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GRANT NUMBER DAMD17-96-1-6017

TITLE: Breast Cancer: Treatment, Outcomes, and Cost-Effectiveness

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REPORT DATE: July 1997

TYPE OF REPORT: Annual

PREPARED FOR: Commander
U.S. Army Medical Research and Materiel Command
Fort Detrick, Frederick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for public release;
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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	July 1997	Annual (1 Jun 96 - 31 May 97)

4. TITLE AND SUBTITLE
Breast Cancer: Treatment, Outcomes, and Cost Effectiveness

5. FUNDING NUMBERS
DAMD17-96-1-6017

6. AUTHOR(S)
Dr. Mark B. McClellan

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
National Bureau of Economic Research
Cambridge, MA 02138

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Medical Research and Materiel Command
Fort Detrick
Frederick, Maryland 21702-5012

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200*

Little is known about the relationships between breast cancer treatments, costs, and outcomes across different population groups, health care delivery settings, and geographic areas. As a result of this uncertainty the cost-effectiveness of different patterns of breast cancer prevention and treatment across such groups, appropriate policies for breast cancer are unclear. This research will develop evidence on these issues using a combination of very large, unique databases that integrate longitudinal information on individual treatments, costs, and outcomes and that have been linked to supplementary datasets with far more clinical detail. We will characterize variations and trends across different demographic and socioeconomic groups in all phases of breast cancer screening and treatment. We will investigate variations and trends for different measures of inpatient and outpatient costs, and different measures of patient outcomes. The resulting empirical cost-effectiveness estimates of alternative approaches to breast cancer treatment can be used to evaluate technologies used for breast cancer treatment and to guide policies affecting breast cancer management.

14. SUBJECT TERMS Breast Cancer	15. NUMBER OF PAGES 9
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

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7/22/97

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INTRODUCTION

Breast cancer is a leading cause of mortality, morbidity, and health-care spending in the United States.[1] Like other diseases with major implications for health policy, however, alternative breast cancer treatment patterns and their cost-effectiveness in practice are not well understood. A large literature has identified substantial geographical variation in the use of medical treatments and procedures that is unrelated to any plausible variations in health characteristics.[2,3] The variations seem instead to reflect differences in provider beliefs about the costs and benefits of alternative treatments, and resulting differences in the "standard practice" of hospitals or provider groups.[4] Medical practice patterns in the United States suggest that such uncertainty appears is a fundamental aspect of care for breast cancer as well. For example, the use of breast-conserving therapy varies threefold across geographical areas and by even larger degrees across hospitals, suggesting significant uncertainty about the best treatment option.

Although randomized clinical trials have provided important guidance for breast cancer treatment decisions,[5,6] they are subject to significant limitations.[7] In particular, randomized clinical trials are expensive and often have sample sizes too small to demonstrate the best treatment for particular kinds of patients; they face ethical obstacles, since physicians or patients suspect one of the alternative treatments will be more effective in particular cases; they are often performed in settings such as teaching hospitals that are not representative of "real-world" practice; they frequently do not include measures of costs and long-term outcomes[8,9]; and they can only provide estimates of "average" not "marginal" effects. For example, most commonly-used medical treatments are clearly effective in some patients, so the relevant question is not whether they should be used, but how often. What would be the effect of a marginal increase or reduction in the use of a treatment? The primary goal of this project is to estimate the effect of alternative treatments on health outcomes in marginal patients, and to identify treatments that could be used less frequently without worsening health outcomes. In addition, because the statistical methods of this project will use treatment and outcome data for an enormous sample of breast cancer patients whose treatment decisions have been made in real-life medical settings, they provide a useful complement to randomized clinical trials.

This project will provide detailed quantitative evidence on the survival, health complications, quality of life implications and costs associated with alternative breast cancer treatments. Medical treatment choices are the most important determinants of both breast cancer outcomes and breast cancer costs. However, there is a great deal of uncertainty about the effectiveness of alternative treatments, as evidenced by the large variation in treatment patterns across geographic regions and individual providers. This project will focus on two categories of treatment decisions. One part of the project will focus on localized breast cancer, including the survival, health complications, quality of life implications and costs associated with radical mastectomy versus breast conserving therapy with adjuvant radiation or chemotherapy. We will also investigate the consequences of alternative approaches to adjuvant therapy and to follow-up surveillance for recurrence. The second part of the project will focus on metastatic breast cancer, emphasizing the consequences of more and less aggressive chemotherapeutic and radiation regimens for survival, cancer and cancer therapy complications, quality of life, and medical costs. Both phases will develop detailed quantitative evidence on variation in treatment for these cancers associated with nonclinical factors such as availability of medical technologies and provider and patient financial incentives, and on the effectiveness of alternative treatments in improving health outcomes. The key resources for the

project are the development of an enormous database on patients treated for breast cancer, and an innovative methodology that has been applied extensively to statistical analyses in economics, but has only recently been used to evaluate the cost and outcome consequences of medical treatment decisions.

