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Ethnic Differences in Geriatric Conditions and Diabetes Complications Among Older, Insured Adults With Diabetes: The Diabetes and Aging Study

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Abstract

Objective: The aim of this study was to evaluate ethnic differences in burden of prevalent geriatric conditions and diabetic complications among older, insured adults with diabetes. **Method:** An observational study was conducted among 115,538 diabetes patients, aged ≥60, in an integrated health care system with uniform access to care. **Results:** Compared with Whites, Asians and Filipinos were more likely to be underweight but had substantively lower prevalence of falls, urinary incontinence, polypharmacy,

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depression, and chronic pain, and were least likely of all groups to have at least one geriatric condition. African Americans had significantly lower prevalence of incontinence and falls, but higher prevalence of dementia; Latinos had a lower prevalence of falls. Except for end-stage renal disease (ESRD), Whites tended to have the highest rates of prevalent diabetic complications. **Discussion:** Among these insured older adults, ethnic health patterns varied substantially; differences were frequently small and rates were often better among select minority groups, suggesting progress toward the Healthy People 2020 objective to reduce health disparities.

Keywords
diabetes mellitus, geriatric conditions, diabetic complications, race, ethnicity

Because the risk of diabetes increases with age and is greater among racial-ethnic minorities (Karter et al., 2013), whose share of the U.S. population is growing (Yeo, 2009), we should anticipate a proportionate increase in the population of older, minority patients living with diabetes in the coming decades. Currently, there is considerable variation in the prevalence of diabetes across race-ethnicity ("ethnic" or "ethnicity" for simplicity), with Whites (7%) having the lowest, Chinese (8%) and Japanese (10%) intermediate, and African Americans and Latinos (14%), and Filipinos (16%) having the highest prevalence (Karter et al., 2013). The incidence of diabetes shows a similar race-ethnic patterning (Karter et al., 2013). Evaluating race-ethnic differences in diabetes health outcomes is an important step toward evaluating whether we are meeting Healthy People 2020 (U.S. Department of Health and Human Services. , 2010) objectives to reduce health disparities.

Although secondary prevention in diabetes focuses primarily on reducing traditional complications of diabetes (e.g., renal failure, heart attack, stroke, amputation), the care of older patients with diabetes is further complicated by the incidence of geriatric conditions (Flacker, 2003). Geriatric conditions (also called geriatric syndromes) are multifactorial health conditions that occur when the accumulated effects of impairments render an older person vulnerable to falls and fractures (Tinetti, 2003), dementia (Stewart & Liolitsa, 1999), urinary incontinence (J. S. Brown et al., 1996), chronic pain (Greene, Stevens, & Feldman, 1999), polypharmacy (Murray & Kroenke, 2001), frailty and weight loss (Hubbard, Lang, Llewellyn, & Rockwood, 2010; Munshi, 2008; Woods et al., 2005), and depression (Anderson, Freedland, Clouse, & Lustman, 2001). Note that although the list of included conditions varies and is not scientifically validated per se, this condition or syndrome has become widely accepted (Munshi, 2008). Geriatric conditions are not

part of the traditional diabetes disease model and can often be overlooked in the care of older adults with diabetes (Cigolle, Langa, Kabeto, Tian, & Blaum, 2007). Geriatric conditions may limit a patient's ability to carry out basic activities of daily living and add clinical complexity that may overwhelm a patient's ability to self-manage his or her diabetes (Blaum et al., 2010). We have shown previously that, for older patients with diabetes, geriatric conditions are important predictors of health-related quality of life (HRQL) and of equal or greater importance than diabetic complications (Laiteerapong et al., 2011). We have also shown that ethnic minorities had better physical HRQL than Whites (Laiteerapong et al., 2013).

In practice, providers individualize care based, in part, on their assessment of a patient's burden of prevalent conditions, including geriatric conditions and traditional diabetic complications. However, the basic epidemiology of geriatric conditions, particularly with respect to ethnic differences, has not been well studied in older patients with diabetes (Anderson et al., 2001; Bertoni, Krop, Anderson, & Brancati, 2002; J. S. Brown, et al., 1996; Stewart & Liolitsa, 1999). In Mexican Americans, there is evidence to suggest that the burden of geriatric conditions has increased in recent years (Beard, Markides, Al Ghatrif, Kuo, & Raji, 2010). However, to what extent the prevalence patterns of geriatric conditions in diabetes patients differ across ethnic groups has not been adequately described (Peek & Chin, 2007). For care providers, increased awareness of ethnic differences may lead to more optimal screening in vulnerable groups. The heterogeneity of culture, language, health beliefs, risk for disease, and other factors across ethnic groups in our oldest patients pose a challenging ethnogeriatric imperative; policy makers and health providers will need a better understanding of the diverse characteristics and needs of the various groups if they are to provide effective geriatric services (Yeo, 2009). Examining the ethnic patterns of prevalent geriatric conditions in diabetes is also needed to focus health care delivery system efforts to reduce disparities and to assure provision of culturally competent and patient-centered care among an increasingly diverse population of elderly patients with diabetes (Peek & Chin, 2007).

This research is part of *The Diabetes & Aging Study*, which is ancillary to the *Diabetes Study of Northern California (DISTANCE)*. The *Diabetes & Aging Study* is a long-term, collaborative investigation to address significant gaps in existing knowledge regarding the natural history, service use, and self-care of an insured, multi-ethnic population of older adults with diabetes. Although socio-economic status (SES) varies by ethnicity in our study population, participants have uniform access to and quality of care. Thus, this investigation of health inequalities will complement population-based studies where SES, access to care, and quality of care may vary significantly

by ethnicity. In this article, we describe ethnic differences in the prevalence of geriatric conditions as well as traditional diabetic complications among older patients with diabetes with uniform access to care.

Research Designs and Methods

The study design is based on a prospective follow-up of a large, multi-ethnic cohort of fully insured patients with diabetes, age 60 years or older. All study participants were insured and received care from a large, non-profit, integrated health care delivery system, Kaiser Permanente Northern California.

