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Health system and patient-level factors associated with multidisciplinary care and patient education among hospitalized, older cancer survivors

Rachelle Brick [a], Daniel J. Hekman [b], Nicole E. Werner [c], Juleen Rodakowski [d], Lisa Cadmus-Bertram [e], Beth Fields [e,*]

[a] Cancer Prevention Fellowship Program, Division of Cancer Prevention, National Cancer Institute, 9609 Medical Center Dr, Rockville, MD 20850, USA
[b] University of Wisconsin-Madison, Department of Emergency Medicine, 600 Highland Avenue Madison, WI 53792, USA
[c] Indiana University, Department of Health & Wellness Design, 1025 E 7th St, Bloomington, IN 47405, USA
[d] University of Pittsburgh, Department of Occupational Therapy, Bridgeside Point I, 100 Technology Drive, Pittsburgh, PA 15219, USA
[e] University of Wisconsin-Madison, Department of Kinesiology, 2170 Medical Sciences Center, 1300 University Avenue, Madison, WI 53706, USA

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ABSTRACT

Objective: The purpose of this study was to examine system- and patient-level factors associated with the number of healthcare disciplines involved in delivery of patient education among hospitalized older cancer survivors.
Methods: We used electronic health record (EHR) data from a single institution documenting patient education among hospitalized older patients (≥65 years) with a history of cancer between 9/1/2018 and 10/1/2019. We used parametric ordinal logistic regression to assess the number of healthcare disciplines involved in documented education activities.
Results: The sample ($n = 446$) was predominantly male, White, and on average 74 years old. Adjusting for patient and system-level variables, men and larger department units had higher odds of receiving education from fewer healthcare disciplines. Patients with a history of breast or prostate cancer and longer lenths of stay had lower odds of receiving patient education from fewer healthcare disciplines.
Conclusion: Hospital size, severity of illness, and cancer type are associated with delivery of multidisciplinary education in this sample.
Innovation: EHR provides an opportunity to identify patterns in patient education among cancer survivors. Future research should investigate provider perspectives of the findings to inform provider- and system-level strategies to improve patient education.

1. Introduction

Of the 18.1 million cancer survivors, older adults represent nearly two-thirds of all new cancer diagnoses [1]. The needs of older adults with acute or chronic cancer experiences are often complex as this population typically incurs late-effect or long-term symptoms, cancer-related comorbidities, and other adverse health outcomes [2]. Multidisciplinary care can play an important role in the management of older cancer survivors. Multidisciplinary care is an innovative model of care coordination that aims to shift the burden of short- and long-term survivorship care delivery from the oncologist to a multidisciplinary care team [3]. It leverages the concurrent input of more than one care healthcare discipline (e.g., physicians, nurses, rehabilitation professionals, social work, and other supportive care services) in the delivery of treatment and care planning [4]. In this care approach, a patient is assessed using a standardized approach to capture age- and cancer-related needs, triaged to speciality or allied health disciplines for needs-based care, and provided with appropriate interventions and educational materials to support health and well-being [5], Thus, survivorship care extends to a host of healthcare disciplines rather than relying on all decisions and interventions to be determined by the attending oncologist alone. Multidisciplinary care teams are associated with delivery of guideline-concordant care [6], survival [7], and timeliness of care service. Furthermore, the provision of patient education to support acute- and long-term health management is a fundamental component of this care delivery model [8,9].

* Corresponding author.
E-mail addresses: Rachelle.brick@nih.gov (R. Brick), djhekman@medicine.wisc.edu (D.J. Hekman), newerner@iu.edu (N.E. Werner), Jur17@pitt.edu (J. Rodakowski), cadmusbertra@wisc.edu (L. Cadmus-Bertram), befields2@wisc.edu (B. Fields).

