



Brief Original Report

Effect of multimodal information delivery for diabetes care on colorectal cancer screening uptake among individuals with type 2 diabetes

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A B S T R A C T

Despite the significant increase in the risk of colorectal cancer (CRC), one-third of individuals with diabetes who met screening recommendations, reported not being up-to-date on CRC screening in the United States. We determined the means through which individuals with type 2 diabetes (T2DM) learned about diabetes care; we further examined their associations with CRC screening uptake. This was a retrospective study of US adults aged 50–75 years diagnosed with T2DM (sample $n = 5595$, representing 14,724,933 Americans). Data from the 2011–2014 Medical Expenditure Panel Survey were analyzed to compare CRC screening uptake in four learning groups for diabetes care: (1) did not learn, (2) learning from health providers only, (3) learning from other sources (including online sources and group class), and (4) learning from health providers and other sources together (combined learning group). Overall, 70.4% individuals with T2DM were up-to-date with CRC screening during 2011–2014. In multivariate logistic regression analysis, the combined learning group had 1.32 (95% confidence interval, 1.01–1.74) times higher odds of being up-to-date on CRC screening than those who did not learn about diabetes care. The odds of being up-to-date on CRC screening were not significant for other learning groups. Our findings suggest that combined ways of health information delivery for diabetes care is associated with increased odds of being up-to-date on CRC screening among individuals with T2DM. Multimodal health information delivery has the potential to result in unintended, positive consequences in preventive care services use.

1. Introduction

It is well documented that individuals diagnosed with type 2 diabetes (T2DM) are at almost 40% greater risk for colorectal cancer (CRC) than the non-diabetics (Siddiqui and Palmer, 2011; Peeters et al., 2015; Yang et al., 2005). Early epidemiologic studies suggest that metabolic syndrome, hyperinsulinemia or insulin resistance may increase the risk of CRC among diabetic patients (Siddiqui and Palmer, 2011), and a recent meta-analysis has shown that having diabetes increases the risk of cancer-specific mortality by about 12% among patients with CRC (Mills et al., 2013).

Despite the proven benefits of early detection (Bibbins-Domingo et al., 2016), the uptake rate of CRC screening has been suboptimal (Hong et al., 2017). It was estimated that about one-third of individuals aged 50 or older with diabetes, who met screening recommendations, reported not being up-to-date on CRC screening (Porter et al., 2016). A recent study found that, among individuals with T2DM, the frequency of diabetes-related visits to care was not associated with receipt of CRC screening, suggesting that diabetic patients may not be referred for CRC screening despite the greater risk of CRC (Porter et al., 2016).

Currently, little is still known about the factors that can help promote recommended CRC screening among those with T2DM.

Behavioral patient education/counseling is considered an essential part of the optimal care for those with chronic conditions (Wagner, 2011). Educational intervention in various settings for diabetes care (including self-management, community-based care, and primary care) has demonstrated its effectiveness in improving patients and treatment outcomes (Wagner, 2011; Yamaoka and Tango, 2005; Norris et al., 2002). However, to date, no known study has attempted to examine the association between diabetes care education and uptake of recommended screening for CRC among those with T2DM. Using a nationally representative sample of US adults, we determined the means through which individuals with T2DM learned about diabetes care and then examined their associations with CRC screening uptake.

2. Methods

We conducted a retrospective analysis of the 2011–2014 Medical Expenditure Panel Survey (MEPS). The MEPS is a complex data set

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utilizing a multistage probability sample design that provides nationally representative information on health service use, expenditures, sources of payment, and health insurance coverage for the US non-institutionalized population ([Agency for Healthcare Research and Quality, 2017](#)). The MEPS Household Component (HC) data files include the Diabetes Care Survey (DCS) to supplement the data set with questions related to diabetes care. MEPS administers the DCS to respondent was ever told by a doctor or health professional that he/she had diabetes ([Agency for Healthcare Research and Quality, 2016](#)). We identified respondents aged 50–75 years, for whom screening is recommended by the US Preventive Services Task Force ([Bibbins-Domingo et al., 2016](#)), and diagnosed with T2DM. Then, we defined them as being up-to-date on CRC screening if they reported having had a blood stool test within the past year, sigmoidoscopy in the past five years, or colonoscopy in the past 10 years. We excluded individuals diagnosed with CRC.