Study Setting

KPNC currently provides care to more than 3 million health plan members (25%-30% of the population of the San Francisco Bay and Sacramento metropolitan region of Northern California). The membership is ethnically and socioeconomically similar to the overall population living in the geographical region (Krieger, 1992). Most KPNC members receive coverage through their employment (via a contracting arrangement with employer groups), although a small proportion of members have individual coverage or are covered via federal insurance (e.g., Medicare/Medicaid). KPNC is not a fee-for-service or claims-based health care delivery system, but rather provides prepaid care that integrates all outpatient, inpatient, laboratory, and pharmacy services. KPNC uses a state-of-the-art electronic medical record (EMR) that comprehensively captures data on all health plan members, including processes of care, inpatient and outpatient utilization, medical diagnoses, procedures, and costs. The health plan maintains a "closed pharmacy system" (pharmacy benefits are only honored at health plan pharmacies) with comprehensive capture of pharmacy utilization for the 96% of members with pharmacy benefits, as well as identification of patients who transfer their prescriptions to out-of-plan pharmacies (Huang, Liu, Moffet, John, & Karter, 2011; Karter et al., 2009).

All diabetes participants in this study were identified via the *KPNC Diabetes Registry* ("Registry"). The registry was first established in 1993 and is updated annually by adding patients newly identified from automated databases of pharmacy data, laboratory data, hospitalization records, and outpatient diagnoses as having diabetes using standardized criteria (Karter et al., 2002). The registry has an estimated sensitivity of 99% based on chart review validation (Karter et al., 2002). These data have been used previously to characterize the natural history of diabetic complications and mortality across a wide variety of sub-populations in numerous epidemiologic and

health services investigations (Huang et al., 2014; Huang et al., 2011; Karter et al., 2002; Karter et al., 2007; Karter et al., 2006).

Study Sample

We identified a cohort of 125,720 diabetes patients from the Registry, age 60 years and older as of January 1, 2010, of whom 120,440 were continuous members of the health plan (no gaps in membership greater than 3 months) during the 2 previous years. Our key exposure of interest was ethnicity, based on EMR data or ascertained by self-report at clinic visits, registrations for Kaiser Permanente membership, member surveys, or on intake for a hospitalization. Ethnicity was categorized as African American, Asian (including Chinese, Japanese, Korean, South Asian, and other Asians), Filipino, Latino, non-Hispanic White (White), or mixed racial-ethnicity. Small ethnic groups (e.g., Native Americans and Pacific Islanders, $n = 532$) as well as those missing ethnicity ($n = 4,902$) were excluded from the analysis. The final cohort consisted of 115,538 participants, including 55% White, 10% African American, 12% Latino, 10% Asian, 7% Filipino, and 6% mixed race-ethnicity. Ethnic contrasts were often statistically significant given the large sample sizes, and thus we focused on differences that we consider to be clinically relevant, for example, relative risk (RR) >1.5 or <0.7 or risk differences (RD) >0.10 (Harper & Lynch, 2005).

Outcomes of Interest

Prevalent geriatric conditions and diabetic complications were ascertained from the KPNC EMR during a 2 year observation window (January 1, 2008, to December 31, 2009). Identification was based on primary diagnostic codes (International Statistical Classification of Diseases and Related Health Problems–9 [ICD-9-CM] codes) or procedure codes (current procedural terminology [CPT]) that have been used in prior studies (see appendix for coding; Huang, Karter, Danielson, Warton, & Ahmed, 2010; Huang et al., 2011; Karter et al., 2002; Laiteerapong et al., 2011; Whitmer, Karter, Yaffe, Quesenberry, & Selby, 2009) for the following geriatric conditions: falls, depression, dementia, chronic pain, underweight, polypharmacy, and urinary incontinence. The history of clinically significant falls was ascertained from outpatient and inpatient diagnostic codes (appendix; Huang et al., 2010). Depression, dementia, and chronic pain were identified from outpatient diagnosis codes based on ascertainment protocols used successfully in recent studies in this population (appendix; Hudson et al., 2013; W. Katon et al., 2012; Laiteerapong et al., 2011; Whitmer, Gunderson, Barrett-Connor,

Quesenberry, & Yaffe, 2005; Whitmer, Gunderson, Quesenberry, Zhou, & Yaffe, 2007; Whitmer et al., 2009; Whitmer, Sidney, Selby, Johnston, & Yaffe, 2005). Being underweight (a conservative marker for frailty; Auyeung, Lee, Kwok, & Woo, 2011; Hubbard et al., 2010; Woods et al., 2005) was defined as body mass index (BMI) <18.5 kg/m^2 and was calculated from height and weight from most recent outpatient records recorded prior to baseline (Cigolle et al., 2007; Whitmer, Sidney, et al., 2005). We defined polypharmacy as the use of ≥4 medications that are distinct pharmacological agents intended for long-term use as described in our previous study showing this threshold was associated with a significantly increased fall risk (Huang et al., 2010). Older patients with diabetes are typically heavily treated with medications (at minimum a statin, angiotensin-converting-enzyme inhibitor (ACE-I), one or more glucose-lowering medications). Thus, polypharmacy is common and often unavoidable given the standard-of-care for diabetes treatment. Polypharmacy does not account for whether any of the component medications were clinically indicated. In this study, we are more interested in polypharmacy as a risk factor (e.g., for falls) and its impact on quality of life. Although there exists no commonly accepted definition of polypharmacy (Fulton & Allen, 2005), the use of four or more prescription medications has been mentioned in previous publications as well (e.g., Tinetti, 2003). Incontinence was ascertained based on outpatient diagnoses. We also identified the following diabetic complications from the EMRs: macrovascular complications (myocardial infarction [MI], stroke, and heart failure [HF]), microvascular complications (amputation, end-stage renal disease [ESRD], and advanced diabetic eye disease), and hypoglycemic events. MI, stroke, congestive heart failure (CHF), and amputation were based on primary diagnoses (ICD-9 codes) in inpatient records only (see appendix). We ascertained ESRD by linking patient data to the Kaiser Permanente dialysis and transplantation registry (which is used to report to the United States Renal Data System). Advanced diabetic eye disease was based either on an outpatient diagnosis of proliferative retinopathy or a photocoagulation procedure. Given the importance of serious hypoglycemic events in older patients with diabetes (Laiteerapong et al., 2011), we created a flag for hypoglycemia based on emergency department and inpatient records.

We also created three summary indices of health burden: (a) any prevalent geriatric condition, (b) any prevalent diabetes-related complication, and (c) Deyo version (Deyo, Cherkin, & Ciol, 1992; Southern, Quan, & Ghali, 2004) of the Charlson comorbidity index (Charlson, Pompei, Ales, & MacKenzie, 1987) using a 2-year pre-baseline capture for the diagnostic and procedure codes and after removing the point for the disease of interest (diabetes) from the index formula.