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Multidisciplinary cancer care for older adults has been successful within geriatric oncology clinics and specialized cancer centers [5]. Patient education and care planning is considered part of the standard cancer care delivery in these settings. However, there is a limited understanding how this care model may be associated with delivery of patient education in acute care settings. Unplanned hospitalization is not considered to be part of the patient's standard care [10]. Older cancer survivors who are hospitalized report additional functional deficits and comorbid conditions [11] that are associated with higher risk of hospitalization [10]. Given the complexity of medical care, older cancer survivors are likely to require extensive hospital-based education and caregiver training prior to discharge for cancer and co-occuring conditions [12-14]. Patient education may take the form of medication management, inpatient stay expectations, restrictions and compensatory strategies for discharge, and home exercise programs [15]. Within inpatient settings, older cancer survivors are often admitted to various hospital units based on bed availability or patterns of practice that may not include a standard geriatric oncology team, especially if clinical management is necessary for a co-occuring non-cancer-related condition [16]. Thus, care provision, including dissemination of patient education to a cancer survivor may differ from more standardized, needs-based, coordinated programs [4,5,16].

Both system- and patient-level factors may be associated with the number of healthcare disciplines that can participate in administration and delivery of patient education in the acute care setting [8]. For example, obstacles to formal education delivery may be related to the the physical environment of a hospital, department size, patient care complexity, and/or access to universal health system electronic health documentation [8]. These factors may be inter-related and associated with delivery of multidisciplinary care processes. Knowledge about these factors may provide insights into navigating the delivery of multidisciplinary cancer care delivery in this setting.

Analysis of electronic health record (EHR) data is a novel approach to capture documented discussions and dissemination of patient education by a variety of healthcare disciplines. EHRs using structured data can easily describe which discipline delivers patient education and what type of education is delivered [15]. Secondary analysis of structured EHR data may also promote hypothesis-generating research, such as identifying multi-level determinants of multidisciplinary patient education and patterns of delivery. The objective of this study was to determine what health system- and patient-level factors are associated with the number of healthcare disciplines, as defined by different discipline types, delivering education to hospitalized older cancer survivors. Information gleaned from this study may aid in the development and implementation of strategies to better deliver patient education, improve the quality of long-term survivorship care, and propose recommendations to refine EHR systems for both clinical and research benefit.

2. Methods

2.1. Setting

An integrated health system of the University of Wisconsin-Madison, UW Health, UW Health is a 505-bed hospital that houses a National Cancer Institute-designated comprehensive cancer care center. The UW Health System treats >60,000 inpatients per year across seven hospitals and emphasizes patient- and family-centered healthcare by developing programing to reflect values and priorities of patients, families, and related stakeholders. To address study aims, we used UW Health EHR data (Epic Systems, Verona, WI) documenting all formal patient education activities for older cancer survivors admitted to inpatient hospitalization. Formal patient and/or caregiver education activities were gathered as structured educational topics based on an EHR naming convention. Details about health care providers with access to the EHR system as well as patient and caregiver education naming conventions are detailed elsewhere [15]. Data from the EHR system was extracted and de-identified by health system research faculty to create a limited dataset, as defined under the Health Insurance Portability and Accountability Act (HIPAA), for analysis. This research was approved by the IRB as an exempt study.

2.2. Sample

Data were retrieved retrospectively for patients who were admitted as inpatients for at least 24 h between 9/1/2018 and 10/1/2019, were at least 65 years old at the time of admission and had a documented ICD10 diagnosis of one of the four most common cancers among older adults–colon or rectum (C18, C19, C20), lung (C34), breast (C50), or prostate (C61)–and were discharged into the care of their caregivers. These cancer types are also associated with highest overall billable costs to Medicare [17] which suggests that costly hospitalizations may be common in these population. Cancer diagnosis was either the primary or secondary reason for hospitalization.

