Effects of Cancer Comorbidity on Disease Management: Making the Case for Diabetes Education (A Report from the SOAR Program)

Lauren Irizarry, BA,¹ Qijuan E. Li, MPH,² Ian Duncan, FSA, MAAA,² Andrew L. Thurston, MD,³
Karen A. Fitzner, PhD,⁴ Beatrice J. Edwards, MD, MPH,⁶ Judith M. McKoy-Bent, BA, BSN,⁵
Katrina M. Tulas, BS,³ and June M. McKoy, MD, MPH, JD, MBA^{3,6,7}

Abstract

Individuals with type II diabetes have an increased risk of cancer diagnosis (relative risk [RR] = 1.12–2.50) and mortality (RR = 1.4) compared to normoglycemic individuals. Biologic mechanisms, including mitogenic effects of insulin, hyperglycemia, and increased oxidative stress, as well as behavioral factors (eg, difficulty managing the comorbidity) may explain the elevated risk. To investigate the effects of the comorbidity on disease management, the authors compared diabetes education utilization in individuals with diabetes–cancer comorbidity to utilization by individuals with diabetes in the absence of cancer. The effect of diabetes education on outcomes was further assessed in the subset of individuals with diabetes–cancer comorbidity. Administrative claims data were used for this analysis. The study population included individuals >60 years of age and members of both commercial and Medicare Advantage health plans from a private national database of payer data, but excluded Medicare fee for service and Medicaid patients. Most of these individuals were eligible to receive reimbursement for diabetes education. Diabetes education utilization was identified using procedure codes. Outcomes were assessed for a 3-year time period. There was little difference in diabetes education utilization between individuals with diabetes in the absence of cancer (3.8% utilization) and those with diabetes–cancer comorbidity (3.5% utilization). Individuals who receive diabetes education are more likely to have multiple HbA1c tests per year, fewer emergency department visits, fewer hospital admissions, and lower care-associated costs (except for outpatient and pharmacy averages). When diabetes coexists with cancer, management of diabetes often lags, making diabetes education an imperative. (*Population Health Management* 2013;16:53–57.

Introduction

CURRENTLY, AMERICANS 65 YEARS OF AGE and older account for approximately 13% of the US population.^{1,2} Based on projections by the United States Census Bureau, by 2030 one in five Americans will be older than 65 years of age, comprising 20.1% of the total population (72.1 million persons).³ Accompanying this aging population is an increasing prevalence of cancer, with the majority of cases occurring in persons older than 65 years of age.⁴ Not only do many of these

patients experience the burden of cancer, but many also must manage comorbidities associated with chronic medical conditions such as diabetes mellitus. Diabetes mellitus afflicts approximately 24 million persons (12.2 million, or 23.1% of these are persons >60 years of age) in the United States and 8%–18% of newly diagnosed cancer patients have this comorbid condition.⁵

There is a growing body of evidence suggesting that patients with diabetes have an increased risk of developing cancer, particularly cancer of the liver, pancreas, endometrium, colon/

¹Northwestern University Feinberg School of Medicine, Chicago, Illinois.

²Solucia Consulting, Farmington, Connecticut.

³Division of General Internal Medicine and Geriatrics, Department of Medicine, and ⁷Department of Preventive Medicine, Northwestern University Feinberg School of Medicine, Chicago, Illinois.

⁴DePaul University, Chicago, Illinois.

⁵Northshore University Health System, Skokie Hospital, Skokie, Illinois.