Statistical Analysis

We estimated the overall and ethnic-specific, crude (unadjusted) 2-year prevalence of each outcome. Given the potential confounding by age and case-mix differences across ethnic groups, we then specified adjusted models using modified Poisson regressions with robust standard errors. We chose this statistical model over the logistic regression as our outcomes were often common (in which case odds ratios are biased effect measures; Zhang & Yu, 1998). In these models, we used the log link function to estimate the adjusted RR (Zou, 2004) and an identity link function to estimate RD (Cheung, 2007), with Whites as the reference group. Confidence intervals (CIs) were estimated using bootstrapping. As we wanted to characterize rather than explain ethnic health differences in older patients with diabetes, we adjusted for a minimal set of confounders: age, sex, duration of diabetes (time since diagnosis), diabetes type (based on a clinical algorithm; Karter et al., 2001), diabetes therapy groups (no medication, oral agents only, insulin only, and oral agents plus insulin), and neighborhood SES (neighborhood deprivation). To identify neighborhood deprivation, we geocoded each patient's address at baseline, and linked it to five contextual (census tract-level) factors (income/poverty, education, employment, housing, and occupation) from the 2000 U.S. census. These census data were then used to calculate the neighborhood deprivation index, previously validated in this (Laraia et al., 2012; Stoddard et al., 2012) and other study populations (Messer et al., 2006). A participant was considered as living in a deprived neighborhood if he or she was in the fourth quartile of the neighborhood deprivation index. This study was approved by the Institutional Review Boards of KPNC and the University of Chicago.

Results

Characterization of Population

The average age of this cohort was 72 years; 19% of participants were 80 years or older (Table 1). Although the distribution of men to women was similar (51% vs. 49%) overall, there were a greater proportion of women among African Americans (55%), Filipinos (54%), and mixed race-ethnicity (53%), and smaller proportions among Asians (47%) and Whites (47%). The vast majority (99%) of those with known type of diabetes had Type 2 diabetes. Sixty percent had been diagnosed with diabetes less than 10 years before baseline, while 21% had diabetes for ≥15 years. Diabetes duration varied significantly by ethnicity: 30% of African American or mixed race/ethnicity patients had diabetes for ≥15 years, while only 20% of other ethnic groups

Table 1. Characteristics of 115,538 Participants ≥60 Years of Age From the *Diabetes & Aging Study* (as of 2010).

	All	African American	Asian	Filipino	Latino	Non-Hispanic White	Mixed race-ethnicity	$p < .05$*
n (row %)	115,538 (100)	11,417 (10)	11,275 (10)	8,162 (7)	14,324 (12)	63,509 (55)	6,851 (6)	
Age								*
60-69	52,816 (46)	5,476 (48)	5,445 (48)	4,623 (57)	6,768 (47)	27,513 (43)	2,991 (44)	
70-79	40,664 (35)	4,047 (36)	3,948 (35)	2,638 (32)	5,264 (37)	22,199 (35)	2,568 (38)	
≥80	22,058 (19)	1,894 (17)	1,882 (17)	901 (11)	2,292 (16)	13,797 (22)	1,292 (19)	
Sex								*
Women	56,425 (49)	6,330 (55)	5,321 (47)	4,365 (54)	7,078 (49)	29,703 (47)	3,628 (53)	
Men	59,113 (51)	5,087 (45)	5,954 (53)	3,797 (47)	7,246 (51)	33,806 (53)	3,223 (47)	
Neighborhood Deprivation Index								*
Most deprived neighbor hoods (fourth quartile)	18,058 (16)	4,252 (37)	1,152 (10)	1,086 (13)	4,036 (28)	6,280 (10)	1,252 (18)	
Duration of diabetes (years)								*
0-4	30,813 (30)	2,433 (23)	2,994 (30)	2,087 (28)	3,465 (28)	18,505 (32)	1,329 (21)	
5-9	30,881 (30)	2,834 (26)	3,018 (30)	2,367 (32)	3,750 (31)	17,110 (30)	1,802 (29)	
10-14	20,600 (20)	2,329 (22)	1,952 (20)	1,564 (21)	2,503 (21)	10,811 (19)	1,441 (23)	
15-19	13,177 (13)	1,877 (18)	1,169 (12)	918 (12)	1,494 (12)	6,567 (11)	1,152 (18)	
≥20	8,757 (8)	1,258 (12)	791 (8)	501 (7)	1,002 (8)	4,679 (8)	526 (8)	
Type of diabetes								*
Type 1	311 (<1)	18 (<1)	8 (<1)	1 (<1)	8 (<1)	265 (<1)	11 (<1)	
Type 2	103,905 (90)	10,713 (94)	9,915 (88)	7,436 (91)	12,205 (85)	57,398 (90)	6,238 (91)	
Unknown	11,322 (10)	686 (6)	1,352 (12)	725 (9)	2,111 (15)	5,846 (9)	602 (9)	

Table 1. (continued)

	All	African American	Asian	Filipino	Latino	Non-Hispanic White	Mixed race-ethnicity	$p < .05$*
Diabetic therapy								*
Medication-free lifestyle	15,999 (14)	1,241 (11)	1,595 (14)	906 (11)	1,482 (10)	10,051 (16)	724 (11)	
Oral agents only	64,883 (56)	6,014 (53)	7,314 (65)	5,256 (64)	8,375 (59)	34,282 (54)	3,642 (53)	
Insulin only	2,990 (3)	442 (4)	182 (2)	88 (1)	274 (2)	1,854 (3)	150 (2)	
Oral agents and insulin	31,666 (27)	3,720 (33)	2,184 (19)	1,912 (23)	4,193 (29)	17,322 (27)	2,335 (34)	
Geriatric syndromes (2-year history)								
Underweight	745 (0.7)	75 (0.7)	182 (1.6)	89 (1.1)	42 (0.3)	329 (0.5)	28 (0.4)	*
Depression	19,435 (17)	1,450 (13)	960 (9)	649 (8)	2,550 (18)	12,381 (20)	1,445 (21)	*
Falls	8,517 (7)	654 (6)	597 (5)	300 (4)	978 (7)	5,402 (9)	586 (9)	*
Dementia	2,237 (2)	268 (2)	174 (2)	85 (1)	266 (2)	1,295 (2)	149 (2)	*
Chronic pain	85,358 (74)	8,627 (76)	7,269 (65)	5,439 (67)	10,847 (76)	47,817 (75)	5,359 (78)	*
Urinary incontinence	8,058 (7)	691 (6)	445 (4)	293 (4)	1,003 (7)	5,031 (8)	595 (9)	*
Polypharmacy	66,194 (57)	6,819 (60)	5,439 (48)	4,295 (53)	7,596 (53)	37,743 (59)	4,302 (63)	*
Any geriatric syndrome	101,102 (88)	10,128 (89)	9,117 (81)	6,782 (83)	12,556 (88)	56,284(89)	6,235 (91)	*
Diabetic complications (2-year history)								
Myocardial infarction	1,542 (1)	112 (1)	128 (1)	111 (1)	152 (1)	919 (2)	120 (2)	*
Stroke	1,518 (1)	115 (1)	89 (1)	61 (1)	163 (1)	962 (2)	128 (2)	*

