Relative Dose Intensity—Improving Treatment and Outcomes in Early-Stage Breast Cancer: A Retrospective Study

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Breast cancer is the second most diagnosed cancer in women after skin cancer, with an estimated 226,870 new cases of invasive breast cancer diagnosed in 2012 in the United States (American Cancer Society [ACS], 2012). Death rates for breast cancer have steadily decreased in women since 1991, when 45,583 deaths occurred compared to the estimated 39,920 deaths in 2012, and with larger decreases noted in women younger than age 50 (a decrease of 3.1% per year) compared to those aged 50 years or older (2.1% per year) (ACS, 2012). The decrease in breast cancer deaths reflects progress in early detection and improved treatment. In addition, the five-year relative survival rate has improved from 63% in the 1960s to 90% in 2012 (ACS, 2012).

Researchers have determined that adjuvant systemic chemotherapy improves patient outcomes. Efficacy of adjuvant chemotherapy for breast cancer has been analyzed in 20-year (Bonadonna, Valagussa, Moliterni, Zambetti, & Brambilla, 1995) and 30-year (Bonadonna et al., 2005) follow-up studies comparing treatment outcomes with surgery alone. The 20-year follow-up of early-stage breast cancer (ESBC)—defined as stages I, II, or III—revealed that patients who were receiving adjuvant chemotherapy with cyclophosphamide, methotrexate, and fluorouracil (CMF) after mastectomy showed significant overall survival, supporting the use of early chemotherapy after mastectomy versus surgery alone for patients at high risk for micrometastasis (Bonadonna et al., 1995). These results confirm that chemotherapy plays a major role in primary management of breast cancer. Additional analysis in the 30-year follow-up (Bonadonna et al., 2005) measuring relapse-free and overall survival by univariate and multivariate

Purpose/Objectives: To determine the amount of chemotherapy delivered compared to amount of chemotherapy scheduled by calculating relative dose intensity (RDI) and to identify factors associated with nonadherence of scheduled treatment regimens for patients with early-stage breast cancer (ESBC).

Design: Retrospective, descriptive, correlational study.

Setting: Two community hospital cancer centers in northern Michigan.

Sample: 77 patients with ESBC receiving adjuvant chemotherapy.

Methods: The RDI Calculator™ was used for data collection. A worksheet was developed for each patient and included characteristics, treatment information, and RDI calculations. SAS®, version 19.2, was used for multivariate analyses based on logistical regression analyzing relationships among dependent and independent variables.

Main Research Variables: Dependent variables were RDI prescribed and RDI received. Independent variables included chemotherapy regimen, clinical characteristics, planned dose, and schedule.

Findings: The average RDI was 86.6%. The average RDI was 86.7% for patients younger than age 65, and 85.5% for those 65 and older. The most common reasons for dose reduction or dose delay were treatment toxicity, chronic disease risk factors, age, unplanned versus planned treatment dose, institution (different standards of care), patient preference, and weight.

Conclusions: Meeting treatment goals of RDI for patients with ESBC has been shown to increase the disease-free survival rate and positively affects overall survival.

Implications for Nursing: Nurses have the unique opportunity to case manage patients with ESBC throughout the spectrum of care. One of the key areas of focus is education of the patient and her family members from the time of diagnosis throughout treatment and rehabilitation.

analyses continued to support the practice. When delivered optimally, CMF benefits patients at risk for relapse and distant disease without detrimental effects (Bonadonna et al., 2005). These studies (Bonadonna et al., 1995, 2005) defined a new practice standard for the treatment of patients with ESBC and substantially contributed to the recommendations of the Consensus Development Conference of the National Institutes of Health (Mincey, Palmieri, & Perez, 2002) on the use of chemotherapy outside a clinical trial (Bonadonna et al., 2005; Early Breast Cancer Trialists' Collaborative Group [EBCTCG], 2005). In addition, newer drugs (e.g., anthracyclines, taxanes) have improved treatment outcomes compared to the CMF regimen studied (Chirivella et al., 2006). Bonadonna et al. (1995) reported that adjuvant chemotherapy delivered at a relative dose intensity (RDI) threshold of 85% or greater achieves long-term survival and has been an indicator of a clinically appropriate intervention. Based on this finding, the authors chose 85% as the threshold for the current study.

