The Missed Patient With Diabetes

How access to health care affects the detection of diabetes

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OBJECTIVE — This study examined the association between access to health care and three classifications of diabetes status: diagnosed, undiagnosed, and no diabetes.

RESEARCH DESIGN AND METHODS — Using data from the 1999–2004 National Health and Nutrition Examination Survey, we identified 110 "missed patients" (fasting plasma glucose >125 mg/dl but without diagnoses of diabetes), 704 patients with diagnosed diabetes, and 4,782 people without diabetes among adults aged 18–64 years. The population percentage undetected among adults with diabetes and the odds ratio of being undetected among adults who reported not having diabetes were compared between groups based on their access to health care.

RESULTS — Among those with diabetes, the percentages having undetected diabetes were 42.2% (95% CI 36.7–47.7) among the uninsured, 25.9% (22.9–28.9) among the insured, 49.3% (43.0–55.6) for those uninsured >1 year, 38.7% (29.2–48.2) for those uninsured ≤1 year, and 24.5% (21.7–27.3) for those continuously insured over the past year. Type of insurance, number of times receiving health care in the past year, and routine patterns of health care utilization were also associated with undetected diabetes. Multivariate adjustment indicated that having undetected diabetes was associated with being uninsured (odds ratio 1.7 [95% CI 1.0–2.9]) and with being uninsured >1 year (2.6 [1.4–5.0]).

CONCLUSIONS — Limited access to health care, especially being uninsured and going without insurance for a long period, was significantly associated with being a "missed patient" with diabetes. Efforts to increase detection of diabetes may need to address issues of access to care.

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I n 2005, an estimated 6.2 million Americans had undiagnosed diabetes (1). Individuals with undiagnosed type 2 diabetes (type 2 diabetes accounts for 90–95% of all diabetes) have significantly higher risks for cardiovascular disease than do individuals without diabetes (2). Failure to diagnose diabetes prevents patients from receiving effective treatments and may have serious consequences, such as blindness, amputation, cardiovascular disease, and death (3). Interventions that can prevent or delay these complications cannot be promptly applied to patients with diabetes unless their disease has been detected (3). Timely detection, therefore, is of great importance, as it can reduce the human and economic cost of diabetes (2).

A recent U.S. Census Bureau report estimated that 15.9%, or 46.6 million, of U.S. residents lacked health insurance in 2005 (4). Uninsured adults, compared with the insured, are much less likely to receive routine checkups or preventive services (5), tend to be more severely ill when diagnosed, and receive less therapeutic care (6). In addition to insurance coverage and the nature of coverage (7), absence of a physician or place for usual source of care is associated with lack of screening, follow-up care, and pharmacologic treatment for hypertension (8). Also,

many insured individuals lack adequate access to health care or have only intermittent health insurance, and states of inadequate coverage are associated with lower use of preventive services (9,10). The absence of continuous insurance coverage can have a particularly severe impact, and a national study found that adults who were uninsured for a long period of time reported much greater unmet health needs than those who were insured (11). While being poor and uninsured is associated with delayed access to health care (12), higher-income adults lacking health care insurance have a decreased use of recommended health care services, and increased income does not attenuate the difference in use between uninsured and insured adults (13). Limited access to health care not only affects the use of preventive services (14) but also elevates the risk of a decline in overall health (15).

To date, few studies have specifically examined the implications of having inadequate insurance coverage among individuals with diabetes. We have seen, however, that uninsured adults with diabetes are less likely to receive needed care and to effectively manage their disease, and those with health insurance have difficulty obtaining needed care when their coverage is inadequate (16,17). Medical organizations have addressed the importance of detecting diabetes (1,2,18), but the relationship between access to preventive services and the likelihood of having undetected diabetes has not been examined. Although two studies (19,20) investigated the relationship between socioeconomic status and the detection of diabetes and found that undiagnosed diabetes was not related to education or income, these studies did not examine the role that access to health care might play in detecting diabetes. Furthermore, no previous nationally representative studies have examined the association of access to health care with the detection of diabetes.

In examining the relationship between access to preventive care and undetected diabetes, we sought to explore how access to health care relates to the detection of diabetes 1) in the diabetic popula-

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tion and 2) in the population who self-reported not having diabetes.

RESEARCH DESIGN AND METHODS

We used cross-sectional data from the 1999–2004 National Health and Nutrition Examination Survey (NHANES), a national population-based health survey that includes personal interviews, medical examinations, and laboratory measurements (21).

