men with prostate cancer undergoing early treatment, which is more expensive than treatment of late disease. More importantly, early detection of prostate cancer will lead to treatment several years earlier than would have occurred otherwise. Since treatment will then be paid for in current rather than future dollars, the opportunity costs of money will make treatment costs resulting from PSA screening more expensive than treatment resulting from traditional detection.

The critical question is, what benefits will be reaped by the expenditure of these additional health-care dollars? If early treatment of clinically localized cancer has little or no effect on cause-specific survival, the additional costs will have been incurred only to limit eventual treatment of local symptoms in the screened men. If early treatment can increase survival, the added expense
would be more worthwhile. Since there are no adequate data available to address this issue, several approaches have been used to develop models to estimate cost effectiveness. Decision-analysis models that evaluate the effectiveness of prostate cancer screening and treatment have found little or no benefit. The current review has demonstrated how the assumptions used in those models can influence the results. Benoit and Naslund have constructed a model of the effectiveness and cost-effectiveness of prostate cancer, but in this model, only concrete parameters, such as cost, published complication rates, and survival data, were used. This quantitative analysis demonstrated that prostate cancer screening may well be an effective and cost-effective health-care intervention compared to currently accepted medical interventions. Although men ages 50 to 70 will potentially benefit the most from PSA screening, this benefit will not be realized until they are in their seventh or eighth decade of life. Society must decide if the years of life saved in these men warrants the use of its limited health-care resources. This decision will be easier when randomized, controlled trials are available to quantify the costs and benefits of PSA screening.

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