2.3. Variables

Variable selection was guided by the System Engineering Initiative for Patient Safety (SEIPS), which is a systems engineering model developed exclusively for healthcare by integrating systems engineering and healthcare quality models (see Fig. 1) [8]. SEIPS depicts a structured work system of interacting components that produce organizational processes to influence organization (e.g. health system), clinician, and patient outcomes [18]. The structured work system is comprised of 1) people (or teams); (2) tasks people perform; (3) tools and technology available and needed; (4) organizational factors (e.g., policies, teamwork); and (5) environment (lighting, noise, layout). By evaluating the patient education data documented in the EHR, the authors were able to identify how many healthcare disciplines delivered education to the patient and/or any patient caregivers [15]. Provider roles represented different healthcare disciplines included nursing, pharmacy, occupational and physical therapy, and nutrition services. Our previous work details that there was no patient education documented by physicians, behavioral health, or social work,limiting the inclusion of these disciplines in our analysis [15]. The outcome of interest was multidisciplinary care as defined by the number of healthcare disciplines on an ordinal scale ranging from 0 to 5 disciplines that delivered education as part of the patient's care. Descriptions of types of healthercare discplines as well as types of education and mode of education are explored elsewhere [15].

Person (e.g., patient) work system variables included demographics: sex, race, age at admission, cancer diagnosis, and learning barriers (language, literacy, or cognitive). Due to low numbers of non-white and non-gender conforming patients, sex and race were both coded as binary variables—male/female and non-Hispanic white or not, respectively. Age was categorized into 5-year bands. After controlling for patient sex, separating the diagnoses of breast and prostate cancer would violate the positivity assumption (that is, each combination of variables has at least one observation in the dataset) implicit in all logistic regression models, so these diagnoses were combined for analysis. Further, these diagnoses were combined as they "reflect similar levels of disability that warrant caregiver education and attention [19]." Providers delivering education selected learning barriers from a list of possible impediments to patient understanding, such as difficulty reading and understanding printed materials due to visual or cognitive deficits. *Organizational work system* variables included reason for visit (cancer-related, other, or not documented [ND]), highest level of care over course of admission (general care or intermediate (IMC) or intensive (ICU) care), length of stay in days, the number of unique departments where the patient received care, and department size based on average number of beds. Due the cluster/multi-modal nature of average department size (range 14–78 beds), size was converted into quantiles for analysis. There were a

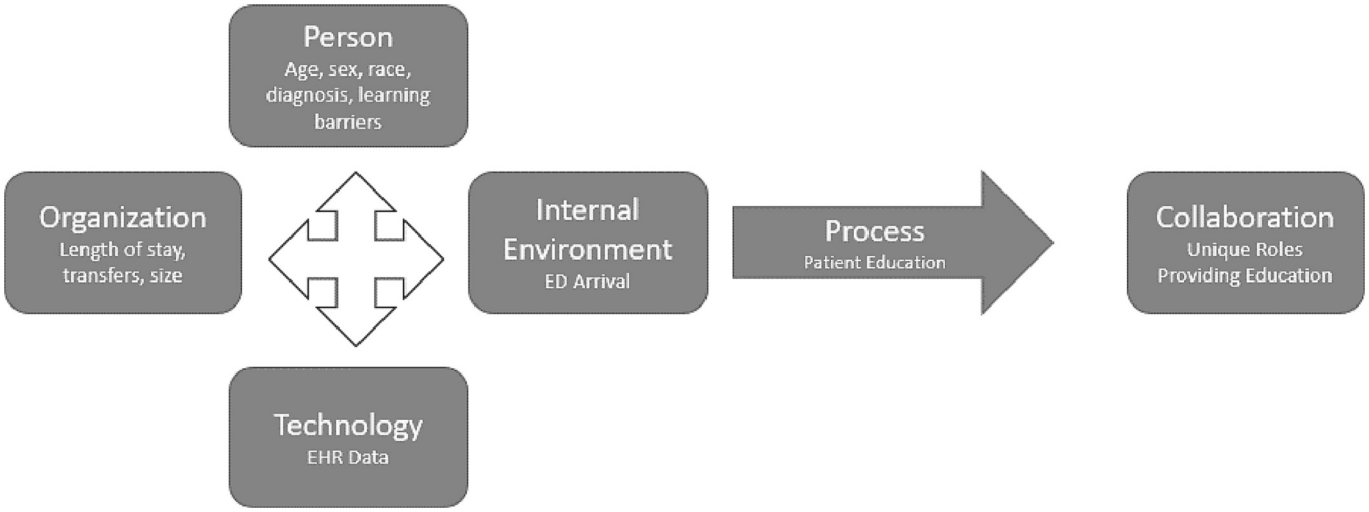

Fig. 1. Mapping of Variables to the SEIPS 2.0 Model.