⁶Robert H. Lurie Comprehensive Cancer Center, Northwestern University, Chicago, Illinois.

rectum, breast, and bladder.^{6–8} Epidemiological studies also indicate that patients with type II diabetes have a 1.12–2.50 relative risk of developing cancer, with the relative risk being lowest for non-Hodgkin's lymphoma and highest for liver cancer.⁹ Potential mechanisms that contribute to this increased risk include the mitogenic effects of insulin, hyperglycemic effects at the cellular level, and increased oxidative stress.⁹ Diabetes is associated with a decreased risk of prostate cancer in men (relative risk=0.84; 95% confidence interval 0.76–0.93).¹⁰ This is believed to be a result of the decreased circulating testosterone in men with diabetes.¹⁰

Individuals with diabetes not only appear to have an increased risk of developing certain cancers, but also have a worse prognosis compared to those without diabetes. Saydah and colleagues showed that, compared to normoglycemic individuals, patients with impaired glucose tolerance, diagnosed diabetes, and undiagnosed diabetes had relative risks of cancer mortality of 1.87, 1.13, and 1.31, respectively.¹¹ This association still occurs when confounding variables, such as smoking, alcohol consumption, and body mass index, are taken into account.⁸ Similarly, a 2008 meta-analysis evaluating cancer patients who had diabetes at the time of diagnosis found that persons with diabetes had an approximate 1.4 times greater risk of dying of cancer than patients with cancer who did not have diabetes.¹²

Although there is good evidence for biologic mechanisms (eg, hyperinsulinemia, hyperglycemia, inflammatory pathways) contributing to this increased risk of cancer incidence and mortality in patients with diabetes, it is possible that there are other factors that account for this association as well. Certain shared risk factors may be involved, such as older age; male sex; African American, Hispanic, Native American, and Asian American/Pacific Islander race/ethnicity; overweight/obesity; poor diet; low physical activity; tobacco smoking; and excessive alcohol consumption.⁷ Furthermore, this increased risk could be related to problems managing the comorbidity; for example, these patients could experience a delayed cancer diagnosis because preventive screening is deferred when more focus is placed on the antecedent diabetes diagnosis.¹²

Given this striking association between diabetes and cancer, the authors wished to better understand differences in diabetes management between patients with diabetes alone and patients with comorbid diabetes and cancer, and to address how diabetes education can be recruited to improve outcomes in patients with this comorbid condition.

Using claims data and specific codes for diabetes education, the authors compared the utilization of diabetes education programs by patients with diabetes–cancer comorbidity to that of patients with diabetes alone. In the cohort of patients with the comorbidity, they then investigated whether diabetes education improves patient outcomes, as determined by the number of emergency department (ED) visits, overnight hospitalizations, and cost of care. The authors postulated that patients who have comorbid diabetes and cancer would be less likely to utilize diabetes education than patients who have a diagnosis of diabetes alone. Among the cohort of patients with this comorbidity, the authors hypothesized that those patients who undergo diabetes education will have better health outcomes than those who do not as indicated by fewer ED visits, fewer overnight hospitalizations, and lower costs of care.

Methods

For this analysis, administrative claims data were used to compare diabetes education utilization by patients aged 60 years or older with a comorbidity of diabetes and cancer to that of patients with diabetes in the absence of cancer. In the subset of individuals with the comorbidity, outcomes including number of ED visits, number of overnight hospital stays, and per member per month (PMPM) cost averages, were further assessed based on whether the patients received diabetes education.

The study population consisted of members of both commercial and Medicare Advantage health plans from a private national database of payer data, but excluded Medicare fee for service and Medicaid patients. The database contains 5-year longitudinal data with approximately 4 million individuals added each year. Each year contains patients with diabetes who have commercial insurance ($n=166,931$) and those with Medicare ($n=56,345$).

Diabetes education utilization was identified using procedure codes (G0108 diabetes outpatient self-management training services, individual, per 30 minutes, and G0109 diabetes self-management training services, group session [2 or more], per 30 minutes). Outcomes were assessed for a 3-year time period (2005–2007). The patients were divided into 3 socioeconomic status classes based on their household zip income: High income ($>\$60,000$), medium income ($\$35,000$ – $\$60,000$), and low income ($<\$35,000$). The Student *t* test and chi-square test were used for statistical analysis. All analyses were performed using SAS software, version 9.2 (SAS Institute Inc., Cary, NC).