At least two analytic approaches will be used in studying both localized and metastatic breast cancer treatment. The cost and outcome consequences of alternative treatments will be estimated using instrumental variables (IV) techniques to correct for differences in the severity of illness among patients receiving alternative treatments. The IV methods will compare patient populations that differ in terms of nonclinical factors (such as access to technologies, competitive pressures, and payment incentives) which influence treatment decisions. These methods permit unbiased analyses of treatment effectiveness using real-world data on very large samples of patients, thereby avoiding many limitations of randomized clinical trials. We will also conduct a series of descriptive analyses to describe how breast cancer treatment varies across hospitals, medical plans, geographical areas, patient characteristics, and over time. As both a component of and supplement to the outcome studies, these descriptive analyses will be used to describe the policy implications of the results.

BODY

1. Experimental Methods, Assumptions, and Procedures

The first year of this research grant has focused on acquiring necessary datasets and creating analytic variables for studying breast cancer in the elderly. With assistance from the National Cancer Institute and the Health Care Financing Administration, we obtained complete medical claims records for all Medicare beneficiaries who were treated for breast cancer between 1984 and 1994. Information regarding all covered services (inpatient, hospital outpatient, ambulatory and physician care, durable medical equipment, home care, hospice care, and skilled-nursing and rehabilitation care), key discharge information (discharge destination and condition), and demographic information (including residence information at the zip code level) are included. Together, these claims data comprised over 50 gigabytes of information that had to be processed into analytic variables for our research. We also obtained detailed information on cancer stage, grade, and course of treatment for all Medicare beneficiaries covered by the Surveillance, Epidemiology and End Results (SEER) Cancer Registry Database who were diagnosed with breast cancer between 1984 and 1993. We have fully linked these registry files to our Medicare claims records.

From these datasets, we have created and checked all of the *individual* level variables that we plan to use in our research, including variables describing the demographic characteristics, associated diagnoses, medical treatments, health care utilization history, medical costs, and outcomes for the populations in our study. For example, variables that we have constructed from the SEER data include the following: breast cancer patient cohorts by year of diagnosis, site and stage at diagnosis, histology, first course of treatment (including multiple modalities, if applicable), survival time, and cause of death. The variables we have constructed from the claims data include the following: various dimensions of treatment costs, measures of the use of followup treatments such as consolidation chemotherapy, and the occurrence of hospitalizations for cancer complications such as metastases, malnutrition, and opportunistic infections. We have explored all cases where SEER and claims data reports of treatments or complications do not agree, and have developed algorithms for resolving all discrepancies.

With the completion of our checks of the individual level data, we have begun to construct variables at the *hospital* level (e.g., presence of an oncology program, ownership, teaching status, characteristics of the volume and mix of cancer patients, and technological capabilities) and the *area* level (including population socioeconomic characteristics, features of hospital regulation and reimbursement, geographic access to intensive services, state laws governing medical malpractice, and the characteristics of medical markets).

We have also begun the descriptive component of our analytic strategy. We have used our individual-level variables to construct preliminary models of differences in cross sections and in trends across subpopulations in health characteristics, utilization, expenditure, and outcome patterns. These exploratory models are being used to identify the most important individual demographic and clinical characteristics for predicting utilization, expenditure, and health outcomes, and to identify the treatments associated with high expenditures and high expenditure growth. We are paying particular attention to the extent to which our models can detect any significant differences for patients from minority racial groups and for patients residing in neighborhoods with low relative and

absolute incomes. The results of these descriptive models will form the basis of our instrumental variables (IV) methods and related statistical techniques to determine directly the costs, benefits and quality-of-life implications of more versus less intensive treatment of breast cancer patients. We are beginning to test the IV models on our preliminary datasets by focusing on two kinds of legal reforms that appear to have important consequences for the treatment of breast cancer patients: state malpractice reforms and state legislation regarding the "right to die."

2. Results and Discussion

The first year of the project has focused on obtaining, checking, and developing analytic variables from a broad range of large databases. While the extensive data checks have led us to conclude that our new analytic datasets are adequate for the proposed research, we have not yet finalized our descriptive or IV estimation results and so do not yet have final results to present on the two major components of the proposed research. We anticipate producing two manuscripts in the next six months on the descriptive component of our analyses, followed by more complete attention to the proposed instrumental variables analyses.

3. Recommendations

No recommendations yet; only one year of project completed so far.

CONCLUSIONS

The data processing and validation, along with the estimation of preliminary versions of our analytic models, constituted the bulk of our first-year work. These initial studies have shown that the proposed analyses are feasible. The execution of these studies using the databases and models developed in year one will constitute the principal tasks for the remaining two years of the project.

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