limited number of patients that had a hospital length of stay of <24 h. For this reason, we collapsed patients with length of stays of 1 or 2 days into one category. Finally, *internal environment* was captured by including whether the patient arrived via the emergency department (ED). The number of variables included in the multivariable analysis relative to the sample size is consistent with recommendations [20].

2.4. Statistical analyses

All data processing was done using R; parametric ordinal logistic regression was done using the MASS R package with the parallel lines (no interactions) assumption to assess the impact of covariates on the odds ratio of having a lower number of unique provider roles involved in patient and family-centered education. An odds ratio > 1 represents an increased probability of fewer roles. Thus, odds ratio < 1 implies more provider roles involved in education.

Following the recommendations made in Liu et al. [21], the authors chose to model the number of roles involved in patient and family-centered education using ordinal logistic regression.

Using the conventions in Venables and Ripley [22], the model was:

$$ln\left(\frac{Pr(Y \leq j)}{Pr(Y > j)}\right) = \beta_{0j} - (\beta_1 x_1 + \ldots + \beta_k x_k) = \beta_{0j} - \eta_1 x_1 - \ldots - \eta_k x_k$$

All Xi covariates are defined above and detailed in Table 2 below.

2.5. Sensitivity analyses

To address biases related to model assumptions and specifications, we performed two sensitivity analyses. First, to account for patients that had multiple hospitalizations during the study period, we ran a sensitivity analysis using a a mixed effects model (random intercept: patient-level; fixed effect: visit-level) to evaluate the effect of non-independence between observations and analyze the fixed effects of the variables of interest. This analysis ruled out whether there were order effects associated with hospitalization as well as overweight of repeat patient demographic or diagnostic categories on model outcomes. Second, the language, cognitive, and literacy barriers to learning as explanatory variables were of interest to us from the perspective of caregiver education and responsibilities. However, representation of these barriers were limited. Given the sparseness representation in the study sample, we ran a model without these variables to see if removal of these covariates impacted the associations of other explanatory variables on the outcome of interest.

3. Results

3.1. Patient population

A total of 446 admissions met the inclusion criteria. There were 341 patients with one hospitalization, 36 with two visits, eight with three visits, one with four visits, and one with five visits during the time period.The patient admissions were predominately male (59%) and White (94%). The average age of patients at the time of arrival to the hospital was 74.0 (SD: 6.1) years. Over half of admissions (62.8%) did not have any documented patient education delivered by a healthcare provider. See Table 1 for descriptive statistics of the distribution of the system- and patient-level factors.

3.2. Multivariable results

Adjusting for patient and system-level variables in the model, men had higher odds of interacting with fewer healthcare disciplines (Adjusted OR:1.493; CI: 1.016–2.194) compared to women. In contrast, patients with longer lengths of stay (4, 5, or 6 days) had significantly lower odds of interacting with fewer disciplines compared to those discharged after 1–2 days in the hospital. Specfiically, for each additional day admitted to the hospital, it was more likely that additional healthcare disciplines were involved in the delivery of patient-education (aOR for 6 days: 0.26; CI: 0.12–0.54; aOR for 7 days: 0.39; CI: 0.22–0.72) as further exhibitied in the monotonic upward trend for length of stay from 3 through 6 days (see Table 2). Additionally, patients with a history of breast or prostate cancer were also less likely to have fewer disciplines involved in their education (aOR: 0.57; CI: 0.36–0.91) compared to those with lung cancer.