(continued)

Table 1. (continued)

	All	African American	Asian	Filipino	Latino	Non-Hispanic White	Mixed race-ethnicity	$p < .05$*
Heart failure	15,224 (13)	1,714 (15)	870 (8)	723 (9)	1,489 (10)	9,415 (15)	1,013 (15)	*
Amputation	1,056 (0.9)	157 (1.4)	32 (0.3)	23 (0.3)	124 (0.9)	639 (1.0)	81 (1.2)	*
End-stage renal disease	2,109 (2)	398 (4)	236 (2)	233 (3)	334 (2)	731 (1)	177 (3)	*
Advanced diabetic eye disease	24,694 (21)	3,060 (27)	2,531 (23)	1,795 (22)	3,520 (25)	11,989 (19)	1,799 (26)	*
Hypoglycemic events	1,266 (1.1)	275 (2.4)	93 (0.8)	64 (0.8)	159 (1.1)	597 (0.9)	78 (1.1)	*
Any diabetes complication	36,630 (32)	4,288 (38)	3,169 (28)	2,329 (29)	4,528 (32)	19,738 (31)	2,578 (38)	*
Charlson Comorbidity Index, Upper Quartile	27,197 (24)	2,987 (26)	1,845 (16)	1,626 (20)	2,889 (20)	15,904 (25)	1,946 (28)	*
Charlson Comorbidity Index, *M* (*SD*)	2.2 (2.1)	2.4 (2.2)	1.8 (1.9)	2.0 (2.0)	2.0 (2.0)	2.3 (2.2)	2.5 (2.2)	*

Note. Column number (percentages) presented unless otherwise indicated.
*Significant ethnic differences at the $p < .05$ level, chi-square test.

had diabetes for ≥15 years. Overall, 30% of the cohort used insulin (alone or in combination with oral agents), and 14% used no diabetes medications. African Americans were most likely and Asians were least likely (37% vs. 21%) to use insulin. African Americans (37%) and Latinos (28%) were significantly more likely to live in economically deprived neighborhoods than Asians (10%), Whites (10%), Filipinos (13%), and mixed race-ethnic (18%).

Diabetic Complications

Overall, 36,630 (32%) had a diagnosis of at least one diabetes-related complication in the past 2 years; some complications were quite common (advanced diabetic eye disease [21%] and HF [13%]), while others (MI, stroke, ESRD, serious hypoglycemic events, and amputation) were relatively rare (<2%). Statistically significant differences by ethnicity were apparent in some cases. Advanced diabetic eye disease in the previous 2 years was significantly more common in African Americans (27%), followed by Latinos (25%), mixed race-ethnicity (26%), Asians (23%), Filipinos (22%), and Whites (19%). After adjustment for age, sex, type of diabetes, duration of diabetes, diabetes therapy, and neighborhood deprivation in the modified Poisson models, each ethnic minority had a 3% to 4% greater prevalence of advanced diabetic eye disease (based on adjusted RDs) than Whites; the RRs ranged from 1.15 (95% CI = [1.11, 1.19]) in African Americans to 1.26 (95% CI = [1.21, 1.31]) in Asians (Table 2).

HF in the previous 2 years was more common in Whites, African Americans, and mixed ethnicity (15% each), compared with Latinos (10%), Filipinos (9%), and Asians (8%). After adjustment, Asians, Filipinos, and Latinos had substantively (4%-5%) lower prevalence of HF than Whites, while African Americans and mixed ethnicity did not differ substantively from Whites with respect to HF prevalence. The RRs were 0.60 (95% CI = [0.56, 0.64]) in Asians, 0.68 (95% CI = [0.64, 0.73]) in Latinos, and 0.69 (95% CI = [0.64, 0.75]) in Filipinos.

ESRD prevalence was significantly more common in ethnic minorities (African American [4%], Filipino and mixed race-ethnicity [3%], Asian and Latino [2%], relative to Whites [1%]). After adjustment, minorities had a 1% to 2% higher prevalence of ESRD than Whites, and the RRs were 2.61 (95% CI = [2.23, 3.07]) in Filipinos, 2.31 (95% CI = [2.02, 2.65]) in African Americans, 2.05 (95% CI: 1.74, 2.41) in Asians, 1.86 (95% CI: 1.60, 2.16) in Latinos, and 1.79 (95% CI: 1.74, 2.41) in mixed race-ethnicity.

The prevalence of amputation varied significantly across ethnic groups. Amputation was significantly less common in Asians and Filipinos (0.3%) relative to Whites (1%). The prevalence in the other groups was more similar

Table 2. Relative and Absolute Ethnic Disparities (Relative Risks and Risk Difference) From Modified Poisson and Modified Least Squares Models[a] (Reference: Non-Hispanic Whites) for 2-year Histories of Geriatric Syndromes and Diabetes Complications Among Community-Dwelling Patients ≥60 Years of Age With Diabetes in the *Diabetes & Aging Study*.

