IMPAIRMENT-DRIVEN PATTERNS OF HEALTH CARE UTILIZATION AMONG BREAST CANCER SURVIVORS OVER TWO DECADES OF FOLLOW UP

Andrea L. Cheville, M.D., MSCE;¹ Jeffrey R. Basford, PhD, M.D.;¹ Mary Lynch, MD;¹ Minji Lee, PhD²; Terry Therneau, PhD²

1. Department of Physical Medicine and Rehabilitation, 2. Department of Health Sciences Research
Mayo Clinic, Rochester, MN

Abstract

Background: Cancer-related impairments degrade survivors’ quality of life, independence, and societal integration, yet may be ameliorated, or even reversed, with effective care. Unfortunately, few patients receive care for their impairments. The impact of this neglect remains under-researched and its impact on healthcare (HC) utilization is unknown.

Objective: To delineate the magnitude and patterns of HC utilization between breast cancer (BC) survivors with and without one of its most common, remediable and functionally limiting sequelae; upper extremity lymphedema.

Design, Setting, Participants: We conducted a population-based, retrospective longitudinal cohort study of Olmsted County, MN residents who were newly diagnosed with BC in the 21 year period beginning on January 1, 1990 and concluding December 31, 2010. HC utilization was characterized using the Berenson-Eggers Type of Service (BETOS) categories.

Main Outcome Measure: Overall HC utilization as well as its compartmentalization into the BETOS categories of: 1) Evaluation and management, 2) Procedures, 3) Imaging, 4) Tests, 5) Durable medical equipment, 6) Physical/occupational therapy, 7) Other, and 8) Exceptions/Unclassified.

Results: The cohort included 1906 subjects of which 94% (1800) had records meeting the inclusion criteria. Mean follow-up per survivor was 8.8 years (median, 8, range 1 - 23 years); 1239 were living and residing in Olmsted County at the study’s conclusion. Analysis revealed that 1) survivors with BC-associated lymphedema used >30% more services annually than their unaffected counterparts; 2) their increased utilization lessened but persisted for at least 10 years after diagnosis; and 3) this finding of increased utilization is robust, extending across all BETOS categories, and is further amplified as BMI increases.

Conclusions: An analysis of BC-related lymphedema as an exemplar of cancer impairment-associated HC utilization revealed that this often remediable condition is associated with a significant, >30%, increase in HC utilization that extends for a prolonged period.

Background

Cancer and its treatment often result in physical impairments that limit a survivor’s quality of life (QoL), independence, and societal integration. Fortunately, effective care can ameliorate, or even reverse, their impact.^{1,2} Effective care, however, requires both the detection of impairments in their early and most modifiable stages, and the rapid initiation of treatment.³ Unfortunately, neither of these capabilities is widely available as current pathways typically involve neither systematic screening for the presence of impairments nor means to provide the needed care.⁴ As a result, few patients receive care for their impairments and more than half of cancer survivors are needlessly limited by treatable impairments.⁵⁻⁷ The impact of this failure is well recognized and is expected to grow as cancer treatment improves and our population ages. What is not known is the cost of this neglect.

Cancer–related impairments are heterogeneous and range from gait instability and recurrent falls due to peripheral neuropathy to chronic pain. Given this heterogeneity, the fiscal impact of all cannot be estimated at once. Yet focusing on a single example can be instructive, and lymphedema, as one of the most studied, serves as an effective exemplar in evaluating impairment-driven health care utilization.

There are several compelling reasons for this choice. First, lymphedema remains common and, despite lymph node sparing surgeries, continues to effect at least 15% of the quarter million patients annually diagnosed with breast cancer (BC), as well as a significant proportion of those treated for melanoma, endometrial, and prostate cancers.⁸⁻¹⁰ Second, as is true of most cancer-related impairments, it is chronic and associated with degraded quality of life, but can be remediated and controlled through early diagnosis and management.³ Third, it can be objectively defined and is easily recognized. Finally, lymphedema shares with other cancer related impairments a propensity to produce additional medical and functional morbidity.

Similar to lymphedema related to other cancers, BCRL’s impact on healthcare (HC) utilization is unstudied, with the exception of a single report that near-term direct costs are substantially increased among survivors with BCRL.¹² The extent to which this increase persists is unknown. In summary, BCRL is a common, disabling, and relatively easy-to-assess exemplar of cancer-related impairments whose long-term impact on health care utilization is unknown. Given this, we conducted a population-based, longitudinal cohort study to characterize the magnitude and patterns of differential health care utilization between BC survivors with and without BCRL.