These analyses were based on data from adults aged 18–64 years who had fasted for ≥8 h. Individuals aged >64 years were excluded because they were commonly entitled to Medicare, the federal health care insurance program (96 of 1,988 subjects aged ≥65 years had undiagnosed diabetes, of whom only 2 reported no health care insurance coverage). The diabetic population consisted of subjects who answered "yes" to the question, "Have you ever been told by a doctor that you have diabetes or sugar diabetes?" plus subjects who answered "no" but had fasting plasma glucose levels ≥126 mg/dl. Those who answered "no" (regardless of fasting plasma glucose values) made up our population who self-reported not having diabetes.

Access to health care can be considered a multidimensional concept, including availability, organization, financing, utilization, and satisfaction among the possible domains (7). In this study, the measures of access used reflect two of these five domains: financing and utilization (7). Financing was measured by the following three variables: 1) uninsured, 2) covered by private insurance, and 3) continuity of insurance coverage. Classified as uninsured were those who responded "no" to the question, "Are you covered by health insurance or some other kind of health care plan?" Those who reported having health insurance (the insured) were asked, "Are you covered by private insurance?" Those who responded "yes" were classified as covered by private insurance, and those responding "no" were considered to have public insurance. Continuity of coverage was derived from three questions: "Are you covered by health insurance or some other kind of health care plan?", "In the past 12 months, was there any time when you did not have any health insurance coverage?", and "About how long has it been since you last had healthcare coverage?" The responses were used to create a three-level variable: continuously insured over the past year, uninsured ≤1 year, and uninsured >1 year.

Utilization was measured by 1) number of times the participant received health care during the past 12 months, derived from the question, "During the past 12 months, how many times have you seen a doctor or other healthcare professional about your health at a doctor's office, a clinic, hospital emergency room, at home or some other place?" and 2) routine patterns of health care utilization, derived from the two questions, "Is there a place that you usually go when you are sick or you need advice about your health?" and "What kind of place do you go to most often: is it a clinic, a doctor's office, ER, or some other place?"

We controlled for six sociodemographic variables in our analysis, including age, sex, race/ethnicity, marital status, education, and family income. We also used as covariates BMI (measured as kilograms divided by the square of height in meters) and a dichotomized version of self-rated health.

Data analysis

We used two approaches to examine the relationship between access to health care and undiagnosed diabetes. First, we focused on the whole diabetic population (diagnosed and undiagnosed) and examined the percentage undetected among those with diabetes (undiagnosed divided by diagnosed plus undiagnosed).

Second, we used multivariate logistic regression models to examine, in the population who self-reported not having diabetes the relationship between access to health care and actually having diabetes. We restricted this analysis to the population who self-reported not having diabetes because diagnosed patients might be more likely to seek insurance and to use health care more often than their undiagnosed counterparts. In our multivariate logistic regression models, covariates included age, sex, race/ethnicity, marital status, education, family income, BMI, and self-rated health.

The sampling weights from the subpopulation of NHANES 1999–2004 participants who had fasted in the morning were utilized in our analyses. Analyses were conducted using SUDAAN statistical software (version 9.0.1) (22). We conducted two-tailed t tests for significance and considered results with a P value of <0.05 to be significant.

RESULTS

In the subsample of adults aged 18–64 years who had fasted, we identified 110 subjects with undiagnosed diabetes, 704 who had been diagnosed, and 4,782 subjects without diabetes. Characteristics of participants for each group was presented in Table 1.

In an analysis adjusted for age, sex, and race/ethnicity, those with undiagnosed diabetes had the least favorable profile of access to health care among the three groups (Table 2). They were significantly more likely to be uninsured than either of the other two groups ($P < 0.01$ for both comparisons). Similarly, they were more likely to be uninsured for >1 year than were these other two groups ($P < 0.01$), and they were the most likely not to have received any health care in the past year. In addition, subjects with undiagnosed diabetes were more likely than those with diagnosed diabetes to lack a usual source of care ($P < 0.01$). If insured, however, the undiagnosed were more likely than the diagnosed to be covered by a private insurance plan.

Percentage undetected among all people with diabetes

The percentage of those with undetected diabetes in the diabetic population was significantly higher among the uninsured than among the insured (42.2% [95% CI 36.7–47.7] vs. 25.9% [22.9–28.9]) (Fig. 1). Among the insured, the percentage undetected among those with private insurance was significantly higher than among those with government insurance (28.5% [25.1–31.9] vs. 17.8% [13.5–22.1]). Continuity of coverage was associated with the percentage undetected. Here, the highest percentage, 49.3% (95% CI 43.0–55.6), was among those uninsured for >1 year, followed by 38.7% (29.2–48.2) among those uninsured <1 year and 24.5% (21.7–27.3) among those insured without discontinuity in the past year.