The DCS includes information about the receipt of diabetes tests and complications of diabetes ([Agency for Healthcare Research and Quality, 2016](#)). Respondents also reported the ways in which they learned about diabetes care. Based on the responses individuals with T2DM were categorized into four groups: (1) did not learn about care (served as the reference group), (2) learning from health care providers only, (3) learning from other sources (including readings on the Internet and taking a group class), and (4) learning from health care providers and other sources combined (combined learning group).

Analyses were conducted in 2017. We estimated multivariate logistic regression models to calculate odds ratios (ORs) for the odds of being up-to-date on CRC screening, adjusting for sociodemographic characteristics (age, gender, race/ethnicity, education, family income, employment, marital status, and census region), health insurance, smoking status, and comorbid conditions (hypertension, high cholesterol, heart disease, stroke, congestive heart failure, and renal failure). Because the greater frequency of provider visit increases the odds of CRC consultation ([Porter et al., 2016](#)), we controlled for health services utilization (number of visits to physicians and non-physician providers) in our model. We set the *P* value for statistical significance at 0.05. All analyses were performed using SPSS Complex Survey, version 24 (IBM Corp., Armonk, NY) and SAS®, version 9.4 (SAS Institute, Cary, NC). This study was reviewed and granted exemption by the institutional review board of the University of Florida.

3. Results

Our study sample included 5595 individuals, representing 14,724,933 Americans aged 50–75 years with T2DM. Overall, 70.4% (95% CI, 67.9%–72.9%; 10 million Americans) individuals with T2DM were up-to-date with CRC screening during 2011–2014.

[Table 1](#) presents up-to-date CRC screening rates by individual characteristics. Except for sex (*P* = 0.12), there were significant differences in CRC screening uptake across individual characteristics. The percentage of being up-to-date was highest among individuals aged 65 years or older (79.3% [95% CI, 75.9%–82.4%]), non-Hispanic Whites (73.6% [95% CI, 71.0%–75.9%]), those with higher education (75.3% [95% CI, 72.4%–77.9%]), higher family income (75.4% [72.5%–78.0%]), who were reportedly married (72.6% [95% CI, 70.0%–75.1%]), had health insurance (74.4% private [95% CI, 72.3%–76.7%] and 68.9% public [95% CI, 66.4%–71.3%]), were non-smoker (71.1% [95% CI, 69.0%–73.1%]), and had greater number of comorbid conditions (76.2% [95% CI, 73.5%–78.7%]). In terms of health information delivery, up-to-date CRC screening rate was highest in the combined learning group (76.2% [95% CI, 73.5%–78.8%]) followed by health providers only 69.3% (95% CI, 67.1%–71.3%), other resources 67.5% (95% CI, 56.6%–76.8%), and did not learn about care (66.1%, [95% CI, 62.4%–69.5%]) groups.

In multivariate logistic regression analysis ([Fig. 1](#)), individuals with T2DM who learned about diabetes care from health providers and other

resources combined had a greater odds for being up-to-date on CRC (OR 1.32, 95% CI, 1.01–1.74) compared with those who did not learn about diabetes care. The odds of being up-to-date on CRC screening were not significant for those that reported learning from health providers only (*P* = 0.78) and also the group that reported learning from other sources only (*P* = 0.52) when compared with the did not learn about diabetes care group.

4. Discussion

To our knowledge, this is the first study to examine the association between the ways of health information delivery for diabetes care and CRC screening uptake among individuals with T2DM. Our findings indicate that about one-third of T2DM patients were not up-to-date with CRC screening, which is consistent with a prior study ([Porter et al., 2016](#)). We also found that individuals with T2DM who learned about diabetes care from health providers and other resources (internet and group class session) combined had a higher prevalence of being up-to-date on CRC screening than the reference group (those did not learn about). Screening uptake was the highest among individuals in the combined learning group than those who learned from health providers only or other resource only group. Consistent with bivariate analyses, individuals in the combined learning group were more likely to be up-to-date on CRC screening than the other three groups in the adjusted analyses. These results indicate that a multimodal patient education format (e.g., combining both online resources/group classes or face-to-face provider interaction) is associated with improved diabetes-related preventive care services use, like CRC screening in this study.