	Relative risks (95% CI)					Risk difference (95% CI)				
	African American	Asian	Filipino	Latino	Mixed race-ethnicity	African American	Asian	Filipino	Latino	Mixed race-ethnicity
Geriatric syndromes										
Underweight	1.31 [0.99, 1.73]	3.39* [2.78, 4.13]	2.73* [2.12, 3.51]	0.76 [0.54, 1.07]	0.90 [0.61, 1.35]	0.002 [−0.0001, 0.004]	0.01* [0.01, 0.01]	0.01* [0.01, 0.01]	−0.001* [−0.002, −0.001]	−0.001 [−0.002, 0.001]
Depression	0.60* [0.57, 0.64]	0.43* [0.40, 0.47]	0.39* [0.36, 0.42]	0.91* [0.87, 0.95]	0.98 [0.93, 1.04]	−0.08* [−0.09, −0.07]	−0.11* [−0.11, −0.10]	−0.12* [−0.13, −0.12]	−0.02* [−0.03, −0.01]	−0.001 [−0.01, 0.01]
Falls	0.64* [0.59, 0.7]	0.65* [0.59, 0.71]	0.49* [0.44, 0.56]	0.84* [0.78, 0.90]	0.94 [0.85, 1.03]	−0.03* [−0.04, −0.03]	−0.03* [−0.03, −0.02]	−0.04* [−0.04, −0.03]	−0.01* [−0.02, −0.01]	−0.01 [−0.01, 0.001]
Dementia	1.29* [1.12, 1.5]	0.86 [0.72, 1.02]	0.76* [0.60, 0.96]	1.12 [0.96, 1.30]	1.14 [0.95, 1.37]	0.01* [0.002, 0.01]	−0.003 [−0.005, 0.0002]	−0.003* [−0.006, −0.001]	0.002 [−0.001, 0.005]	0.002 [−0.02, 0.006]
Chronic pain	1.0 [0.99, 1.01]	0.86* [0.85, 0.87]	0.89* [0.87, 0.9]	1.01 [1.0, 1.02]	1.03* [1.02, 1.05]	−0.001 [−0.01, 0.01]	−0.11* [−0.12, −0.1]	−0.08* [−0.1, −0.07]	0.01 [−0.002, 0.02]	0.02* [0.01, 0.04]
Urinary incontinence	0.72* [0.66, 0.78]	0.51* [0.46, 0.57]	0.47* [0.41, 0.53]	0.9* [0.84, 0.97]	1.0 [0.92, 1.1]	−0.02* [−0.03, −0.02]	−0.04* [−0.04, −0.03]	−0.04* [−0.05, −0.04]	−0.01* [−0.01, −0.003]	0 [−0.01, 0.01]
Polypharmacy	0.96* [0.94, 0.98]	0.82* [0.80, 0.84]	0.88* [0.86, 0.90]	0.86* [0.85, 0.88]	1.0 [0.97, 1.01]	−0.02* [−0.03, −0.01]	−0.10* [−0.12, −0.09]	−0.07* [−0.08, −0.06]	−0.08* [−0.09, −0.07]	−0.004 [−0.02, 0.01]
Any geriatric syndrome	1.0 [0.99, 1.0]	0.91* [0.90, 0.92]	0.94* [0.93, 0.95]	0.99* [0.98, 0.99]	1.02* [1.01, 1.02]	−0.004 [−0.01, 0.003]	−0.08* [−0.09, −0.07]	−0.05* [−0.06, −0.05]	−0.01* [−0.02, −0.01]	0.01* [0.01, 0.02]
Diabetes-related complications										
Myocardial Infarction	0.64* [0.52, 0.80]	0.79* [0.64, 0.98]	1.11 [0.90, 1.37]	0.76* [0.62, 0.92]	1.11 [0.90, 1.38]	−0.01* [−0.01, −0.003]	−0.03* [−0.005, −0.0004]	0.001 [−0.002, 0.004]	−0.003* [−0.006, −0.001]	0.002 [−0.002, 0.005]
Stroke	0.63* [0.51, 0.78]	0.58* [0.46, 0.73]	0.59* [0.45, 0.77]	0.77* [0.64, 0.93]	1.13 [0.92, 1.39]	−0.01* [−0.01, −0.003]	−0.01* [−0.01, −0.004]	−0.01* [−0.01, −0.003]	−0.003* [−0.01, −0.001]	0.002 [−0.002, 0.006]

Table 2. (continued)

	Relative risks (95% CI)					Risk difference (95% CI)				
	African American	Asian	Filipino	Latino	Mixed race-ethnicity	African American	Asian	Filipino	Latino	Mixed race-ethnicity
Heart failure	0.92* [0.88, 0.97]	0.60* [0.56, 0.64]	0.69* [0.64, 0.75]	0.68* [0.64, 0.73]	0.94 [0.88, 1.0]	−0.01* [−0.02, −0.002]	−0.05* [−0.06, −0.05]	−0.04* [−0.05, −0.03]	−0.05* [−0.05, −0.04]	−0.01* [−0.02, −0.001]
Amputation	1.2 [0.96, 1.4]	0.35* [0.24, 0.51]	0.26* [0.16, 0.43]	0.83 [0.66, 1.03]	1.0 [0.77, 1.3]	0.002 [0, 0.005]	−0.01* [−0.01, −0.004]	−0.01* [−0.01, −0.005]	−0.002 [−0.004, 0]	0 [−0.003, 0.003]
End-stage renal disease	2.31* [2.02, 2.65]	2.05* [1.74, 2.41]	2.61* [2.23, 3.07]	1.86* [1.60, 2.16]	1.79* [1.49, 2.15]	0.02* [0.01, 0.02]	0.01* [0.01, 0.01]	0.02* [0.01, 0.02]	0.01* [0.01, 0.01]	0.01* [0.01, 0.01]
Advanced diabetic eye disease	1.15* [1.11, 1.19]	1.26* [1.21, 1.31]	1.21* [1.16, 1.27]	1.19* [1.15, 1.24]	1.16* [1.11, 1.21]	0.03* [0.02, 0.04]	0.04* [0.04, 0.05]	0.04* [0.03, 0.05]	0.03* [0.03, 0.04]	0.03* [0.02, 0.04]
Hypoglycemic events	1.95* [1.66, 2.30]	1.03 [0.8, 1.32]	0.97 [0.73, 1.29]	1.16 [0.94, 1.42]	0.89 [0.67, 1.19]	0.01* [0.01, 0.01]	0.001 [−0.001, 0.003]	0.0003 [−0.002, 0.003]	0.002 [0.001, 0.004]	−0.002 [−0.004, 0.001]
Any diabetes complication	1.05* [1.03, 1.08]	0.97 [0.94, 1.01]	0.99 [0.95, 1.02]	0.96* [0.93, 0.98]	1.08* [1.04, 1.11]	0.02* [0.01, 0.03]	−0.01 [−0.01, −0.003]	−0.002 [−0.01, 0.01]	−0.01* [−0.02, −0.01]	0.02* [0.01, 0.03]
Charlson Comorbidity Index, upper quartile	0.96* [0.93, 1.0]	0.73* [0.70, 0.77]	0.90* [0.86, 0.94]	0.80* [0.77, 0.83]	1.06* [1.02, 1.11]	−0.01 [−0.02, 0.002]	−0.06* [−0.07, −0.05]	−0.02* [−0.03, −0.01]	−0.05* [−0.06, −0.04]	0.01* [0.002, 0.03]