RDI describes the relationship of the actual dose and schedule of chemotherapy delivered to the intended dose and schedule of the standard chemotherapy regimen (Hryniuk, Frei, & Wright, 1998). Clinical trials support the importance of sustaining full dose intensity in adjuvant chemotherapy for patients with ESBC (Bonadonna et al., 1995, 2005). Dose and timing in the administration of cytotoxic therapy are seen as important variables in cancer treatment (Bonadonna et al., 1995; Hryniuk et al., 1998), and studies have shown that, for some regimens, RDI below the threshold (85%) for patients with cancer may lead to little or no clinical benefit, therefore compromising outcomes (Chirivella et al., 2006; Lohrisch et al., 2006). However, a study by Lyman, Dale, and Crawford (2003) of nationwide community practices revealed that 56% of patients with ESBC received an RDI of less than 85%, mostly attributed to delays or dose reductions, and thus compromising outcomes.

With treatment of breast cancer dependent on optimal dosing and schedules, patients continue to be undertreated based on a number of factors. A review of the literature found that the most common reason for dose delays and reductions is neutropenia, resulting in low RDI. With the advent of granulocyte–colony-stimulating factors (G-CSFs) (e.g., pegfilgrastim, filgrastim, sargramostim) and clinical prediction models for febrile neutropenia, coupled with proactive support for patients at risk for hematologic toxicities, healthcare professionals may override the standard of care to prevent life-threatening situations and optimize outcomes (Vogel et al., 2005). Other factors for low RDI include obesity, age, socioeconomic status, race, and lack of a primary G-CSF prophylaxis (Crawford et al., 2008;

Griggs et al., 2007; Liu, Doan, Malin, & Leonard, 2009; Lyman et al., 2003; Shayne et al., 2009; Smith, 2006).

The purpose of the current study is to assess practice patterns for treatment of patients with ESBC in two community cancer centers in northern Michigan. The primary objective of the study is to assess the RDI percent delivered and the frequency that chemotherapy RDI is less than 85%. The secondary objective is to identify factors causing reduced RDI. Identifying these factors may guide the use of various supportive patient care modalities.

Nursing Significance

Oncology nurses have the unique opportunity to establish relationships with patients with breast cancer and their families because of their ongoing presence during the course of chemotherapy treatment. Chemotherapy is associated with numerous side effects, such as nausea, hair loss, fatigue, and febrile neutropenia, as well as compromised quality of life during and after treatment (National Comprehensive Cancer Network [NCCN], 2010). Patients must weigh the benefits versus the risks associated with treatment for their respective disease. Close monitoring of patients during treatment coupled with excellent education and proactive supportive interventions may ultimately result in successful completion of the prescribed treatment regimens.

Patient Preferences

Jansen et al. (2001) studied patient preferences for adjuvant chemotherapy as a major indicator for acceptance of treatment regimens and found that attention to the patient's own preferences and opinions were highly relevant and an emphasis on patient autonomy and an increased decision-making role for the patient required that these opinions were assessed explicitly. Nurses are in a position to use theoretical and evidence-based practice to proactively manage patient issues that may result in nonadherence to treatment. The goal of nursing is to provide evidence-based care that promotes quality outcomes for patients and their families (Burns & Grove, 2009). Inherent within the principle of evidence-based practice is the investigation of best research evidence generated by a synthesis of quality studies, clinical expertise of the nurse providing care, and identification of patient needs (treatment) and values based on individual preferences to the clinical encounter (Jansen et al., 2001).

The Oncology Nursing Society ([ONS], 2010) has supported evidence-based practice with the development of the Putting Evidence Into Practice (PEP) evidence-based practice resource area (www.ons.org/Research/PEP) to provide nurses with a guide to identify, critically

appraise, and use evidence-based interventions to solve clinical problems in patients with cancer. ONS's PEP program gives detailed evidence-based information for current nurse-sensitive patient outcomes. PEP is an important tool to use in conjunction with the interdisciplinary team regarding decisions based on an individual patient's characteristics, values, and preferences regarding decisions for treatment with a consideration of potential harms as well as benefits, and as an assessment of the feasibility of implementing the intervention within the specific care setting.