Results

For the total data set of individuals 60 years of age or older, the demographic profile was similar for both cohorts. The average age was 73 ± 7.44 years for the group with diabetes alone and 75 ± 7.13 years for the diabetes–cancer group ($P<0.0001$). Fifty-two percent of the diabetes alone group was female, compared to 42% of the diabetes–cancer comorbidity group ($P<0.0001$). For both groups, the majority of individuals ($n=56,205$, approximately 87%) were classified as urban ($P=0.0012$); a little over 50% were classified as middle income ($P=0.5772$), approximately 40% as low income ($P=0.0274$) and only about 6% as high income ($P=0.0004$). There was no significant difference in the percentage of individuals receiving diabetes education between these 2 groups ($P=0.1233$). The percentage was strikingly small; only 3.8% of the diabetes without cancer group and 3.5% of the diabetes with cancer group received diabetes education.

Among the subset of individuals with diabetes–cancer comorbidity, demographic differences were noted between those who received diabetes education and those who did not. Individuals who received diabetes education were younger (age 73 ± 6.99 years) than those who did not receive diabetes education (age 75 ± 7.13 years) ($P<0.0001$). Females were more likely to receive diabetes education ($P=0.0028$). The other variables assessed (percent urban and percent low, middle, and high income) were not found to be significantly different between the 2 cohorts. Hemoglobin A1c (HbA1c) tests and number of hospital admissions were found to differ significantly between the diabetes education

TABLE 1. OUTCOMES OF PATIENTS >60 YEARS OF AGE WITH COMORBID DIABETES AND CANCER BASED ON WHETHER THEY RECEIVED DIABETES EDUCATION

	Non-Diabetes Education				Diabetes Education				P Value
	2005	2006	2007	3-Year Average	2005	2006	2007	3-Year Average	
Members	2527	2633	3118	8278	107	99	93	299	—
A1c test (1+)	78.7%	80.1%	77.3%	78.6%	86.0%	88.9%	89.2%	88.0%	0.0005
A1c test (2+)	49.3%	47.7%	48.1%	48.3%	61.7%	64.6%	69.9%	65.2%	< 0.0001
ER visits/1000	493	415	479	463	529	343	366	416	0.3397
Admits/1000	827	826	977	883	557	535	905	658	0.0121
Average cost PMPM									
Total cost PMPM	\$2192	\$2177	\$2500	\$2303	\$2146	\$1927	\$1856	\$1983	0.0991
Inpatient	\$790	\$805	\$880	\$829	\$790	\$656	\$521	\$661	0.3767
Outpatient	\$509	\$418	\$498	\$476	\$406	\$444	\$409	\$420	0.2872
Professional	\$646	\$705	\$845	\$740	\$646	\$578	\$640	\$622	0.1031
Pharmacy	\$248	\$249	\$277	\$259	\$303	\$249	\$285	\$280	0.3094

Bolded rows indicate $p < 0.05$.

ER, emergency room; PMPM, per member per month.

and nondiabetes education groups (Table 1). Over the 3-year period examined, patients who received diabetes education had greater adherence to diabetes testing and lower frequency of hospitalizations and ED visits. Over the 3-year period, the total hospital admissions/1000 was higher in the nondiabetes education group as compared to the diabetes education group. The diabetes education group was found to have fewer ED visits and lower PMPM cost averages, although these differences did not reach statistical significance. The only cost that was found to be higher among the diabetes education group was the PMPM pharmacy average. PMPM is a measure of average monthly member cost over time.

The authors analyzed PMPM by major service category: inpatient, outpatient, professional, and pharmacy. The only cost that was found to be higher among the diabetes education group was the pharmacy cost PMPM, as one would expect, given that one of the foci of diabetes education is increased patient compliance with medication regimens.

