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Electronic health record-based assessment of cardiovascular health: The stroke prevention in healthcare delivery environments (SPHERE) study

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ABSTRACT

<3% of Americans have ideal cardiovascular health (CVH). The primary care encounter provides a setting in which to conduct patient-provider discussions of CVH. We implemented a CVH risk assessment, visualization, and decision-making tool that automatically populates with electronic health record (EHR) data during the encounter in order to encourage patient-centered CVH discussions among at-risk, yet under-treated, populations. We quantified five of the seven CVH behaviors and factors that were available in The Ohio State University Wexner Medical Center's EHR at baseline (May–July 2013) and compared values to those ascertained at one-year (May–July 2014) among intervention ($n = 109$) and control ($n = 42$) patients. The CVH of women in the intervention clinic improved relative to the metrics of body mass index (16% to 21% ideal) and diabetes (62% to 68% ideal), but not for smoking, total cholesterol, or blood pressure. Meanwhile, the CVH of women in the control clinic either held constant or worsened slightly as measured using those same metrics. Providers need easy-to-use tools at the point-of-care to help patients improve CVH. We demonstrated that the EHR could deliver such a tool using an existing American Heart Association framework, and we noted small improvements in CVH in our patient population. Future work is needed to assess how to best harness the potential of such tools in order to have the greatest impact on the CVH of a larger patient population.

1. Introduction

Poor cardiovascular health (CVH) is associated with an increased risk for cardiovascular (Foraker et al., 2016; Folsom et al., 2011; Rasmussen-Torvik et al., 2013; Kulshreshtha et al., 2013) and other chronic diseases (Lloyd-Jones, 2014). CVH is amenable to change via prevention efforts (Lloyd-Jones, 2014; Bambs and Reis, 2011; Foraker et al., 2012). Population-level approaches to reduce tobacco use and promote healthy dietary choices (Eyre et al., 2004) are needed to achieve the American Heart Association's (AHA's) goal of "improving the CVH of all Americans 20% by 2020" (Lloyd-Jones et al., 2010). Prevention discussions at the point-of-care and early CVH interventions in the primary care setting may enhance and reinforce population-level strategies to improve CVH for all Americans (Peiris et al., 2015).

The increasing need for high-quality, patient-centered documentation at the point-of-care places time constraints on primary care providers, thus limiting behavior modification counseling during a patient encounter (Haire-Joshu and Klein, 2011; Huang et al., 2004). Evidence suggests that patient-centeredness decreases as providers increase attention to an electronic health record (EHR) (Street et al., 2014). In fact, primary care providers spend almost as much time documenting the encounter as they do in direct patient care (Ammenwerth and Spötl, 2009). Further, CVH data are often located on various screens throughout the EHR, limiting the ability of care providers to synthesize and reason upon such data, particularly in time-constrained practice settings. Compounding this problem, many providers lack training in delivering prevention messages and supporting behavior change (Kushner, 2010; Gunther et al., 2012). In a similar manner, few current

Abbreviations: 95% CI, 95% confidence interval; ACC, American College of Cardiology; AHA, American Heart Association; CDS, clinical decision support; CVH, cardiovascular health; EHR, electronic health record; GEE, generalized estimation equation; OSUWMC, Ohio State University Wexner Medical Center; SD, standard deviation; SPHERE, stroke prevention in healthcare delivery environments.

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EHR platforms provide tailored healthcare communication functionality as an alternative to shared decision-making (Mantwill et al., 2015; O'Malley et al., 2015; Chrimes et al., 2014). As a result of these barriers, few providers discuss physical activity or other lifestyle changes with patients nor do patients receive adequate information support to enable or promote such healthy behaviors (Eakin et al., 2005).

Clinical decision support (CDS) within EHR systems helps providers with decision-making tasks about individual patients at the point-of-care (Berner, 2006), and modifies provider behavior by recommending specific actions or reminding providers of clinical care guidelines (Rothman et al., 2012), prompts smoking cessation counseling and referrals (Sharifi et al., 2014), facilitates goal-setting among pre-diabetics (Chrimes et al., 2014), lowers cholesterol (Zamora et al., 2013), and increases appropriate prescribing (Litvin et al., 2013). There is growing consensus for improved patient outcomes through implementation of EHR tools in cardiothoracic surgery (Razavi et al., 2014), specialty clinics, and primary care (Zamora et al., 2013).

In response to the preceding challenges and opportunities, we developed and evaluated a novel, easy-to-use, EHR-based CVH assessment tool for use in primary care that automatically populates with EHR data and renders an interactive visual display of a patient's CVH score (Foraker et al., 2014). We hypothesized that the CVH of patients with access to our CVH tool would improve over a one-year period, while the CVH of patients without access to the tool would stay the same or worsen.