Both evidence-based medicine and evidence-based practice assert that making clinical decisions based on best evidence, either from the research literature or clinical expertise, improves the quality of care and the patient's quality of life. The beneficial effects of chemotherapy for patients with ESBC are dependent on adherence to evidence-based medicine and evidence-based practice by the patient, the healthcare professional, and the healthcare system (Adisa, Lawal, & Adesunkanmi, 2008; Gillespie, 2001; Lenhart, 2005; Ziegler & Citron, 2006).

Literature Review

Researchers have found that adjuvant treatment with chemotherapy for breast cancer improves recurrence-free and overall survival rates after achieving surgical control of the primary tumor (Adjuvant Breast Cancer Trials Collaborative Group, 2007; Bonadonna et al., 1995, 2005; DeVita, Hellman, & Rosenberg, 2005; EBCTCG, 2005). The importance of dose intensity has been studied thoroughly and the current hypothesis is that diminished intensity of chemotherapy in some regimens may adversely affect the expected benefit (Bonadonna et al., 1995, 2005; DeVita et al., 2005).

Hryniuk et al. (1998) analyzed treatment outcomes in various tumor types as a function of dose intensity. Dose intensity is defined as the "amount of drug delivered per unit of time, expressed as milligrams per square meter per week, regardless of the schedule or route of administration" (Hryniuk et al., 1998, p. 3137). Hryniuk et al. (1998) concluded that the application of this concept (dose intensity) required the establishment of a dose response database for single agents so that dose intensity can be determined for any particular combination of drugs.

Optimal cancer chemotherapy and efficacy on dose scheduling also can be predicted by the Gompertzian Tumor Growth Model (Norton, 1988), a mathematical theory of cancer cell proliferation and amount of tumor burden at the time of diagnosis. The pioneering work of Norton (1997) supported the model predicting greater tumor cell death and slower tumor regrowth between cycles with compression of the schedule of chemo-

therapeutic agents. This established the Norton-Simon Model (based on the Gompertzian Tumor Growth Model), which predicts that chemotherapy given in quick succession allows less time for tumor regrowth between cycles or the development of drug-resistant mutants. The biologic basis suggests that, by increasing the dose density of chemotherapy during the rapid tumor growth phase, greater cell apoptosis can be induced. Enhanced cell apoptosis is, therefore, obtained through a greater chemotherapy dose rate.

Despite the evidence-based rationale for maintaining RDI of 85% or greater for patients with ESBC, studies show that clinicians often under treat these patients. In a study by Shayne, Crawford, Dale, Culakova, and Lyman (2006) of 3,707 patients from 190 community oncology practices, 30% of patients received less than 85% of the standard dose of their regimen, with correlating factors including treatment regimen, age, comorbidities, year of treatment, and use of prophylactic G-CSF. Additional studies confirmed these findings with the added issues of scheduling problems, socioeconomic factors, and febrile neutropenia (Crawford et al., 2008; Griggs et al., 2007; Link et al., 2001; Lyman, 2006, 2009; Shayne et al., 2009). In Lyman (2006), myelosuppression appeared to be a major cause of dose delay and dose reduction despite availability of G-CSFs and associated cost effectiveness. Many cytotoxic agents and combinations recommended for patients with ESBC by the NCCN (2010) (e.g., doxorubicin, cyclophosphamide, paclitaxel) were associated with more myelosuppression than those preferred in earlier studies when survival benefits were favorable (Bonadonna, 1995, 2005). Complications from treatment included infection, sepsis, hospitalization, and even death (Crawford et al., 2008), all of which could cause nurses and patients reluctance toward maintaining adherence to clinical treatment.