Larger departments (quantiles 2 and 4) had increased odds of have having fewer healthcare disciplines deliver patient education compared to the smallest departments with the lowest average number of beds (aOR for fourth quantile: 4.06; CI: 1.9–8.64). See Table 2 for a complete listing of regression coefficients.

3.3. Sensitivity analyses

Results of the sensitivity analyses can be found in the Supplementary Materials. Multivariable model findings revealed minor differences between the original model and the model accounting for the weight of multiple patient visits. For example, while magnitude and direction of the association between individuals who were 85 years and older and number of healthcare disciplines compared to those aged 65–69 did not

Table 1
Patient Characteristics.

	N (%) or Mean (SD)
Total visits included in the analysis	446
Sex (% Male)	261 (58.5)
Race (% NH White)	420 (94.2)
Age Group	
65–69	237 (53.1)
70–84	121 (27.1)
80–84	60 (13.5)
85+	28 (6.3)
Length of Stay (Days)	
1–2	149 (33.4)
3	77 (17.3)
4	58 (13.0)
5	45 (10.1)
6	35 (7.8)
7+	82 (18.4)
Chief Complaint related to Hospitalization	
Cancer-related	16 (3.6)
Other	150 (33.6)
Not Documented	280 (62.8)
Qualifying Cancer Diagnosis	
Breast	44 (9.9)
Colon or Rectum	94 (21.1)
Lung	181 (40.6)
Multiple	5 (1.1)
Prostate	122 (27.4)
Emergency Department Arrival	148 (33.2)
Intensive Medical Unit or Intensive Care Unit Admission duringHospitalization	91 (20.4)
Language Learning Barrier	5 (1.1)
Cognitive Learning Barrier	1 (0.2)
Literacy Learning Barrier	18 (4.0)
Average Department Census	45.64 (14.82)
Number of Health Care Disciplines Documenting Patient Education Delivery	
0	266 (59.6)
1	151 (33.9)
2	21 (4.7)
3	6 (1.3)
4	1 (0.2)
5	1 (0.2)

change, the estimate became significant. Thus, individuals aged 85 years and older have lower odds of having fewer healthcare disciplines involved in education compared to individuals aged 65–69 years (aOR: 0.760; CI: 0.759–0.761). Similarly, while individuals diagnosed with colon or rectum cancer trended toward significantly lower odds of having fewer healthcare disciplines involved in education in the original analysis, the sensitivity analysis revealed a significant association (aOR: 0.652; CI:0.651–0.653). As it relates to removing the learning barrier variables, there were no changes in the direction or significance of the remaining explanatory variables in the model. Given that there were no meaningful changes in the direction or magnitude of the explanatory variables in both models, we presented findings from the original analysis, inclusive of patients with multiple hospitalizations as well as learning barrier covariates.

4. Discussion and conclusion

4.1. Discussion

Our primary focus was to examine what system and patient-level factors were associated with the number of healthcare disciplines delivering education to older hospitalized adults with a history of cancer. EHR can make significant contributions to the knowledge base of geriatric oncology patient education and have the potential to uncover patterns of patient education delivery in a multidisciplinary care team. The SEIPS model provided guidance to examine multi-level information within EHR to identify barriers to patient care delivery as well as integrate this information to improve delivery of cancer education to this population. From the analyses, we learned that both system- (e.g., unit size) and patient-level (e.g., gender and length of stay) factors in the model affected the number of healthcare disciplines involved in the delivery of patient and caregiver education. The findings also shed light on strategies to improve EHR documentation templates to optimize use of learning health systems for patient care, health records, and health services research, such as the one examined in this analysis.