[a]Models adjusted for age, sex, type and duration of diabetes, type of diabetes therapy and neighborhood deprivation.
*Significant ethnic disparity at the $p < .05$ level.

to Whites: African American (1.4%), mixed race-ethnicity (1.2%), and Latino (0.9%). Although there were significant ethnic differences in amputation on the relative scale, absolute differences were small (RD ≤ 0.01%). After adjustment, Asians (RR = 0.35; 95% CI = [0.24, 0.51]) and Filipinos (RR = 0.26; 95% CI = [0.16, 0.43]) had lower prevalence of amputation relative to Whites. The amputation prevalence among African Americans, Latinos, and mixed race-ethnicity did not differ from that of Whites.

The prevalence of MI and stroke in the previous 2 years was quite low (~1% for both). Prevalent MI was significantly more common in Whites than minorities other than mixed race-ethnicity. African Americans (RR = 0.64; 95% CI = [0.52, 0.80]), Latinos (RR = 0.76; 95% CI = [0.62, 0.92]), and Asians (RR = 0.79; 95% CI = [0.64, 0.98]) had a much lower 2-year history relative to Whites, while Filipinos and mixed race-ethnicity did not differ from Whites with respect to MI. Relative to Whites, prevalent stroke was also less common in Asians (RR = 0.58; 95% CI = [0.46, 0.73]), Filipinos (RR = 0.59; 95% CI = [0.45, 0.77]), African Americans (RR = 0.63; 95% CI = [0.51, 0.78]), and Latinos (RR = 0.77; 95% CI = [0.64, 0.93]). Mixed race-ethnicity did not differ from Whites with respect to stroke. Although the MI and stroke rates varied significantly across ethnic groups on the relative scale, the absolute differences were small (RD ≤ 1%).

Geriatric Conditions

In this cohort, 101,102 (88%) had at least one geriatric condition recorded in the previous 2 years. Some geriatric conditions were widespread (chronic pain [74%], polypharmacy [57%], depression [17%]), while the remaining conditions were relatively uncommon (urinary incontinence and falls [7%], dementia [2%], and underweight [<1%]). The prevalence of geriatric conditions did not differ substantively across ethnic groups, except for a few notable exceptions described below.

Chronic pain was less common in Asians and Filipinos (65% and 67%, respectively) compared with other ethnic groups (Whites [75%], African Americans [76%], Latinos [76%], and mixed race-ethnic [78%]). After adjustment, Asians and Filipinos had 11 and 8 percentage points (based on adjusted RD) lower prevalence of chronic pain (RR = 0.86; 95% CI = [0.85, 0.87] and RR = 0.89; 95% CI = [0.87, 0.90]) compared with Whites. However, the prevalence of chronic pain among African Americans, Latinos, and mixed race-ethnicity did not differ substantively from that of Whites.

The prevalence of polypharmacy was relatively similar across ethnic groups: mixed race-ethnicity (63%), African Americans (60%), Whites (59%),

Latinos and Filipinos (53%), and Asians (48%). After adjustment, Asians (RR = 0.82; 95% CI = [0.80, 0.84]), Latinos (RR = 0.86; 95% CI = [0.85, 0.88]), and Filipinos (RR = 0.88; 95% CI = [0.86, 0.90]) had lower prevalence compared with Whites.

Filipinos and Asians also had substantively lower prevalence of depression (8% and 9%, respectively) compared with African Americans (13%), Latinos (18%), Whites (20%), and mixed race-ethnic (21%). Compared with Whites, Asians and Filipinos had 11 and 12 percentage points lower (based on adjusted RD) depression prevalence after adjustment, which translated to a RR = 0.43 (95% CI = [0.40, 0.47]) and RR = 0.39 (95% CI = [0.36, 0.42]) on a relative scale.

Urinary incontinence was most common in mixed race-ethnicity and Whites (9% and 8%, respectively), intermediate in African Americans (6%) and Latinos (7%), and least common in Asians and Filipinos (4% each). After adjustment, there was a 4% and 2% lower prevalence of incontinence for Filipinos and African compared with non-Hispanic Whites. On a relative scale, Filipinos RR = 0.47 (95% CI = [0.41, 0.53]), Asians RR = 0.51 (95% CI = [0.46, 0.57]), and African American RR = 0.721 (95% CI = [0.56, 0.78]) had significantly lower prevalence, whereas Latinos and mixed race-ethnic did not differ substantively from Whites.

The prevalence of falls in the previous 2 years varied significantly across ethnic groups. Fall prevalence was lowest in Filipinos (4%) and highest in Whites and those with mixed race-ethnicity (9% for both). After adjustment, Filipinos (RR = 0.49; 95% CI = [0.44, 0.56]), African Americans (RR = 0.64; 95% CI = [0.59, 0.70]), Asians (RR = 0.65; 95% CI = [0.59, 0.71]), and Latinos (RR = 0.84; 95% CI = [0.78, 0.90]) had lower prevalence of falls relative to Whites, but mixed race-ethnic did not differ from Whites. While there the differences were significant on the relative scale, the absolute differences based on the adjusted RDs were small (≤0.04%).

The prevalence of underweight in the previous 2 years varied significantly across ethnic groups. Being underweight was most common in Asians (1.6%) and least common in Latinos (0.3%). Absolute differences based on the adjusted RDs were small (≤1%), although there were significant ethnic differences on the relative scale. After adjustment, Asians (RR = 3.39; 95% CI = [2.78, 4.13]) and Filipinos (RR = 2.73; 95% CI = [2.12, 3.51]) had significantly higher prevalence of being underweight relative to Whites, while the prevalence among African Americans, Latinos, and mixed race-ethnic did not differ from that of Whites.

The crude prevalence of dementia was similar across ethnic groups. Absolute differences were very small (RD ≤1%), although there was two

significant differences by ethnicity on the relative scale. After adjustment, African Americans (RR = 1.29; 95% CI = [1.12, 1.50]) had significantly higher and Filipinos (RR = 0.76; 95% CI = [0.60, 0.96]) had significantly lower prevalence of dementia relative to Whites, while the prevalence among Latinos, Asians, and mixed race-ethnic did not differ from that of Whites.