Although many clinical trials of adjuvant therapy are performed in academic centers, the delivery of this therapy is considered standard practice for appropriately trained practitioners in the community setting (Link et al., 2001). However, patients and practice environments allow for more significant variations in delivery than are represented in controlled trial settings. Use of delays or dose reductions may be used as strategies to minimize myelosuppression so as to decrease chemotherapy-induced toxicities (Dale, McCarter, Crawford, & Lyman, 2003). Factors such as older age and comorbidities compound the choice of treatment regimens and toxicities. In addition, patient preferences may have an impact on the intensity with which chemotherapy is delivered (Griggs et al., 2007). In the nonacademic setting, variations in the treatment of patients with ESBC are, for the most part, largely undocumented. A need exists for formalized studies of chemotherapy administration in the community setting,

which may assist organizations in collecting data for appropriate quality indicators to measure optimal cancer care. The cost effectiveness of proactive, aggressive, supportive measures such as the use of G-CSF should become quality indicators for the treatment of breast cancer (Liu et al., 2009; Vogel et al., 2005).

Methods

Design

A descriptive, correlational design was used for the study examining patients with ESBC receiving adjuvant chemotherapy. This design was selected based on the ability to identify relationships among study variables. No manipulation or control of variables was conducted within the study. Dependent variables were the RDI prescribed and the RDI received. Independent variables included chemotherapy regimen, clinical characteristics, unplanned dose, and schedule. A retrospective review of the medical records was completed to collect data from patients with ESBC diagnosed and treated from 2008–2009 at two community hospital cancer centers in northern Michigan. Both institutions are accredited by the Commission on Cancer of the American College of Surgeons (ACOS) as community, comprehensive cancer centers and have affiliation with National Cancer Institute–designated academic centers.

Sample

Case finding and patient selection were obtained initially through the respective tumor registries of the two institutions in northern Michigan, the accountable registries for ACOS-certified cancer programs and affiliated with state and national registries for cancer incidence, treatment, and outcomes (ACOS, 2009). Data collection included the intervention (chemotherapy), baseline state (patient characteristics), and identifiable outcome (RDI scheduled and delivered).

Confidentiality of participants was protected by using only case numbers for any data collected from files. Permission for this study was obtained from the institutional review board at Oakland University (where the researcher was a student in the doctor of nursing practitioner [DNP] program) and the research advisory committees and institutional review boards of the two cancer centers in northern Michigan.

Inclusion criteria included being female, having ESBC, and receiving adjuvant chemotherapy. Exclusion criteria included metastatic disease at diagnosis, being a patient in a clinical trial, and not receiving chemotherapy. Patient and practitioner identities were protected through the use of anonymous numeric codes, and all identifying data were omitted.

Initially, 112 patients with ESBC were identified for record review, 41 from institution A and 71 from insti-

tution B. After record review and abstracting, 34 cases were excluded from the study, 10 from institution A and 24 from institution B. Reasons for exclusion included 20 treated elsewhere, 5 in clinical trials, 2 male breast cancer, 1 lymphoma of the breast, 1 deceased, 2 refused treatment, 1 recurrent disease, and 2 lost to follow-up. The total number of evaluable patients was 77: 31 cases from institution A with two treating physicians and 46 cases from institution B with five treating physicians. Ninety-five worksheets were included in the analysis, allowing for appropriate treatment regimen and scheduling of chemotherapy regimen. The investigator obtained data from each medical record and entered information into the RDI Calculator™ to create a patient worksheet, which included general information, treatment information, laboratory values, toxicities and interventions, and RDI results.

Procedure

The RDI Calculator was used to compute the RDI of individual patients undergoing chemotherapy based on predetermined calculations. A three-part worksheet was developed for each patient. Part one included patient characteristics of age, height, gender, and diagnosis, as well as treatment regimen. Part two included patient treatment information (cycle start date), weight (body surface area [BSA]), and actual dose of each chemotherapy agent. Part three included the calculated RDI for each patient and other data such as laboratory values, toxicities, and interventions. The results of the three-part worksheet allowed for the creation of standard RDI reports; charted comparisons of RDI between patients with different diagnoses, treatment plans, and characteristics; and customized reports for subsets of patients, based on variables, for additional analysis.

