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Original Study

Changing Patterns of Glucose-Lowering Medication Use in VA Nursing Home Residents With Diabetes, 2005 to 2011

Sei J. Lee MD, MAS *, Irena Stijacic-Cenzer MS, Caroline Barnhart BA, Keelan McClymont MA, Michael A. Steinman MD

Division of Geriatrics, San Francisco VA and University of California San Francisco, San Francisco, CA

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A B S T R A C T

Objective: Although nursing home (NH) residents make up a large and growing proportion of Americans with diabetes mellitus, little is known about how glucose-lowering medications are used in this population. We sought to examine glucose-lowering medication use in Veterans Affairs (VA) NH residents with diabetes between 2005 and 2011.

Research Design and Methods: Retrospective cohort study, using linked laboratory, pharmacy, administrative, and NH Minimum Dataset (MDS) 2.0 databases in 123 VA NHs. A total of 9431 long-stay (>90 days) VA NH residents older than 65 followed for 52,313 person-quarters. We identified receipt of glucose-lowering medications, including insulin, metformin, sulfonylureas, thiazolidinediones, and others (alpha-glucosidase inhibitors, meglitinides, glucagonlike peptide-1 analogs, dipeptidyl peptidase-4 inhibitors and amylin analogs) per quarter.

Results: The rates of sulfonylurea use in long-stay NH residents dropped dramatically from 24% in 2005 to 12% in 2011 ($P < .001$), driven in large part by the dramatic decrease in glyburide use (10% to 2%, $P < .001$). There was sharp drop in thiazolidinedione use in 2007 (4% to <1%, $P < .001$). Metformin use was stable, ranging between 7% and 9% ($P = .24$). Insulin use increased slightly from 30% to 32% ($P < .001$). Use of other classes of glucose-lowering medications was stable ($P = .22$) and low, remaining below 1.3%.

Conclusions and Relevance: Between 2005 and 2011, there were dramatic declines in use of sulfonylureas and thiazolidinediones in VA NH residents, suggesting that prescribing practices can be quickly changed in this setting.

Frail nursing home (NH) residents make up a large, growing and understudied segment of the diabetes population in the United States.[1] The most recent National Nursing Home Survey suggests that 1 in 4 NH residents aged 65 and older have a diagnosis of diabetes.[2] Further, projections estimate that between 2005 and 2050, the prevalence of diabetes will skyrocket 449% among those older than 75 years.[3,4] However, surprisingly little is known about current diabetes care practices in NHs,[5,6] in part because few national pharmacoepidemiologic data resources exist for NHs.

To improve prescribing practices in NH residents with diabetes, data are needed on recent prescribing practices as well as how prescribing patterns have evolved over time. Recent care practices provide baseline data and a benchmark for any future improvement interventions. Examining prescribing patterns over time provides insights into how prescribing patterns will evolve into the future and how we can shape these trends to promote high-quality care.

The past decade has been an exciting, dynamic time for glycemic control care practices. Initially, data suggested that near-normal glycemic control may lead to improved outcomes, leading many guidelines to recommend tighter glycemic control.[7] Then, thiazolidinediones were found to increase cardiovascular risks, leading to a "black box" warning in 2007.[8–10] In 2008, the Action to Control Cardiovascular Risk in Diabetes study showed increased all-cause mortality for patients randomized to more intensive glycemic control,[11] diminishing enthusiasm for tight glycemic control, especially for older adults.[12] Guidelines and quality indicators have serially incorporated these and other new study results, leading to a shifting landscape of diabetes care practices.[2,13–15]

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* Address correspondence to Sei J. Lee, MD, MAS, Division of Geriatrics, University of California San Francisco, 4150 Clement St, Bldg 1, Room 220F, San Francisco, CA 94121.

E-mail address: sei.lee@ucsf.edu (S.J. Lee).

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Thus, we sought to leverage the national pharmacoepidemiologic data available for Veterans Affairs (VA) NHs to describe glycemic medication prescribing practices between 2005 and 2011. The objective of this study was to conduct exploratory research that will provide data on recent prescribing practices that will inform future efforts to improve glucose-lowering medication prescribing in NHs.

Methods

Study Population

We examined long-stay patients age 65 or older with diabetes who were admitted to VA NHs (known as Community Living Centers or VA CLCs) between January 1, 2005, and September 30, 2011. We defined long-stay CLC residents as veterans staying in a CLC for 90+ days (n = 40,025), identified through the National Patient Care Database extended care files, which provides admission and discharge dates. Using the American Diabetes Association (ADA) criteria for diagnosing diabetes mellitus,[15] we used administrative data to identify long-stay CLC residents with diabetes if they had a hemoglobin A1c (HbA1c) of 6.5% or higher by using the VA Laboratory Results file, or if they had an HbA1c lower than 6.5% but were on glucose-reducing medications at the time of the test. This resulted in our final analytic cohort of 9431 residents.