Hypoglycemia

Clinically recognized, serious hypoglycemic events in the previous 2 years were relatively rare (1% overall), but only African Americans stood out as having significantly higher prevalence than Whites (2.4% vs. 0.9%). After adjustment, African Americans had slightly higher prevalence of hypoglycemic events than Whites (risk difference = 0.01%), while the relative risk (RR) was 1.95 (95% CI = [1.66, 2.30]) in African Americans relative to Whites. Severe hypoglycemia prevalence among Asians, Filipinos, Latinos, and mixed race-ethnicity did not differ from that of Whites.

Summary Measures

Although statistically significant, the ethnic differences in having at least one diabetes complication were marginal: 38% of African Americans and mixed race-ethnicity, 32% Latinos, 31% Whites, 29% Filipinos, and 28% of Asians had at least one diabetes complication. After adjustment, absolute differences were small (RD ≤ 2%), and although sometimes significant, the ethnic differences on the relative scale were not substantive (ranging from RR 0.96 to 1.08).

Although differences were statistically significant, the prevalence of having any geriatric condition did not differ markedly by ethnicity: 89% of African Americans and Whites had at least one geriatric condition, followed by 88% of Latinos, 83% of Filipinos, and 81% of Asians. After adjustment, absolute differences based on the adjusted RDs were small (≤1%) except for Asians (8%; 95% CI = [7%, 9%] less than Whites) and Filipinos (5%; 95% CI = [5%, 6%] less than Whites). While sometimes significant, the ethnic differences on the relative scale were not substantive (ranging from RR 0.91 to 1.02).

Although ethnic differences in the Deyo version of the Charlson comorbidity scores were not pronounced, the likelihood of a heavy comorbidity burden (scoring in the upper quartile, score >3) did differ by ethnicity. Asians and Latinos were 6% (95% CI = [5%, 7%]) and 5% (95% CI = [4%, 6%]), respectively, less likely to have a heavy comorbidity burden. These findings

were consistent on a relative scale (RR = 0.73; 95% CI = [0.70, 0.77] and RR = 0.80; 95% CI = [0.77, 0.83], respectively). The remaining ethnic groups did not differ substantively.

Conclusion

This is one of the first studies to detail ethnic differences in the prevalence of geriatric conditions and diabetic complications in a fully insured, ethnically diverse population of older patients with diabetes. Overall, prevalent diabetic complications, geriatric conditions, and comorbidity burden were quite heterogeneous across ethnicity and outcome; moreover, the magnitude of the ethnic differences was often modest. Thus, it is difficult to make simple generalizations about which ethnic groups of older patients with diabetes consistently have substantively higher or lower disease burden. However, Asians and Filipinos tended to have the lowest prevalence and Whites the highest prevalence for more of the complications and geriatric conditions we studied. These findings may explain why, among older patients with diabetes, Whites often have the poorest HRQL (Laiteerapong et al., 2013).

There were a few noteworthy and substantive epidemiologic patterns by ethnicity. Relative to Whites, the prevalence of chronic pain was much lower in Asians and Filipinos; urinary incontinence was much lower in Filipinos, Asians, and African Americans; depression was lower in Filipinos, Asians, and African Americans; being underweight was twice as common in Asians and Filipinos. Some of these patterns are potentially attributable to cultural differences, for example, willingness to discuss depressive symptoms (Hudson et al., 2013). Amputation had one third the prevalence in Asians and Filipinos relative to the other groups. The prevalence of ESRD was substantially elevated (e.g., more than twofold in Filipinos, African Americans, and Asians) in all minority groups relative to Whites, whereas Whites had higher prevalence of cardiovascular outcomes (MI, stroke, and HF). Relative to Whites, Asians and Latinos also had lower prevalence of each cardiovascular complication, while Filipinos had lower prevalence of HF and stroke only. African Americans stood out as having the highest prevalence of hypoglycemic events, but the lowest prevalence of MI. For most outcomes, mixed race-ethnic patients had prevalence patterns similar to Whites. Based on the summary measures of disease burden, there were no substantive differences in the prevalence of having at least one diabetes complication. Asians and Filipinos were somewhat less likely to have at least one geriatric condition, and Asians and Latinos were least likely to have a heavy comorbidity burden based on the Charlson Index. Similar to another study from this population,

we found relatively small differences in the prevalence of dementia by race/ethnicity (Mayeda et al., 2014).

Identifying the modifiable factors that explain the widely varying ethnic differences in disease burden will be very difficult if not intractable. If there were consistent ethnic patterns in the use of widely effective preventive medicine (e.g., blood pressure, lipid, and glycemic control measures), health behaviors (e.g., medication adherence, diet and weight control, exercise, smoking cessation), or absence of barriers (e.g., financial or language-based), we might expect patterns in disease burden to be consistent within ethnic groups with similar risk factor profile. Instead, we observe no consistency across outcomes. For example, when comparing microvascular outcomes, Asians have exceptionally low prevalence of amputations, but very high prevalence of ESRD. This heterogeneity could be explained by some influential, but unmeasured outcome-specific explanatory factor(s) (e.g., outcome-specific genetic susceptibility or environmental risks) that differ across ethnic groups in terms of prevalence and effect size.

There are some limitations that should be noted. This analysis was designed to characterize ethnic differences in prevalent conditions among older patients with diabetes. The findings are cross-sectional, and thus not meant to imply causal relationships, but rather reflect the overall health burden and clinical characteristics of a diverse cohort of older patients with diabetes. Because we used a complete case analysis, we excluded participants with missing data (e.g., the 10% with unknown type of diabetes). Selective survival may play a role in observed epidemiologic patterns as patients who experienced a fatal complication would not have been present in this cohort. We focused on health conditions that would likely be relevant in a clinical encounter and were reliably available by restricting to events that occurred within the previous 2 years. Thus some complications which occurred prior to 2 years before baseline may not be reflected (e.g., amputation that did not occur during the observation window may not be captured). Therefore comparisons of conditions that persist over time (e.g., amputation, dementia) with acute events (e.g., MI or serious hypoglycemic event) may underestimate total prevalence of the latter. Given a diagnosis of depression may not be recorded due to patient concerns of stigma, our measure of depression likely underestimates its true prevalence and this may vary significantly across ethnic groups (Hudson et al., 2013; W. J. Katon et al., 2004). Members of some ethnic groups may be less likely to report certain symptoms (e.g., "feeling depressed") to their provider, which can influence the likelihood of clinical detection. We have shown previously that, among participants who self-reported significant depressive