Discussion

As the United States population ages, greater focus must be placed on managing patients with comorbid medical conditions. Among the many health conditions afflicting patients older than 60 years of age, cancer and diabetes both place an incredible burden on individual patients and their caregivers. Studies suggest a link between diabetes and cancer, and note that individuals with this comorbidity suffer worse outcomes than individuals with cancer alone.^{6-9,11,12} In fact, similar studies have shown a link between obesity and cancer across multiple organ systems, and it is presumed that a national rise in the rate of obesity in the geriatric population is directly related to the increased incidence of diabetes and cancer.^{13,14} The percentage of the population older than age 65 with diabetes has increased to 27%, making it critically important to understand the best ways to specifically manage patients with this comorbidity; targeted management of this population group will undoubtedly improve diabetes-related outcomes and might lower the cost of care.¹⁵

In this study, a private claims database was used to evaluate the correlation between comorbidity and diabetes education among a cohort of individuals older than 60 years of age with a diabetes-cancer comorbidity compared to individuals with diabetes alone. A variety of outcomes were then assessed in the diabetes-cancer group based on whether these individuals received diabetes education. Contrary to our hypothesis, we found that having the comorbid condition did not translate into a lower likelihood of utilizing diabetes education. Both the diabetes without cancer and the diabetes-cancer groups were equally unlikely to utilize diabetes education services, with only 3.8% of the total population studied utilizing diabetes education. However, 2 of the demographic factors examined were found to be associated with utilization of diabetes education. Those individuals who utilized diabetes education were more likely to be female and to be younger than those who did not utilize diabetes education. Education utilization also might have been constrained by Medicare rules, because Medicare pays for limited diabetes education visits and frequency; up to 10 hours of diabetes education are covered in the first 12-month period, but only 2 hours are covered in each subsequent year. It is also possible that people were offered the services but did not utilize them because of transportation and travel concerns.

Our analysis of the subset of individuals with the diabetes-cancer comorbidity revealed that diabetes education improved several of the outcomes assessed. A greater percentage of individuals in the diabetes education group were found to have their HbA1c tested at least once or at least twice during the 3 years as compared to the nondiabetes education group (Table 1). Multiple studies, including the Diabetes Control and Complications Trial and the United Kingdom Prospective Diabetes Study, have shown benefit from monitoring HbA1c levels; HbA1c levels provide important information about microvascular and macrovascular risk. Current American Diabetes Association guidelines recommend achieving an HbA1c level of 7% or lower (although the American Geriatric Society recommends that HbA1c goals be individualized in the elderly population).¹⁶⁻¹⁸ HbA1c levels have been shown to be effective predictors of

diabetic complications and are an essential tool for the management of patients with diabetes.¹⁹ Monitoring of HbA1c levels by patients in this study might indicate an interest in assuming a more proactive role in their health care.

Diabetes education in this population appeared to correlate with such outcomes as number of ED visits and hospital admissions. It is well settled that patients older than age 65 account for up to 20% of ED visits, a 5-fold increased likelihood of hospital admission, and an increased risk for hospital readmission in the 90-day interval post discharge. These statistics reflect an increase in health care cost and resource utilization, and have fueled efforts to institute transition programs aimed at safely preventing readmissions, particularly among the high-risk elderly.^{20–23} The diabetes education group in our study had fewer overall ED visits and fewer hospital admissions, although the difference in ED visits was not statistically significant (Table 1). These findings suggest that those individuals who received diabetes education experienced fewer severe health complications than those who did not receive diabetes education. These results might reflect effective management in the outpatient setting. PMPM cost averages also were found to be lower in the diabetes education group as compared to the nondiabetes education group, although the difference was not statistically significant. Specifically, the PMPM total cost, inpatient, outpatient, and professional averages were lower in the group that received diabetes education, while the pharmacy cost for outpatient drugs (pharmacy) PMPM was higher (Table 1), suggesting that patients with diabetes education are more adherent to their medication regimens and, consequently, less likely to use expensive outpatient and inpatient services. Alternatively, the cost differences may be attributable to severity of illness differences among those who received diabetes education and those who did not.