The number of times that health care was received in the past year was associated with having undetected diabetes. Percentages undetected ranged from 72.8% (95% CI 66.9–78.7) among those not seeing a health care professional in the last year to 47.2% (39.8–54.6) among those who received care just once to 33.1% (26.8–39.4) among those receiving care two to three times to 16.7% (13.2–20.2) among those who received care four times or more. Among those who usually used clinics and health care

Table 1—*Characteristics of participants aged 18–64 years*

Variables	Diagnosed diabetes (n = 704)		Undiagnosed diabetes (n = 110)		Nondiabetic population (n = 4,782)	
	n	Weighted % or mean	n	Weighted % or mean	n	Weighted % or mean
Mean age (in years)		49.9		50.2		39.0
Sex (female)	363	48.7	47	36.8	2,539	51.7
Race (non-Hispanic white)	217	58.3	47	68.4	2,215	71.2
Race (black)	201	18.4	25	13.0	993	11.2
Race (Hispanic)	261	17.4	34	14.2	1,426	13.5
Race (others)	25	6.0	4	4.4	148	4.2
Marital status (married)	401	57.3	60	56.7	2,319	55.1
Educational attainment						
Less than high school	300	28.7	53	32.8	1,441	19.0
High school	152	23.7	19	22.7	1,200	26.2
More than high school	252	47.5	38	44.6	2,141	54.8
Family income <$20,000 per year	266†	29.6	43†	26.6	1,389†	22.2
Mean BMI (kg/m^2)		32.9		34.1		27.6
Self-rated health						
Good, very good, or excellent	335	55.3	74	73.6	4,007†	86.4
Fair or poor	369	44.7	36	26.4	770†	13.6

*Data source: NHANES 1999–2004; analytic population included participants with diagnosed diabetes, undiagnosed diabetes, and no diabetes; all data weighted by morning fasting sample weight. †Twenty of 704 subjects with diagnosed diabetes, 6 of 110 subjects with undiagnosed diabetes, and 121 of 4,782 subjects without diabetes did not report family income; 5 of 4,782 subjects without diabetes did not report their health status. These missing data will not appear in the regression models in Table 3.

centers for health care purposes, the percentage undetected was 31.1% (25.4–36.8). The percentage undetected was 26.7% (23.3–30.1) in subjects usually using doctor's offices or HMO facilities. This percentage was 12.3% (5.6–19.0) in subjects usually using hospital emergency rooms or hospital outpatient departments. Among those not using any health care facility, the percentage undetected was 66.2% (56.1–76.3).

Table 2—*Profile of access to health care among U.S. adults aged 18–64 years: NHANES 1999–2004*

Access to care	Diagnosed diabetes		Undiagnosed diabetes		Nondiabetic population	
	n/N	Estimated % (95% CI)	n/N	Estimated % (95% CI)	n/N	Estimated % (95% CI)
Financing						
Uninsured	144/704	19.3 (14.0–26.1)	38/110	36.6 (32.8–40.6)	1,314/4,782	21.2 (19.4–23.2)
Covered by private insurance in insured	388/560	76.6 (66.2–84.6)	57/72	89.9 (83.0–94.2)	2,893/3,468	88.4 (87.1–89.7)
Continuity of insurance coverage						
Uninsured >1 year	66/647†	10.9 (6.8–17.1)	24/101†	25.6 (21.0–30.8)	541/4,239†	11.9 (10.3–13.7)
Uninsured ≤1 year	63/647†	11.6 (7.0–18.5)	14/101†	12.4 (6.9–21.4)	572/4,239†	11.3 (9.9–12.9)
Continuously insured over past year	518/647†	77.5 (71.4–82.7)	63/101†	62.0 (54.7–68.7)	3,126/4,239†	76.8 (74.6–78.8)
Utilization						
Number of times received health care over past year						
None	27/704	2.4 (1.4–4.0)	27/110	24.0 (19.4–29.3)	979/4,781	19.5 (17.9–21.2)
Once a year	57/704	4.9 (3.3–7.4)	18/110	9.2 (6.2–13.3)	1,004/4,781	21.5 (19.9–23.3)
Two to three	158/704	29.8 (22.1–38.9)	26/110	33.8 (26.4–42.0)	1,279/4,781	27.6 (26.3–28.9)
Four or more	462/704	62.8 (54.2–70.7)	39/110	33.0 (26.0–40.9)	1,519/4,781	31.4 (29.7–33.1)
Routine patterns of health care utilization						
No place	34/704	3.0 (1.5–6.0)	17/110	14.1 (10.7–18.4)	1,017/4,781	18.1 (16.7–19.7)
Hospital emergency room, outpatient department, or other	63/704	5.2 (3.3–8.1)	4/110	2.0 (0.8–4.8)	273/4,781	5.0 (4.4–5.7)
Clinic or health care centers	179/704	20.2 (13.8–28.5)	26/110	15.2 (9.7–22.9)	969/4,781	17.8 (15.0–21.0)
Doctor's office or HMO	428/704	71.7 (63.2–78.8)	63/110	68.7 (61.4–75.2)	2,522/4,781	59.0 (56.5–61.5)