2. Material and methods

As we have described previously (Foraker et al., 2014), the stroke prevention in healthcare delivery environments (SPHERE) tool was developed and implemented in the outpatient EHR of a general internal medicine clinic at The Ohio State University Wexner Medical Center (OSUWMC) (Foraker et al., 2014). Briefly, the SPHERE tool (Supplementary Figure) was designed to increase patient-provider communication around prevention. The SPHERE tool launches within the EHR during a patient encounter, and is viewable by both patient and provider. The provider uses the interactive features of the tool (slider bars and buttons) to show how changes in each CVH component can impact their overall CVH. Providers in the intervention clinic were not incentivized to use the tool; details on its use are presented in a separate publication (Foraker et al., 2015).

Our eligible patient population included women who were 65 years of age or older at the time of the baseline encounter. Control clinic patients were seen in a different outpatient clinic in the OSUWMC system, and received usual care with regard to prevention discussions. The study, with a waiver of informed consent, was approved by The Ohio State University's Institutional Review Board (approval number 2013H0083).

Baseline demographic and CVH data for the eligible patient population at both clinics were obtained from the EHR for the time period of May 1, 2013 through July 31, 2013. The SPHERE tool was accessible to providers in the intervention clinic beginning October 6, 2013. Follow-up CVH data were queried one-year later for encounters occurring between May 1, 2014 and July 31, 2014. We conducted a group-level analysis on the subset of women seen in the intervention clinic ($n = 109$) and women seen in the control clinic ($n = 42$) who had an encounter during both time periods. We also report on the CVH of all eligible patients seen during baseline and/or follow-up periods. Baseline data indicated that 160 eligible patients were seen in the intervention clinic, and 62 eligible patients were seen in the control clinic. Follow-up data collection yielded 168 eligible intervention patients and 96 eligible control patients.

Baseline and follow-up data included the demographic variables of age and race (white, black, other). We used the most recent data (collected within the past 12 months) to characterize smoking status, body mass index (BMI), total cholesterol, blood pressure, and fasting glucose/hemoglobin A1c. Two other components of CVH, physical activity and diet, were infrequently entered as unstructured data in clinic notes, and were not computationally actionable as free text. Therefore, we excluded these two variables from the current study report.

We assigned patients to ideal, intermediate, and poor categories of the AHA's CVH metric as shown in Table 1, based on values associated with each of the biometric components, with the exception of fasting glucose/hemoglobin A1c (American Diabetes Association, 2012). For fasting glucose, we categorized participants into ideal (not taking glucose-lowering medication) and intermediate (taking glucose-lowering medication) CVH categories due to high levels of missing data for both fasting glucose and hemoglobin A1c laboratory values in our EHR.

2.1. Statistical methods

Demographic factors in both control and intervention clinic were characterized as mean (SD) for continuous variables and as proportions for categorical variables. For each of the five CVH categories, the proportion of women in each clinic in each category (e.g., ideal, intermediate, or poor health or missing) was reported both at baseline and post-intervention. Overall CVH score, calculated as 2 points for idea, 1 point for intermediate, and 0 for poor on each of the five available factors was calculated for each participant and the change in average CVH score in aggregate (pre-post) for each clinic was estimated using a GEE approach to account for correlations on women measured during both periods. The main analysis comprised the subset of women who were observed during both baseline and follow-up periods. A secondary analysis investigated changes among all eligible women seen during baseline and/or follow-up.

Data analysis was conducted using STATA (StataCorp). Statistical significance was set at 0.05.

3. Results

At baseline, the average age of the subset of patients seen in the intervention clinic was 75 years, while the average age was 72 in the control clinic (Table 2). Differences were seen at baseline by race between the intervention (35% black) and control (21% black) clinics. The demographic data in the intervention clinic did not change appreciably between the baseline and follow-up periods in either clinic. The baseline data of all eligible women seen during the baseline and/or follow-up periods in the intervention clinic had a similar distribution of demographic factors compared to the subset of patients at baseline. Similarly, the subset of patients in the control clinic had nearly equivalent demographic characteristics compared to all eligible women seen during the baseline and/or follow-up periods in the control clinic (Table 2).

Among women in the intervention clinic who were seen during both the baseline and follow-up periods, we observed CVH improve on the metrics of BMI (14.7 to 19.3% ideal) and diabetes (56.9 to 62.4% ideal) from baseline to follow-up. Meanwhile, the CVH of women in the control clinic either held constant (diabetes; 83.3% ideal) or worsened slightly (BMI; 23.8 to 19.0% ideal) from baseline to follow-up.

At baseline, a greater proportion of all eligible patients in the intervention clinic (Fig. 1C) were in ideal CVH compared to those in the control clinic (Fig. 1D) for current smoking and total cholesterol. However, eligible patients in the intervention clinic were more likely to be in poor CVH for BMI and blood pressure, and to be treated for diabetes, compared to the control clinic. Among all eligible patients in the intervention clinic, improvements were seen from baseline to follow-up for BMI (18.1 to 20.2% ideal) and diabetes status (59.4 to 63.7% ideal).

Average overall CVH score increased by 0.024 (95% CI: −0.24 to 0.29) in the intervention clinic ($p = 0.86$), indicating that improvements in BMI and diabetes were somewhat offset by losses on other factors. Conversely, CVH components either held constant or worsened among eligible patients seen in the control clinic. In the control clinic,