Our findings support a prior study showing that individuals who received diabetes education had lower costs compared to individuals who did not.²⁴ Specifically, follow-up risk analysis by Duncan et al found a significant difference in costs for patients who received diabetes education versus those who did not; no differences were seen among the Medicare group.²⁴ Enrollees who received 2 or more sessions incurred lower costs than those who received 1 or no sessions. Undoubtedly, although cost savings were achieved as a result of decreased hospital admission, ongoing diabetes education prescribed beyond that provided in close nexus to the diabetes diagnosis visit is necessary to produce the cost savings.

To date, studies investigating the effects of patient education on health outcomes in patients with comorbid medical conditions are sparse. One such study by Goepfinger et al assessed the effect of self-management education on various health outcomes in patients with arthritis and an average of 4 comorbid medical conditions. These self-management programs resulted in statistically significant improvements in self-efficacy and health-related quality of life among study participants after 4 months.²⁵ This study supports the premise that patient education has the ability to improve overall health outcomes in patients with comorbidities. Further research is needed to better understand this relationship.

Limitations

Because the study was limited to patients older than age 60, the sample size was relatively small. A future study with a larger cohort of individuals is forthcoming. Specifically, we will assess the effects of potential confounding variables on outcomes. A propensity match or regression analysis to match populations aged <65 years with those aged >65 years will be performed.

Conclusions

Despite the limitations mentioned, our findings suggest a benefit of diabetes education in individuals older than age 60 with comorbid diabetes and cancer. Individuals who received diabetes education were more likely to have regular outpatient follow-up (HbA1c testing), which resulted in fewer hospitalizations, lower health care expenditures, and fewer ED visits. Despite these potential benefits, diabetes education was underutilized. In the total study population, only 3.8% of individuals received diabetes education, and only 3.5% of individuals with diabetes–cancer comorbidity utilized diabetes education. Considering that prior studies also have shown that individuals with this comorbidity have a worse prognosis than those with cancer alone, physicians and midlevel providers must prioritize diabetes education and must advocate for its expanded utilization in the care of patients who are balancing both diseases. Future studies are needed to investigate the impact of diabetes education on cancer–diabetes comorbidity in a larger cohort of individuals and with a focus on specific cancer subtypes.

Author Disclosure Statement

Dr. McKoy was supported by National Institutes of Health/National Cancer Institute grant 1 K01 CA134554-01 and Ms. Irizarry was supported by the Northwestern University Feinberg Medical Student Summer Research Program.

Drs. Thurston, Fitzner, Edwards, and McKoy, and Ms. Irizarry, Mr. Li, Mr. Duncan, Ms. McKoy-Bent, and Ms. Tulas disclosed no conflicts of interest with regard to the research, authorship, and/or publication of this article.

References

1. Administration on Aging. A Profile of Older Americans: 2011. The Older Population. Available at: http://www.aoa.gov/aoaroot/aging_statistics/Profile/2011/3.aspx. Accessed March 12, 2012.
2. Altekruse SF, Kosary CL, Krapcho M, et al., eds. SEER Cancer Statistics Review, 1975–2007. Available at: http://seer.cancer.gov/csr/1975_2007. Accessed March 12, 2012.
3. Administration on Aging. A Profile of Older Americans: 2011. Future Growth. Available at: http://www.aoa.gov/aoaroot/aging_statistics/Profile/2011/4.aspx. Accessed March 12, 2012.
4. Centers for Disease Control and Prevention. Cancer survivorship—United States, 1971–2001. *MMWR Morb Mortal Wkly Rep*. 2004;53:526–529.
5. Ko C, Chaudhry S. The need for a multidisciplinary approach to cancer care. *J Surg Res* 2002;105:53–57.
6. Richardson LC, Pollack LA. Therapy insight: Influence of type 2 diabetes on the development, treatment and outcomes of cancer. *Nat Clin Pract Oncol* 2005;2:48–53.