Reports were obtained from the RDI Calculator, including average RDI for all patients in a group with subsets of information comparing treating physician,
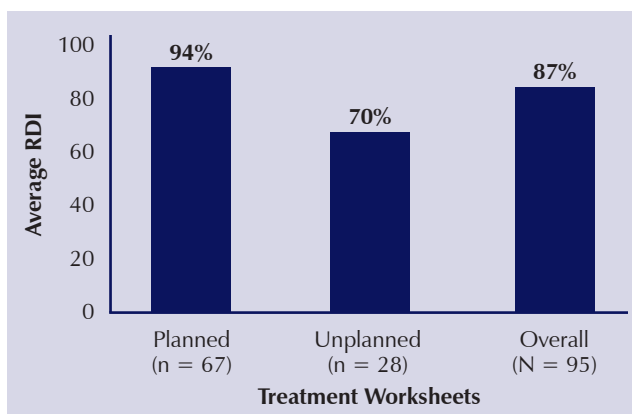
Figure 1. Average Relative Dose Intensity (RDI) for Patients in the Study

institution, cancer type, cancer status, cancer stage, treatment regimen, and patient characteristics. Information from the RDI Calculator was transferred to a Microsoft® Excel® spreadsheet for purposes of further analysis and validation of data. SAS®, version 19.2, was used for multivariate analyses based on logistical regression analyzing relationships among dependent and independent variables.

Data Analysis

Data analysis included use of the RDI Calculator to evaluate the distribution of each clinical variable reviewed and appropriate summary measures (i.e., percent of RDI) with descriptive statistics. The relationship between clinical variables and successful outcomes (RDI less than 85% = failure; RDI of 85% or greater = success) was evaluated by logistic regression. Conducting one overall analysis protected against type 1 errors. A level of $p < 0.05$ was considered statistically significant. A two-sided test of the null hypothesis was used throughout the analysis (Burns & Grove, 2009). Control of bias was achieved by abstracting data from the medical record and entering in the described tool without personal interpretation or explanation of information obtained.

Results

Relative Dose Intensity Calculator Results

The average RDI for all evaluable patients entered into the study was 86.6%, with differences in institution A (n = 36, 38%) and institution B (n = 59, 62%) being 89.5% and 85.4%, respectively. Average RDI by cancer stage was 86% for stage I (n = 39, 41%), 88% for stage II (n = 43, 45%), and 86% for stage III (n = 13, 14%). Differences among the seven treating physicians across both institutions were noted; however, for the purpose of this study, analysis was not included but will be offered to the respective institutions' quality improvement programs. Average RDI for patients younger than age 65 (n = 68, 72%) was 86.7%, and 85.5% for patients 65 years and older (n = 27, 28%).

Of the total patients entered into the study, 32 (34%) were identified who received less than 85% of the scheduled dose of treatment regimen with an average RDI of 68%, and 63 (66%) received 85% or greater with an average RDI of 95%. The most common reasons for dose reduction or dose delay included treatment toxicity, chronic disease risk factors (cardiovascular disease), age, unplanned versus planned treatment dose (ordered but not received), institution (different standards of care), and weight (see Figure 1).

Average RDI by treating regimen was calculated for 17 various regimens, with 4 regimens constituting the bulk of treatment (83%). The remaining regimens comprised only three or fewer patients per regimen and were not sufficient to draw any conclusions from. Of the most frequently used regimens, three of the four met RDI targets: docetaxel and cyclophosphamide with 23 patients (24%) at 89.5%, dose-dense doxorubicin and cyclophosphamide with 23 patients (24%) at 88%, and paclitaxel weekly for 12 cycles with 12 patients (13%) at 92%. Dose-dense doxorubicin, cyclophosphamide, and paclitaxel (ACT) with 21 patients (22%) had an RDI of only 82% despite the use of G-CSFs (which must be used with a dose-dense regimen).

Statistical Analysis

After review of data collected by the RDI Calculator, additional analyses were conducted to predict factors associated with successful RDI (85% or greater) and to determine statistical significance. The relationship between clinical variables (predictor variables) and successful outcomes (RDI of 85% or greater, dependent variable) was evaluated by stepwise logistic regression. Specific covariates were identified by the researcher after an initial review of the data. These included use of G-CSF, institution standards, presence of febrile neutropenia, risk factors for cardiovascular disease, planned versus unplanned treatment, stage of disease, age, and weight (see Table 1).