*Data source: NHANES 1999–2004; analytic population included participants with diagnosed diabetes, undiagnosed diabetes, and no diabetes; estimated percentages for the U.S. were weighted by morning fasting sample weights and adjusted by age, sex, and race/ethnicity. †Fifty-seven of 704 subjects with diagnosed diabetes, 9 of 110 subjects with undiagnosed diabetes, and 543 of 4,782 subjects without diabetes did not report their continuity of insurance coverage.
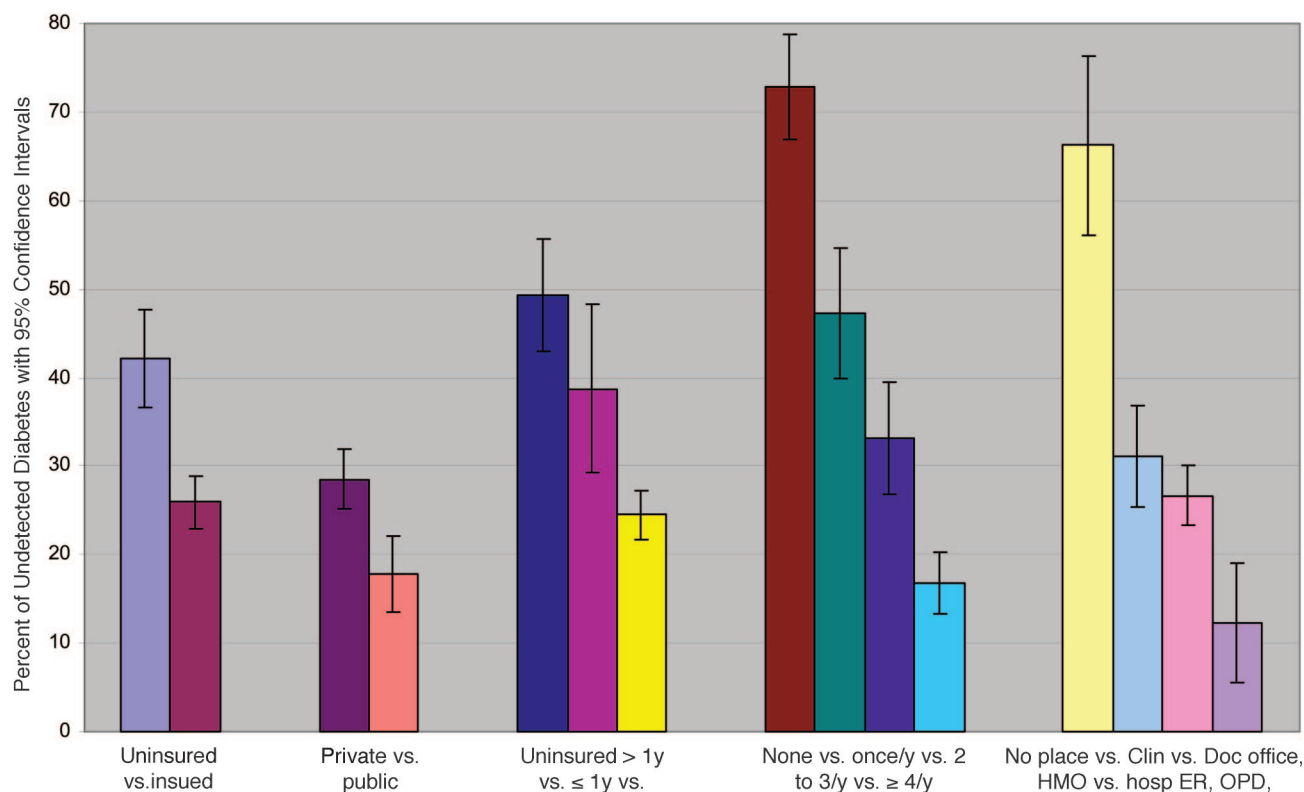
Figure 1—*Percent of undetected diabetes among people with diabetes by access to care. y-axis: percentage of undetected diabetes with 95% CI. x-axis: access to care. Clin, clinics; Doc, doctor; Hosp ER, hospital emergency room; Hosp OPD, hospital outpatient department.*

Multivariate analysis

In our multinomial logistic analyses, we examined the relationship between access to health care and failure to detect diabetes in the population who self-reported not having diabetes (Table 3).

