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# Initiation of treatment for incident diabetes: Evidence from the electronic health records in an ambulatory care setting

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ABSTRACT

*Objective:* We examined patterns and predictors of initiation of treatment for incident diabetes in an ambulatory care setting in the US.
*Methods:* Data were extracted from electronic health records (EHR) for active patients ≥35 years in a multispecialty, multiclinic ambulatory care organization with 1000 providers. New onset type 2 diabetes and subsequent treatment were identified using lab, diagnosis, medication prescription, and service use data. Time from the first evidence of diabetes until initial treatment, either medication or education/counseling, was examined using a Kaplan–Meier hazards curve. Potential predictors of initial treatment were examined using multinomial logistic models accounting for physician random effects.
*Results:* Of 2258 patients with incident diabetes, 55% received either medication or education/counseling (20% received both) during the first year. Of the treated patients, 68% received a treatment within the first four weeks, and 13% after initial 16 weeks. Strong positive predictors ($P < 0.01$) of combined treatment were younger age, higher fasting glucose at diagnosis, obesity, and visits with an endocrinologist.
*Conclusions:* Among insured patients who have a primary care provider in a multispecialty health care system, incident diabetes is treated only half the time. Improved algorithms for identifying incident diabetes from the EHR and team approach for monitoring may help treatment initiation.


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## 1. Introduction

Guidelines for type 2 diabetes recommend early initiation of therapy, with lifestyle counseling and medication offered concomitantly [1,2]. Studies have shown the importance of early identification and treatment of diabetes for preventing long-term complications [3]. Even in the pre-diabetic stage, initiation of lifestyle changes and medications are beneficial [4–8]. Existing studies suggest an epidemic of under-diagnosis and under-treatment of diabetes and its complications in the US [9–12].

Little is known about how *incident* diabetes is treated in ambulatory care practices. It is unknown, for example, how long it takes to receive treatment after the identification of diabetes, and patient and practice factors contributing to the timing of treatment initiation. Addressing such questions requires observation of real-world practices serving patients with varying demographics and clinical conditions, and longitudinally linked data on patient clinical history, utilization pattern and provider practice style [13,14].

We examined initial treatment of incident diabetes, utilizing data from electronic health records (EHRs), reflecting clinical practice in typical ambulatory care setting. We first describe timing and initial treatment choices for patients who are newly identified as having diabetes. We then evaluate demographic and clinical risk factors and service use pattern that are associated with initial treatment of diabetes.

## 2. Methods

### 2.1. Study setting and data source

The study used demographic and clinical data, including anthropometric measures, physician diagnoses, laboratory results and prescription medications, extracted from EpicCare® (Epic Systems, Verona WI) EHRs for the patients at a large multi-specialty, mixed-payer, outpatient, group practice with approximately 1000 physicians in northern California. The EHR system has been in use since 2000 across all the clinics and providers included in the study. The demographic characteristics of the patients are similar to that of residents in the surrounding service area [15].

The study population included active patients of the health care system (i.e., those who visited primary care or endocrinology departments) who were age 35 years or older, never had type 1 diabetes and were not pregnant during the surveillance period: 1/1/2007–6/30/2010 ($n = 254{,}259$). We then identified patients with type 2 diabetes. Evidence for type 2 diabetes included (1) two physician diagnosis of diabetes (ICD-9 codes 250.xx) in the EHR Problem List or (2) two abnormal laboratory values (fasting glucose, random glucose, oral glucose tolerance or HbA1c tests) according to the 2005 American Diabetes Association (ADA) guideline [16]. Among patients with type 2 diabetes ($n = 20{,}341$), we excluded patients who had evidence of diabetes or diabetes treatment before the study entry. To ascertain "new" diabetes status, we further excluded patients who had been in the health care system less than one year before the first evidence of diabetes.

Among patients identified as having incident diabetes ($n = 3237$), we excluded patients with active cancer (554 patients) or serious kidney or liver disease (239 patients), based on clinical encounter diagnosis. Of the remaining 2429 patients, we then excluded 171 patients who did not make contacts with a primary care physician during follow up period (i.e., from the initial evidence to 6/30/2011) to ensure that the study sample consisted of active primary care patients and thus did not receive care exclusively outside the health care system during the follow-up, leaving 2258 patients included in the study. All analytical data sets were HIPAA de-identified and no patients were contacted for the study.

### 2.2. Treatment options

Treatment options for diabetes include medication prescription or education/counseling. Education/counseling was defined to include attendance in classes focused on diabetes-related lifestyle management, physician-led shared medical appointments on diabetes, or individual counseling with dietitians or nutritionists (see http://www.pamf.org/diabetes/for examples of classes). Participation in education/counseling sessions (whether it is reimbursed by payers, self-paid or free of charge) was documented in the EHR. All treatments occurred on or after confirmatory evidence of diabetes. We assessed guideline-adherent treatment options classified into: (1) both education/counseling and medication prescription, (2) medication prescription only, and (3) education/counseling only.

### 2.3. Covariates in multivariate models of predictors of treatment

For clinical risk factors for treatment, we examined baseline values of fasting glucose, HbA1c, obesity (BMI $\geq 30\,kg/m^2$), overweight (BMI $\geq 25\,kg/m^2$ and $<30\,kg/m^2$), systolic blood pressure, triglyceride, and low density lipoprotein (LDL) cholesterol. For all the clinical values, we used the value measured and recorded on the date nearest (within the window of 365 days prior to 30 days post) to the first evidence of diabetes. Patient demographic characteristics included were age, sex, insurance type, race/ethnicity, and limited English proficiency (i.e., primary language not English). We also included three indicators of service use during the first year following initial diagnosis of diabetes: (1) any visit to an endocrinology department, (2) a visit to other specialty or urgent care, and (3) no physician office visit.

### 2.4. Statistical analysis

To describe time to initial treatment, we computed a Kaplan–Meier cumulative treatment curve. The starting point was the date of first evidence of incident type 2 diabetes and the end point was the date of initial treatment or, if not treated, at the 12 months of follow-up.

We examined summary statistics and bivariate relationships of patient and physician characteristics with treatment options. Fisher's exact test and $X^2$ test were used for the bivariate comparisons, as appropriate.