Table 1. Stepwise Logistic Regression of Successful Relative Dose Intensity of 85% or Greater

Variable	n	N	Total %	p
G-CSF				NS
Yes	48	77	62	
No	13	18	72	
Institution				0.2827
A	25	36	69	
B	36	59	61	
Neutropenia				NS
No	57	89	64	
Yes	4	6	67	
Cardiovascular disease				0.023
No	40	55	78	
Yes	21	40	53	
Treatment				< 0.0001
Planned	55	67	82	
Unplanned	6	28	21	
Stage				NS
I	25	39	64	
II	28	43	65	
III	8	13	62	
Age (years)				0.1593
Younger than 65	42	68	62	
65 and older	19	27	70	
Weight	95	95	100	0.0007
Overall success[a]	61	95	64	–

N = 95 worksheets

[a] 95% confidence interval [0.5372, 0.7379]

G-CSF—granulocyte–colony-stimulating factor; NS—not significant

G-CSFs were noted to be used appropriately during chart review, and were not a significant factor in predicting successful outcomes (i.e., 85% or greater) (p > 0.35). However, the statistical power associated with this comparison may be marginal given the small number of patients who did not use G-CSFs (n = 13). Slight differences were found between the two institutions and may be further investigated to evaluate population served and practice patterns inherent to the respective institutions. Despite the presence of febrile neutropenia, no significant effect on RDI was found. The risk factor of cardiovascular disease created a significant effect on successful RDI and an important finding with a p value of 0.023 (statistically significant). The presence of cardiovascular disease as a comorbidity may affect prescribing habits because of a possible increase in complications. The statistical significance of planned treatment versus unplanned treatment (p < 0.0001) was not surprising because of the toxicity experienced during treatment, which compromised the treatment goal despite aggressive side-effect management. No significant correlation was found with stage of disease and RDI. Additional interpretation of the data with logistic regression found that age was statistically significant (p = 0.1593), with the aged 65 years and older population more likely to be successful with meeting the RDI goal (see Figure 2).

The most dramatic relationship was weight (BSA) (p = 0.0007). As weight increased, less probability existed of receiving the successful treatment goal of RDI of 85%

or greater (see Figure 3). In summary, using the step-wise logistic regression model to determine strength of correlation with variables for successful RDI, in order of statistical significance, was unplanned treatment, weight, cardiovascular disease, age, and institution standards of care. No significant effect was found with stage of disease, neutropenia, or use of G-CSFs.

Overall success was noted in 64% (n = 61) of worksheets studied. Dose reductions or discontinuation of treatment prior to completion of the regimen (unplanned treatment) was further analyzed to determine possible causative factors. In the RDI computation, a treatment regimen of ACT in 21 patients (22%) achieved an average RDI of 82% despite the use of G-CSFs. On further review of worksheets, it was observed that dose reduction or discontinuation was related to the paclitaxel regimen, with neurotoxicity most often cited as the reason. Alternatively, the group of patients who received a schedule of 12 weekly paclitaxel doses was more successful with an RDI of 88%. This information may prompt healthcare providers to choose less toxic, appropriate regimens for ESBC adjuvant treatment. Another observation noted in the three-part worksheet was pharmacy personnel rounding down the dose prescribed as a cost-containment measure (i.e., 120 mg to 100 mg), which also is an ethical concern. This is an example of how the numerous healthcare professionals within an institution are involved in the care of the patient and how what they do may affect dosing before the patient actually receives treatment. Organizations would realize benefits from developing multidisciplinary teams that include all members participating in the care of the patient and developing standards of care based on outcome data.

Discussion

The importance of appropriate dosing of chemotherapy affecting overall survival and disease-free survival for patients with ESBC was investigated in this study as quality improvement measures based on evidence-based practice and evidence-based medicine. Prior to the study, healthcare professionals believed that patients received appropriate dose and scheduling of their respective treatment regimen; however, no formal study had been conducted in a defined geographic area. Data analyzed through the use of the RDI Calculator and subsequent statistical analysis found variables that influenced practice from the patient, healthcare provider, and institution perspective.