symptoms on a patient survey, Asians and Filipinos were less likely than Whites to have a diagnosis of depression recorded by their providers (Hudson et al., 2013). Thus, it is unknown to what extent observed ethnic differences were influenced by differential reporting to physicians. In addition, because the data needed to calculate neighborhood deprivation index were no longer available in the 2010 census, we adjusted for neighborhood contextual factors from the 2000 census. Thus, some residual confounding may be attributable due to unrecorded changes in neighborhood deprivation. Our findings among Latinos who are primarily of Mexican descent may not apply to other Latino groups. Finally, we caution that study conclusions may not apply to uninsured or underinsured groups, which may be more heavily represented by more disadvantaged ethnic groups (e.g., Latinos). We therefore cannot establish whether the rather modest ethnic differences observed in this study would be similar or different from those in uninsured or underinsured populations, or from a population-based study that includes all levels or different types of insurance status. Ethnic differences in insurance coverage and access to care are an important cause of existing health disparities. As an example, a recent experimental study showed that eliminating medication copayments reduced disparities in cardiovascular care (Choudhry et al., 2014).

The key strengths of this *Diabetes & Aging Study* include its large sample size and ethnic diversity. The KPNC Diabetes Registry is one of the largest diabetes registries in the world and maintains a wealth of high-quality clinical data. Moreover, this population has a very low patient turnover rate (~5% discontinue membership each year including censoring due to death), affording outcome ascertainment with minimal loss to follow-up. In the United States, social inequalities in health are often attributable to social differences in quality or access to care. This exploration of prevalent ethnic health differences is unique given it was conducted in a population with uniform access to care from an integrated health care delivery system, reducing the variation in access to care common in population-based studies. Thus, this study will serve as an important complement to population-based studies, helping clarify the extent to which access to and quality of care may affect our characterization of health disparities. However, it is important to distinguish between offered versus accepted care. Particularly vulnerable patients (e.g., those with limited English proficiency or living in poverty) may experience unique barriers (e.g., language or financial), may be less likely to utilize offered care (Karter, Ferrara, Darbinian, Ackerson, & Selby, 2000), or may have poorer outcomes (Fernandez et al., 2011; Karter et al., 2002). Although the rate of utilization may differ somewhat across ethnic groups, offered care has been

shown to be relatively uniform in this health care setting (A. F. Brown et al., 2005; Lyles et al., 2011; Martin, Selby, & Zhang, 1995).

It is important that quality indicators and quantitative measures encourage appropriate care for older adults, while not ignoring the lag-time to benefit and potential harm of preventive interventions (Lee & Walter, 2011). Geriatric conditions are important to the functioning and quality of life of older adults (Laiteerapong et al., 2011) and acknowledged in current models of diabetes care, yet their prevalence in multi-ethnic populations of older patients with diabetes has not been well documented. We observed that geriatric conditions are much more common than diabetic complications, and deserve attention as they affect clinical decision making (Blaum et al., 2010; Cigolle et al., 2007; Laiteerapong et al., 2011). In this population of older adults with diabetes, geriatric conditions were almost 3 times as prevalent (88%) as a recent history of a diabetes complication (32%). More than half of the patients had clinically recognized chronic pain, and approximately one in five had clinically recognized depression. Our previous research found that, in general, having a geriatric condition was associated with a greater decrement of HRQL than for traditional diabetic complications (Laiteerapong et al., 2011), underscoring the importance of evaluating and addressing geriatric conditions in diabetes clinical practice.

Although the specific patterns were quite heterogeneous across outcomes and ethnic groups, older Asians and Filipinos with diabetes were generally less burdened with geriatric conditions compared with Whites. Compared with Whites, Asians and Filipinos had substantively lower prevalence of falls, urinary incontinence, depression, and chronic pain, and were least likely of all groups to have at least one geriatric condition. Compared with Whites, African Americans also had significantly lower prevalence of incontinence and falls, but higher prevalence of dementia; Latinos had a lower prevalence of falls. Moreover, the magnitude of the differences was, for the most part modest, possibly attributable to the uniform access to care. Among these insured older adults, the ethnic patterns vary substantially by condition or complication; differences are frequently small and rates are often better among select minority groups, suggesting progress toward the Healthy People 2020 objective to reduce health disparities. More research is needed to identify factors that may explain the more substantive observed differences (e.g., ESRD or amputation) and establish whether those factors are modifiable. It would also be important to understand whether settings with poorer access to care (e.g., underinsured population) experience larger ethnic differences in health among older patients with diabetes as compared with observations from this insured cohort offered uniform care in an integrated health care delivery system.

Appendix

Source and Codes for Outcome Ascertainment

Outcome	Source	Codes
Chronic pain	Outpatient	ICD-9 codes: 339.0-339.4, 339.8, 346.00-346.03, 346.10-346.13, 346.20-346.23, 346.40-346.43, 346.5-346.6, 346.70-346.73, 377.2, 710-727, 729.0-729.9, 784.0
Depression	Outpatient	ICD-9 codes 296.2, 296.3, 298.0, 300.4, 309.0, 309.28, or 311
Falls	Outpatient and inpatient	ICD-9: E880-E888
Urinary incontinence	Outpatient	ICD-9: 788.3
Dementia	Outpatient	ICD-9: 290.0, 290.1, 290.4, 331.0
Amputation	Inpatient	CPT-codes: 27598, 27880, 27881, 27882, 27884, 27886, 27888, 27889, 28800, 28805, 28820, 28825, 28810, 27290, 27295 ICD-9 codes: 84.10-84.19
Blindness	Outpatient	369
Proliferative retinopathy	Outpatient	250.50, 250.51, 250.52, 250.53, 362.01, 362.02
Photocoagulation Procedure (panretinal or focal)	Outpatient procedure	CPT-codes: 67208, 67210, 67227, 67228
Heart failure	Inpatient	402.01, 402.11, 402.91, and 428
ESRD	Kaiser ESRD registry only.	ESRD registry
Myocardial infarction	Inpatient	410
Ischemic or hemorrhagic Stroke	Inpatient	431.x, 433.x, 434.x, and 436.x.
Hypoglycemic event (requiring medical assistance)	Outpatient (emergency department only) and inpatient	251.0-251.2

Note. ICD-9 = International Statistical Classification of Diseases and Related Health Problems–9; CPT = current procedural terminology; ESRD = end-stage renal disease.

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