7. Giovannucci E, Harlan DM, Archer MC, et al. Diabetes and cancer: A consensus report. *Diabetes Care* 2010;33:1674–1685.
8. Jee SH, Ohrr H, Sull JW, Yun JE, Ji M, Samet JM. Fasting serum glucose level and cancer risk in Korean men and women. *JAMA* 2005;293:194–202.
9. Vigneri P, Frasca F, Sciacca L, Pandini G, Vigneri R. Diabetes and cancer. *Endocr Relat Cancer* 2009;16:1103–1123.
10. Kasper JS, Giovannucci E. A meta-analysis of diabetes mellitus and the risk of prostate cancer. *Cancer Epidemiol Biomarkers Prev* 2006;15:2056–2062.
11. Saydah SH, Loria CM, Eberhardt MS, Brancati FL. Abnormal glucose tolerance and the risk of cancer death in the United States. *Am J Epidemiol* 2003;157:1092–1100.
12. Barone BB, Yeh HC, Snyder CF, et al. Long-term all-cause mortality in cancer patients with preexisting diabetes mellitus: A systematic review and meta-analysis. *JAMA* 2008;300:2754–2764.
13. Calle EE, Kaaks R. Overweight, obesity and cancer: Epidemiological evidence and proposed mechanisms. *Nat Rev Cancer* 2004;4:579–591.
14. Bianchini F, Kaaks R, Vainio H. Overweight, obesity, and cancer risk. *Lancet Oncol* 2002;3:565–574.
15. National Center for Health Statistics. *Health, United States, 2010: With Special Feature on Death and Dying*. Hyattsville, MD: National Center for Health Statistics; 2011.
16. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group. *Lancet* 1998;352:837–853.
17. American Diabetes Association. Standards of medical care in diabetes. *Diabetes Care* 2004;27:S15–S35.
18. Brown AF, Mangione CM, Saliba D, Sarkisian CA. Guidelines for improving the care of the older person with diabetes mellitus. *J Am Geriatr Soc* 2003;51:S265–S280.
19. Saudek CD, Derr RL, Kalyani RR. Assessing glycemia in diabetes using self-monitoring blood glucose and hemoglobin A1c. *JAMA* 2006;295:1688–1697.
20. Aminzadeh F, Dalziel WB. Older adults in the emergency department: A systematic review of patterns of use, adverse outcomes, and effectiveness of interventions. *Ann Emerg Med* 2002;39:238–247.
21. Denman SJ, Ettinger WH, Zarkin BA, Coon PJ, Casani JA. Short-term outcomes of elderly patients discharged from an emergency department. *J Am Geriatr Soc* 1989;37:937–943.
22. Stott DJ, Buttery AK, Bowman A, et al. Comprehensive geriatric assessment and home-based rehabilitation for elderly people with a history of recurrent non-elective hospital admissions. *Age Ageing* 2006;35:487–491.
23. Koehler BE, Richter KM, Youngblood L, et al. Reduction of 30-day postdischarge hospital readmission or emergency department (ED) visit rates in high-risk elderly medical patients through delivery of a targeted care bundle. *J Hosp Med* 2009;4:211–218.
24. Duncan I, Birkmeyer C, Coughlin S, Li QE, Sherr D, Boren S. Assessing the value of diabetes education. *Diabetes Educ* 2009;35:752–760.
25. Goeppinger J, Armstrong B, Schwartz T, Ensley D, Brady TJ. Self-management education for persons with arthritis: Managing co-morbidity and eliminating health disparities. *Arthritis Rheum* 2007;57:1081–1088.

Address correspondence to:

June M. McKoy, MD, MPH, JD, MBA

Department of Medicine and Preventive Medicine

Northwestern University Feinberg School of Medicine

645 N. Michigan Avenue, Suite 630

Chicago, IL 60611

E-mail: j-mckoy@northwestern.edu