It is important for public health workers and health educators to better understand the ways in which mode of delivery of health information affects screening behavior positively. Previous studies have not shown the effectiveness of group session and online-based interventions ([Rickheim et al., 2002](#); [Cavallo et al., 2012](#)); however, we observed increased odds of being up-to-date when they are combined with health providers together. Our findings are not surprising, given that the majority of intervention for behavior change is designed as a combination of programs or strategies to maximize the retention of information delivered ([Giuse et al., 2012](#); [Chang et al., 2014](#)). In addition, interventions including multiple educational programs and stages are found to be exceptionally effective for individual behavior change such as weight loss ([Johns et al., 2014](#)) and vaccination ([Dempsey and Zimet, 2015](#)). Taken together, our findings suggest that delivering health information using a single mode may not be effective at getting patient up-to-date on recommended health screening, but may be effective when delivering in a combination format.

5. Limitations

The current study has its limitation. First, it was a cross-sectional design, which limited our ability to explore the causality between diabetes care education and CRC screening. Future randomized controlled trial is warranted to certify this association. Second, a larger sample size of screening up-to-date group (70%) may yield a higher significance level when compared with the not up-to-date group (30%). Lastly, in the nature of secondary data analysis, we were able to examine only available information in the dataset. It has been reported that interventions of self-management for a single chronic condition may have a spillover effect to improve management of other conditions ([Foster et al., 2007](#)) and improved interaction quality with health care providers are positively associated with the uptake of CRC screening ([Hong et al., 2018](#)). Further studies should explore and examine other possible, unintended positive effects of factors, aside from socio-economic determinants, on patient health behavior and associated outcomes among those with T2DM.

Table 1
Characteristics of individuals with diabetes by CRC screening up-to-date status.

| Variable | Sample N | Individuals with DM (row % [95% CI]) | | P value |
|---|------------|--------------------------------------|------------------|---------|
| | | Up-to-date | Not up-to-date | |
| | | 3731 | 1864 | |
| | Weighted N | 10,212,775 | 4,512,158 | |
| Age | | | | < 0.001 |
| 50–54 | | 48.2 (43.2–53.2) | 51.8 (46.8–56.8) | |
| 55–59 | | 65.0 (60.3–69.5) | 35.0 (30.5–39.7) | |
| 60–64 | | 72.3 (68.3–76.0) | 27.7 (24.0–31.7) | |
| 65–69 | | 79.3 (75.9–82.4) | 20.7 (17.6–24.1) | |
| 70–75 | | 76.9 (72.5–80.7) | 23.1 (19.3–27.5) | |
| Sex | | | | 0.122 |
| Male | | 71.6 (69.2–74.0) | 28.4 (26.0–30.8) | |
| Female | | 69.2 (66.8–71.5) | 30.8 (28.5–33.2) | |
| Race/ethnicity | | | | < 0.001 |
| Non-Hispanic white | | 73.6 (71.0–75.9) | 26.4 (24.1–29.0) | |
| Non-Hispanic black | | 72.4 (69.8–74.9) | 27.6 (25.1–30.2) | |
| Hispanic | | 59.1 (55.3–62.8) | 40.9 (37.2–44.7) | |
| Non-Hispanic Asian | | 55.8 (49.3–62.0) | 44.2 (38.0–50.7) | |
| Others | | 72.1 (59.8–81.7) | 27.9 (18.3–40.2) | |
| Education | | | | < 0.001 |
| High school/GED or less | | 67.7 (65.2–70.1) | 32.3 (29.9–34.8) | |
| Some college or higher | | 75.3 (72.4–77.9) | 24.7 (22.1–27.6) | |
| Family income | | | | < 0.001 |
| < FPL 200% | | 65.4 (62.9–67.8) | 34.6 (32.2–37.1) | |
| FPL 200–399% | | 71.0 (68.1–73.7) | 29.0 (26.3–31.9) | |
| ≥ FPL 400% | | 75.4 (72.5–78.0) | 24.6 (22.0–27.5) | |
| Employment | | | | 0.009 |
| Employed | | 67.5 (64.5–70.3) | 32.5 (29.7–35.5) | |
| Unemployed | | 71.9 (69.7–74.0) | 28.1 (26.0–30.3) | |
| Marital status | | | | 0.004 |
| Married | | 72.6 (70.0–75.1) | 27.4 (24.9–30.0) | |
| Not married | | 67.4 (64.9–69.8) | 32.6 (30.2–35.1) | |
| Health insurance | | | | < 0.001 |
| Private | | 74.5 (72.3–76.7) | 25.5 (23.3–27.7) | |
| Public | | 68.9 (66.4–71.3) | 31.1 (28.7–33.6) | |
| Uninsured | | 40.6 (34.2–47.4) | 59.4 (52.6–65.8) | |
| Current smoking | | | | 0.099 |
| Yes | | 67.1 (62.8–71.2) | 32.9 (28.8–37.2) | |
| No | | 71.1 (69.0–73.1) | 28.9 (26.9–31.0) | |
| Number of comorbidities | | | | < 0.001 |
| 0 | | 54.9 (48.1–61.5) | 45.1 (38.5–51.9) | |
| 1 | | 64.3 (60.4–68.0) | 35.7 (32.0–39.6) | |
| 2 | | 70.1 (67.2–72.9) | 29.9 (27.1–32.8) | |
| 3 + | | 76.2 (73.5–78.7) | 23.8 (21.3–26.5) | |
| Way to learn about diabetes care | | | | < 0.001 |
| Did not learned | | 66.1 (62.4–69.5) | 33.9 (30.5–37.6) | |
| From a health provider, only | | 69.3 (67.1–71.3) | 30.7 (28.7–32.9) | |
| From other sources, only ^a | | 67.5 (56.6–76.8) | 32.5 (23.2–43.4) | |
| Health provider + multiple sources together | | 76.2 (73.5–78.8) | 23.8 (21.2–26.5) | |