Methods

Study Sample: All incident cases of breast cancer in Olmsted County between 1/1/1990 and 12/31/2010.

Data:

Independent variable: Presence of breast cancer-related arm lymphedema as ascertained by diagnostic codes, natural language processing-enhanced record review, survey.

Dependent variable: HC utilization charges from January 1, 1995, when billing codes first became available through the REP, or index date, if after 1995, through 12/31/2012 were characterized using the well validated and widely used Berenson-Eggers Type of Service (BETOS) categories. BETOS codes are assigned for each Health Care Financing Administration Common Procedure Coding System (HCPCS) procedure code. They were devised as readily understandable clinical categories (as opposed to statistical or financial categories) for analyzing increases in Medicare expenditures. BETOS categories include: 1) Evaluation and management, 2) Procedures, 3) Imaging, 4) Tests, 5) Durable medical equipment, 6) Physical/occupational therapy, 7) Other, and 8) Exceptions/Unclassified.

Covariates: Breast cancer stage, breast surgery, axially surgery, radiation therapy, systemic breast cancer treatment (chemotherapy, hormonal therapy), number of lymph nodes removed, BMI, affected side, age, gender

Statistical analyses: BETOS counts were aggregated by survivorship year of post BC follow-up for each patient creating a data set with multiple rows per subject. The primary analysis used all BETOS codes. Secondary analyses used specific categories of evaluation and management, imaging, procedures and physical/occupational therapy. Since the data are counts, analysis was based on Poisson regression; to account for possible correlation of within subject rows generalized estimating equations (GEE) were used, assuming an autoregressive error pattern. Model covariates included gender, age, cancer stage, breast and axillary surgery, and adjuvant hormonal therapy, chemotherapy, or radiation therapy (receipt of any versus none). Splines were used to model the relationship between response and the continuous covariates of BMI and age. Exploration of the model’s goodness of fit included the use of other correlation structures (exchangeable and working independence), the use of zero-inflated models to account for subjects with no follow-up costs, and the use of over-dispersed Poisson and negative binomial models to account for possible excess between-patient variation.

Results

- 1906 Olmsted County residents developed incident BC from 1990 to 2010
- 1800 were assessed as 25 (1.3%) had not granted permission for use of their health records and 81 (4.2%) had no recording of additional HC encounters.
- 86 individuals entered the cohort each calendar year (range 45 to 118).
- Members contributed a mean of 8.8 years of follow up per survivor (median, 8, range 1 - 23 years).
- When follow up was completed, 1239 cohort members we alive and resided in Olmsted County.

GEE Quasipoisson model output

Coefficients	Estimate	Robust S.E.	P
Intercept	-4.52	6.10	.46
age (spline)			< .001
BMI (spline)			< .001
Lymphedema	0.26	0.03	< .001
Year since index	-0.02	0.003	< .001
Axillary surgery*			
Sentinel lymph node biopsy	0.06	0.04	.12
Axillary dissection	0.05	0.04	.17
Breast surgery†			
Mastectomy	-0.09	0.04	.03
Mastectomy with contralateral simple mastectomy	-0.11	0.05	.02
Male	0.82	0.25	.001
Any hormone	-0.09	0.03	< .001
Any chemotherapy	0.11	0.03	.001
Any radiation‡	-0.10	0.04	.01
Calendar year of service	0.005	0.003	.12
Stage II§	0.16	0.03	< .001
Stage III§	0.39	0.06	< .001
Stage IV§	0.43	0.14	.002

* Control was “no axillary surgery.”
† Control was “lumpectomy or excisional biopsy”
‡ Control was “no radiation”
§ Control was “Stage B-I”

Utilization increase associated with BCRL across service types

All utilization as a function of BMI & Age

Conclusions

- BCRL is associated with persistently increased utilization of all service types that persists at least a decade following BC diagnosis. The increase, 31% overall, could not be wholly accounted for by BCRL-related treatment and morbidity. Efforts to detect and address impairments in a timely manner warrant examination as a means to mitigate sustained increases in survivors’ HC utilization.