Measures: Noninsulin Medications

Our primary study question was to determine the rates of use of glucose-lowering medications over time in long-term CLC patients with diabetes. We examined the medication use in each of the 27 quarters between January 1, 2005, and September 30, 2011.

For noninsulin glucose-lowering medications, we used the Pharmacy Benefits Management (PBM) database, which contains information on medications dispensed to patients in the VA system.[16] For each medication, the PBM database included start date, amount dispensed, drug name, and instructions for use, allowing us to estimate the end date for each medication. Noninsulin medications were divided into 4 categories: (1) Metformin; (2) sulfonylureas; (3) thiazolidinediones or TZDs; and (4) other medications (ie, alpha-glucosidase inhibitor, meglitinides, glucagonlike peptide-1 analogs, dipeptidyl peptidase-4 inhibitors, amylin analogs). Sulfonylureas were further divided into glipizide and glyburide. A medication was considered as used in a quarter if it was used at any day during that quarter. The full list of medications can be found in the Appendix.

Measures: Insulin

We categorized pharmacy-dispensed insulin into basal or long-acting insulin (ie, glargine or neutral protamine hagedorn) and bolus or short-acting insulin (ie, regular or aspart).

We were unable to rely solely on the PBM database for insulin because it does not contain information on ward stock medications. Ward stock medications, such as insulin, could be given to patients without a specific pharmacy-dispensing action tied to an individual patient. Thus, if insulin was recorded in the PBM database, it was dispensed by pharmacy for a specific resident; however, if insulin was not recorded in the PBM database, it may still have been dispensed to that resident as a ward stock medication.

Thus, we estimated the rates of insulin use by combining (1) rates of dispensed insulin from PBM data and (2) estimated rates of ward stock insulin use using multiple imputation with additional information including data from the Minimum Dataset (MDS) 2.0. The MDS is collected on all VA NH residents through quarterly surveys usually filled out by a nurse trained as an MDS data abstractor.[17] One MDS data element asks, "Record the number of days injections of any type were received in the past 7 days." VA NH residents who had no reported injection use were categorized as not having used insulin.

To estimate the rates of ward stock insulin use, we used multiple imputation prediction models using age, comorbidities, use of glucose-lowering medications (other than insulin) and VA station number to estimate the likelihood of insulin use.[18,19] Specifically, we developed our models using NH residents with pharmacy-dispensed insulin as insulin users and NH residents with MDS data reporting no injections as insulin nonusers. Then we applied this model to NH residents who had a report of recent injection but no pharmacy record of insulin, allowing us to estimate the likelihood of insulin use for these NH residents. Then we repeated the process with bootstrap datasets to obtain estimates of uncertainty of our predictions. Compared with alternative methods, multiple imputation appears to produce less biased prevalence estimates and standard errors.[19]

To explore the validity of our methodology to estimate insulin use, we examined the rates of injections in NH residents with diabetes and without diabetes. We found that the injection use rate was much higher among residents with diabetes (54% versus 18%, $P < .001$), suggesting that MDS injection data included insulin use. The discrimination of our insulin use prediction model was excellent with a c-statistic of 0.81.

Measures: Comorbidities and Function

Presence of comorbid conditions, including history of hypoglycemia, was determined using International Classification of Diseases, Ninth Revision codes from the outpatient and inpatient visits up to 1 year before admission to CLC. Activities of daily living (ADL) score and weight loss data were obtained from the MDS 2.0 data. Weight loss was determined using the question, "Weight loss: 5% or more in past 30 days or 10% or more in past 180 days." The MDS-ADL score was calculated using 7 activities (bed mobility, transfer, locomotion, dressing, eating, toilet use, and personal hygiene) assessed on a 5-level scale (independent, supervision, limited assistance, extensive assistance, and total dependence). The MDS-ADL score in each assessment is between 0 and 28 (higher scores indicating greater ADL limitations)[20] and has been successfully used in previous studies.[21]

Statistical Analysis

We used descriptive statistics to describe basic characteristics of patients in our sample. The prevalence of use of glucose-lowering medications over time was examined graphically by plotting the rates of use in each of the 27 quarters in our study period. Using linear regression, we determined the best fit line through the data. We tested whether the slope of each line differed from zero to determine whether rates of medications were stable, increasing, or decreasing during our study period.

All the analyses were done using SAS software, version 9.4 (SAS institute, Cary, NC) and Stata, version 13.1 (Stata Corp, College Station, TX). The Committee on Human Research at the University of California, San Francisco and the Research and Development Committee of the San Francisco VA Medical Center reviewed and approved this study.

Results

Characteristics of Study Cohort

Our study population consisted of 9431 long-term residents in VA CLCs with diabetes mellitus, followed for 52,313 person-quarters. Baseline characteristics for study subjects are presented in Table 1. Mean age of patients was 78 years with 67% older than 75; most were men (98%). Sixty-seven percent of them were hospitalized in the