We discovered that larger department units were less likely to provide patient education by multiple healthcare disciplines. Studies report that involvement of multidisciplinary providers is affected by a host of factors, including size of unit and available resources [23]. For example, larger departments may deliver patients and their caregivers education using specific or selected health care disciplines that span multiple education areas to improve efficiency of care delivery. Alternatively, more hospital beds tend to translate into more medical services, leaving little opportunity for health care disciplines to collaborate and work as a team [24]. However, organizational systems would benefit from addressing such work challenges as successful disease management relies on patient-centric, interdisciplinary care [23]. The current EHR documentation system does not capture co-treatment by disciplines, informal conversations between healthcare disciplines and providers, patients and their caregivers, or evolving system processes that further contextualize our findings. This hypothesis corroborates why over half of patients did not have a documented patient education interaction. Of note, there was no representation of physician, behavioral health, or social work, three common disciplines within acute care hospitals, as it is documented in alternate software systems. By maintaing separate documentation systems across acute care settings, important information on patient education may be lost and limit the opportunities to engage the patient and healthcare team in care planning. Integration and utilization of direct messaging technology may help facilitate team-based care and reassurance for adequate education and discharge training across necessary disciplines. Furthermore, revising documentation systems to accommodate for text boxes and select all features across all documenting healthcare disciplines may encourage greater detail on patient care delivery that is not currently captured through current coding structure.

Several similarities between our findings and other patient education-focused studies were found. Compared to men and shorter lengths of stay (1–2 days), women and longer hospital admissions were likely to experience education from a greater number of healthcare disciplines. Gender differences in health information seeking may be one explanation for our finding. In particular, females are more likely than males to seek out treatment information [25], which could lead to the engagement and participation of more disciplines. Patients that are more medically complex are highly likely to experience longer lengths of stay [26] and necessitate consultation by additional discipline types. As a result of having to manage a chief admission complaint, residual effects of cancer and comorbidities may compound to keep patients in the hospital for longer durations, subsequently receiving more referrals to a broader number of health care providers. Lastly, individuals with breast or prostate cancer, and colon or rectal cancer following the sensitivity analysis, had lower odds of interacting with fewer disciplines compared to lung cancer. One explanation for this finding is that there is less available evidence regarding impact of multidisciplinary care on cancer-realted outcomes for individuals with a lung cancer diagnosis compared to these cancer types [27,28]. Thus, there may be fewer established benchmarks and guidelines to direct healthcare providers to use this model for individauls with a lung cancer diagnosis. Future research should consider patient- and provider-perspectives on why individuals with lung cancer are less likely to receive multidisplinary patient education compared to other diagnoses. This is of particular interest as this diagnosis is associated with higher morbidity and mortality rates [29] and these patietns often encounter multiple hospitalizations [17,30].

While receiving multiple referrals may represent a more

Table 2
Patient- and system-level factors associated with number of healthcare disciplines delivering patient education.