First, the importance of scheduling of chemotherapy was analyzed, noting both
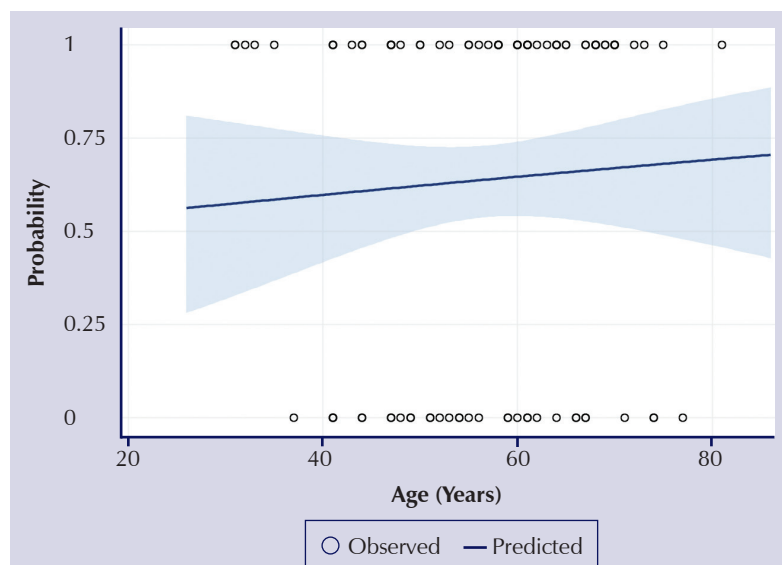
Note. Predicted probabilities for success = 1
Note. When data were separated by age (observed), using regression analysis, the group of 65 years and older had a higher probability of success in meeting treatment relative dose intensity of 85% or greater.
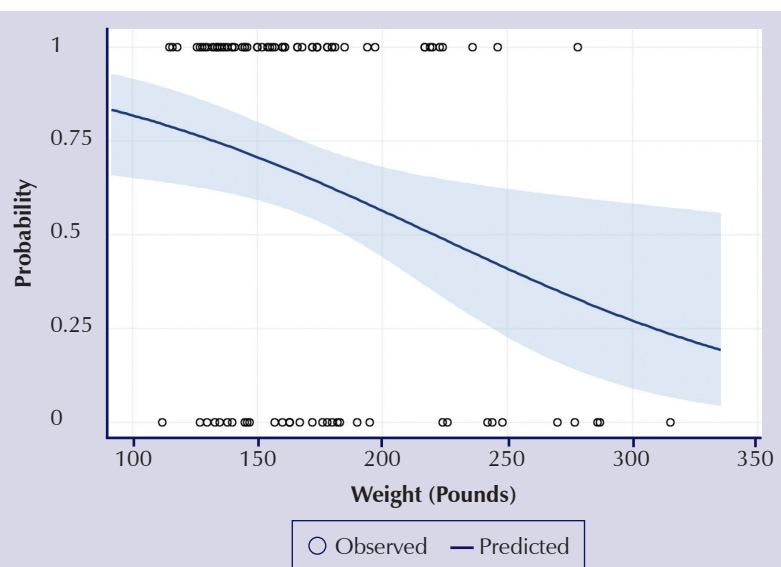
Figure 2. Probability of Success (Relative Dose Intensity of 85% or Greater) and Age Grouping

patient and healthcare provider delays. This was most prevalent in the patient population (14%), citing personal or social reasons (i.e., holidays or vacations). Only 2% of dose delays were instituted by the healthcare provider and most often were related to a medical issue such as myelosuppression, infection, other illnesses, and the cumulative effects of treatment such as profound fatigue. This reveals an opportunity to respond to the possible knowledge deficit among patients with ESBC and the importance of maintaining schedule of chemotherapy with regard to improving clinical outcomes and overall survival. The nurse is frequently involved at this juncture (during treatment cycles, particularly with cumulative side effects) and can address the many issues patients experience, including poorly controlled symptoms that can impact functional abilities, quality of life, and even survival if treatment plans are compromised. The frequency of encounters by the patients within the healthcare system, from initial diagnosis through the treatment cycle, lends itself to continual counseling of patients by nurses.