Note. Statistically significance between groups were detected by Chi-square test (Place of Study: Gainesville, FL. Time of study: June 2017). Percentages are weighted to approximate the population estimates. Abbreviations: CRC = colorectal cancer, CI, confidence interval; GED = general equivalency diploma, FPL = federal poverty level.

^a Other sources include readings on the Internet or taking group sessions.

6. Conclusions

In conclusion, combined ways of learning about diabetes care, but not learning from health providers or other resources (online material or group session) alone, is associated with statistically significant increased odds of being up-to-date on CRC screening among individuals with T2DM. Collaborative patient education/interventions using various media may contribute to efforts to improve CRC screening uptake among individuals at increased risk.

Declaration

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Ways of Learning about DM Care

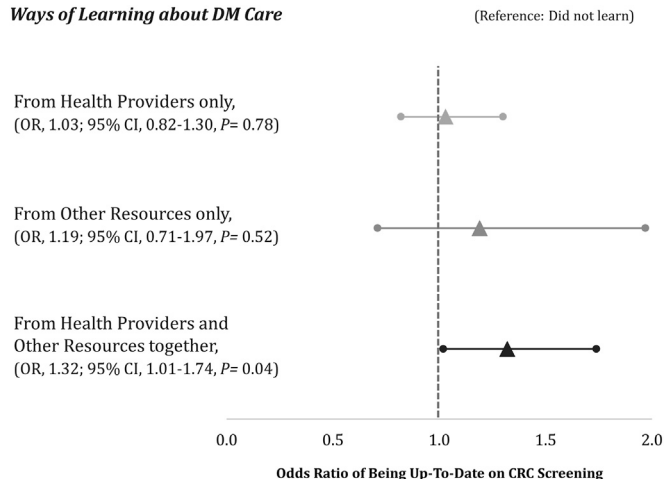


Fig. 1. Adjusted Associations between Ways of Learning about Diabetes Care and Colorectal Cancer (CRC) Screening.

Abbreviations: CRC, colorectal cancer; OR, odds ratio; CI, confidence interval; DM, diabetes mellitus. Other sources include readings on the Internet or taking group sessions. Odds ratios and 95% confidence interval were computed using multivariate logistic regression models adjusting for age, sex, race/ethnicity, family income, marital status, employment, region, insurance status, smoking status, comorbid conditions, and number of healthcare visits (Place of Study: Gainesville, FL. Time of study: June 2017).

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