Coefficient	beta	standard error	t-value	*p*-value	OR lower bound	OR (e^beta)	OR upper bound
Sex							
Female (Reference)	0.401	0.196	−2.048	*0.021	1.016	1.493	2.194
Male							
Race							
Non-Hispanic White (Reference)	−0.372	0.397	0.938	0.175	0.316	0.689	1.504
Other Race or Ethnicity							
Age Group							
65–69 years (Reference)	–	–	–	–	–	–	–
Age Group 70–84	0.278	0.215	−1.296	0.098	0.866	1.321	2.014
Age Group 80–84	−0.303	0.287	1.053	0.147	0.420	0.739	1.300
Age Group 85+	−0.277	0.389	0.712	0.238	0.353	0.758	1.628
Length of Stay (Days)							
1–2 (Reference Group)	−0.216	0.271	0.800	0.212	0.473	0.805	1.371
3							
4	−0.583	0.322	1.815	*0.035	0.297	0.558	1.050
5	−0.606	0.348	1.738	0.420	0.275	0.546	1.083
6	−1.351	0.375	3.605	* < 0.001	0.124	0.259	0.541
7+	−0.933	0.304	3.072	*0.001	0.216	0.393	0.715
Chief Complaint							
Cancer-Related (Reference Group)	0.873	0.911	−0.958	0.169	0.399	2.394	14.359
Not Cancer Related							
Chief Complaint Not Documented	−1.039	0.902	1.153	0.125	0.060	0.354	2.082
Cancer Diagnosis							
Lung Cancer (Reference Group)	−0.425	0.287	1.477	0.070	0.372	0.654	1.151
Colon or Rectum							
Cancer Dx Breast or Prostate	−0.555	0.235	2.363	*0.009	0.362	0.574	0.911
Cancer Dx Multiple	−0.539	1.023	0.527	0.299	0.078	0.583	4.358
Arrival Status							
Non-Emergency DepartmentEntry (Reference Group)							
Emergency Department Arrival	−0.561	1.162	0.483	0.315	0.058	0.570	5.604
Admission Level							
General Medicine (Reference Group)	−0.284	0.289	0.984	0.163	0.427	0.753	1.328
Ever in IMC/ICU							
Learning Barrier							
None (Reference Group)	0.520	0.789	−0.659	0.255	0.356	1.681	7.931
Language Learning Barrier							
Literacy Learning Barrier	−1.201	1.947	0.617	0.269	0.007	0.301	13.816
Cognitive Learning Barrier	0.444	0.462	−0.961	0.169	0.629	1.559	3.868
Number of Departments where treated	−0.151	0.205	0.734	0.232	0.574	0.860	1.288
Average Department Size							
1st Quantile (Reference Group)							
2nd Quantile	1.323	0.302	−4.385	* < 0.001	2.074	3.754	6.792
3rd Quantile	0.706	0.362	−1.953	*0.026	0.995	2.026	4.125
4th Quantile	1.400	0.384	−3.642	* < 0.001	1.905	4.056	8.638

Note. * = statistically significant. Odds ratios >1 indicate a larger odds of having fewer roles involved in education.

comprehensive approach to addressing patient needs, it often requires more coordination among the healthcare team members. Adopting and incorporating a comprehensive geriatric assessment into the care process and daily workflow may be one way to streamline coordination and address both the consequences of cancer and aging that affect patients. Mariano and colleagues [16] found that delivery of the geriatric assessment is feasible among older cancer survivors during unplanned hospital admissions. Use of this assessment may help to overcome barriers in inconsistent referral to supportive care services and more coordinated efforts at educating patients and caregivers on discharge planning and health self-management. However, this study was unable to reduce rates of readmission, a key quality indicator of high value care [31]. Furthermore, our study's findings can inform other studies interested in investigating the use of geriatric assessment to drive coordinated multidisciplinary care and streamline education by identifying patients in this population with the greatest needs and modifiable system-level factors.

To achieve high quality education for older cancer survivors and their caregivers, future health services research should explore implementation plans for enhancing care coordination among multidisciplinary teams in inpatient hospital settings. Example plans to develop and test may include "providing clear and reliable mechanisms to contact the care team, improving and standardizing care transitions, and developing patient navigator programs" [32]. In addition, providers need adequate time to complete a geriatric comprehensive assessment [16], regardless of size of unit and other system-level demands. A comprehensive geriatric assessment can help a lead provider determine what additional disciplines, if any, are needed on the healthcare team to meet the educational needs of older hospitalized adults with cancer and their caregivers [11]. Likewise, future research should consider the perspectives and experiences of providers to further explore facilitators and barriers related to patient and caregiver education in this population. Use of focus groups among various healthcare disciplines and system-level representatives may also refine the EHR platform to capture patient and caregiver education delivery more reliably in this population.

This study has several limitations. The initial intent of our study was to identify how multidisciplinary care is associated with patient education within cancer care delivery. However, most patients had an "Unknown Chief Complaint," limiting our generalization of findings directly to cancer education, specifically. Surprisingly, lack of clarification of the primary diagnosis or rationale for admission is a common omittance or difficult to extract in EHR clinical analyses [33]. Health systems should focus on resolving this limitation to accurately characterize sub-populations of interest for clarity of patient-provider communication and improved utility in learning health systems.