Risk factors also were studied, with the most prevalent subset being cardiovascular disease. Screening patients prior to prescribing regimens could be incorporated into treatment planning, noting possible effects on outcomes. Numerous tools are available to healthcare providers to appropriately screen and assess patients prior to initiation of treatment, such as the NCCN (2011) guidelines on myeloid growth factors.

Age groups initially were studied in the RDI computation, and slightly higher average RDI was noted in the younger than 65 group at 86.7% than for patients 65 years or older at 85.5%. However, in the regression analysis, the 65 and older population had a higher probability of success in meeting treatment goals. This was an interesting observation, for most often the older population tends to be undertreated because of side effects and comorbidities (Shayne et al., 2009). It may be reasonable to pursue research exploring attitudes and personal characteristics of this age group and their acceptance and adherence to chemotherapy regimens. Nurses have an opportunity to explore this difference in age groups and gain insights on how appropriate interventions lead to successful outcomes while preserving quality of life in this subset of patients.

Weight and success of treatment goals (RDI of 85% or greater) was observed to be one of the most significant findings (p = 0.0007). According to the literature, overweight and obese patients tend to be undertreated

Note. Predicted probabilities for success = 1
Note. When data were separated by weight (observed), using regression analysis, the overweight and obese patients had a lower probability of success in meeting treatment relative dose intensity of 85% or greater.

Figure 3. Probability of Success (Relative Dose Intensity of 85% or Greater) and Weight Grouping

(Griggs et al., 2007; Shayne et al., 2006). Numerous factors were observed in the study that led to dose reduction. The most frequent finding was BSA capped at 2 at the onset of treatment, therefore decreasing RDI. Also, BSA calculated in RDI may differ from an individual healthcare provider's formula for BSA, accounting for variances in dosing. Therefore, formulating standards among the caregiver team for continuity in dosing of chemotherapy agents is recommended.

Conclusion

Meeting treatment goals of RDI for ESBC has been shown to increase the disease-free survival rate and affects overall survival (Bonadonna et al., 1995, 2005). Based on these findings, the current study was conducted to evaluate treatment outcomes at two community cancer centers in northern Michigan. Overall average RDI was 86.6%, with minor differences between the two centers. Significant findings affecting success were age, weight, and the presence of cardiovascular disease, which were attributed to the patient, and unplanned treatment, which was attributed to healthcare professionals and healthcare system-related circumstances. Results from the current study have identified factors associated with nonadherence to treatment guidelines and can be useful for future continuous quality improvement activities focused on improving patient outcomes.

Implications for Nursing

The results of this study have identified numerous opportunities for future endeavors for oncology nurses. The increasing number of patients with cancer, an aging population (cancer incidence increases with age), and people living longer with a cancer diagnosis (survivors of all ages) will demand an increased amount of specialized care (Adams, 2009). Oncology nurses possess the skills, compassion, patience, and understanding necessary to be educators, counselors, and researchers for this group of patients.

One of the key areas of focus is education of the patient and family members from the time of diagnosis throughout treatment and rehabilitation. At the onset of establishing treatment schemas, nurses can discuss in greater detail and help with patients' follow-up questions, which may offer insights into variables (e.g., patient weight) that affect adherence to treatment guidelines. The ability to offer nonjudgmental advice with strong listening skills will hopefully translate into meeting successful treatment goals with ongoing close surveillance. These results also may prompt additional research regarding patient adherence to treatment regimens and incorporate social beliefs, cultural perspectives, personal bias, and personal health objectives. In addition, close attention to symptom management, leading to quality of life and positive experience without compromising patient preferences, should be an important aspect throughout the experience. Finally, as active members of a multidisciplinary team, nurses can assist the organization's capacity to influence patient health while preserving autonomy through development of evidence-based guidelines, as well as facilitate performance measurement and quality improvement.

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