Greater training and quality checks should be established to ensure complete documentation of EHR systems for both clinical utility by the patient and providers of various disciplines, as well as research benefit to optimize health care delivery.

Given the busy nature of acute hospitalization, not all education delivery may have been captured in the EHR. Informal discussions between provider types, including physicians, patient care technicians, or social work, and patients and their caregivers may not have been included due to documentation in alternative workflows (e.g., notes) or informal conversations. There may have also been other patient, caregiver, provider and organizational factors that could not be accounted for given the existing EHR system (e.g., cancer stage). For example, the current documentation system utilized only structured data that accounted for pre-populated education areas. A review of EHR data applications to clinical care recommended that EHR systems incorporate free-text chart notes to better contextualize structured data and account for unique clinical experiences [33]. Although the EHR system has a patient education specific documentation pathway, we also were unable to account for narrative text that may have been placed in other portions of the EHR or discipline specific templates (e.g., physician, behavioral health, social work, etc.). This may introduce bias in estimates produced. Furthermore, we were unable to account for number of individual providers within a given healthcare discipline that interacted with the patient given limitations of the HIPAA-compliant limited dataset. Future work should explore how variation in the total number of provider interactions across disciplines may compare to the associations found in our findings.

This is a single-site study in a patient population that was predominately non-Hispanic white. Therefore, results have limited external validity and replication is needed by sites that have more diverse patient populations. Further, while the rationale to support the statistical model was valid, differences may have potentially been seen if the those with a history of breast and prostate cancer types would have had equal numbers and been separated. Finally, it should be noted that the model was a preliminary investigation about the relationship between variables and outcomes in the aggregate, and not intended as a predictive model.

4.2. Innovation

This is the first analysis to use EHR data to provide objective insight into the relationship between number of healthcare disciplines (e.g., multidisciplinary cancer care) and delivery of patient education. The findings reveal potential targets of patient- and provider-level interventions that will improve delivery of patient education in this vulnerable population. It is also one of the first applications of the SEIPS model to improve patient experience and education in a cancer population and hospital setting. The SEIPS model enables health systems and researchers to analyze the multi-level contexts in which patient and provider interactions occur. Application of this model may help to overcome barriers in cancer care coordination, for older adults who often require input from multiple healthcare disciplines given complex medical histories. The SEIPS model also provides the groundwork to learn about, test, and adapt future patient education delivery methods. Thus, we can apply feedback from these findings back into local work systems for testing. Furthermore, this study reveals barriers and facilitators to documentation in learning health systems. Investments in EHR have promoted transparency in clinical care between systems, providers, and patients. However, this analysis uncovers that there are limitations to current formats within EHR systems. Future work resulting from this analysis point to addressing process barriers related to EHR to make it a valued tool from the patient perspective, as well as for research practice to optimize care.

4.3. Conclusion

In conclusion, our study shows that several system and patient-level factors may be associated with delivery of patient-education among hospitalized older cancer survivors; namely, size of the hospital unit, patient gender and severity of illness. Increased awareness and understanding of the relationship of these factors on the delivery of education by multidisciplinary teams could help systems and providers identify and apply strategies to ensure adequate education and care management is provided to this growing population.

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Author contribution

Study concepts: Beth Fields, Rachelle Brick, Juleen Rodakowski.
Study design: Beth Fields, Rachelle Brick, Juleen Rodakowski.
Data acquisition: Beth Fields, Dann Hekman.
Quality control of data and algorithms: Dann Hekman.
Data analysis and interpretation: Beth Fields, Dann Hekman, Rachelle. Brick, Juleen Rodakowski, Lisa Cadmus-Bertram.
Statistical analysis: Dann Hekman.
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Manuscript editing: Beth Fields, Dann Hekman, Rachelle Brick, Juleen. Rodakowski, Lisa Cadmus-Bertram.
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Declaration of Competing Interest

The authors declare that there are no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pecinn.2023.100192.

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