Table 3—*Multivariate-adjusted odds ratios for diabetes not being detected by indicators of access**

Access to care	Odds ratio (95% CI)
Financing	
Uninsured	1.7 (1.0–2.9)
Covered by private insurance in insured	2.1 (1.2–3.6)
Continuity of insurance coverage	
Uninsured >1 year	2.5 (1.3–4.8)
Uninsured ≤1 year	2.6 (1.0–6.8)
Continuously insured over past year	1.0 (referent)
Utilization	
Number of times receiving health care over past year	
None	1.3 (0.6–2.8)
Once a year	1.0 (0.5–2.2)
Two to three	1.2 (0.5–2.7)
Four or more	1.0 (Ref.)
Routine patterns of health care utilization	
No place	0.8 (0.3–1.9)
Hospital emergency room, outpatient department, or other	0.4 (0.1–2.0)
Clinic or health care centers	1.0 (0.5–2.1)
Doctor's office or HMO	1.0 (Ref.)

Data source: NHANES 1999–2004. *Analytic population included participants with undiagnosed diabetes and no diabetes. Covariates included age, sex, race/ethnicity, marital status, education, family income, BMI, and self-rated health (full model can be provided upon request). Each odds ratio refers to a separate logistic regression, and the number of observations in continuity of insurance coverage regression is 4,208 and in all other regressions is 4,760 after excluding missing data.

After we adjusted for age, sex, race/ethnicity, marital status, education, family income, BMI, and self-rated health, we found that compared with subjects without diabetes, those with undetected diabetes were significantly more likely to be uninsured (odds ratio 1.7 [95% CI 1.0–2.9]) and uninsured for >1 year (2.6 [1.4–5.0]).

CONCLUSIONS — Having undetected diabetes puts one's health at substantial risk (1,2), but timely detection of diabetes is difficult without access to health care. Using a nationally representative sample, we found that lack of access to care significantly elevated the risk of going undiagnosed. We found that undetected diabetes was related to insurance coverage, routine patterns of health care utilization, and continuity of coverage. The type of insurance and the number of times a health care professional was seen in the past year were also associated with having undetected diabetes. It is also noteworthy that those with undiagnosed diabetes were significantly more likely than those without diabetes to be uninsured or to be uninsured for >1 year.

Previous studies (9–11) have indicated that continuity of coverage is even

more important than coverage per se in determining health status. Similarly, our study indicated that access to care was significantly related to the failure to detect diabetes, and the continuity of access was also important in determining whether diabetes would go undetected. In our study, subjects uninsured for >1 year were essentially twice as likely as insured subjects without a break in insurance over the past year to have undetected diabetes. Type 2 diabetes, a chronic disease, takes a long time to develop and reach its diagnostic threshold. During the progression to diabetes, access to primary care plays a crucial role in its timely detection. The longer an individual is without insurance coverage, the longer she or he may go with undetected diabetes.

We found that those covered by private plans were significantly more likely to be undiagnosed when they actually had diabetes than were those covered by government insurance. This finding may seem counterintuitive, but we know that some private insurance companies provide limited coverage for preventive care (17,23), and private coverage tends to be more discontinuous (24). It is worth noting that some government health plans (e.g., those offered through the Department of Veterans Affairs) provide relatively effective preventive care for their enrollees with diabetes (17), and the Veteran's Affairs professional staff may accordingly be more attuned to recommendations for diabetes screening.

Previous studies (19,20) have not found a relationship between education or income and the risk of having undetected diabetes. These studies, however, did not examine the role played by access to health care (another aspect of socioeconomic status) in the detection of diabetes. Although we found no significant difference by education or income between being diagnosed and undiagnosed among individuals with diabetes, our analyses have shown that access to health care plays an important role in detecting diabetes.

Although race/ethnicity is related to diabetes and poor access to care (1,25), we found no evidence that race/ethnicity affects the association between access to health care and detection of diabetes. A recent study (26), using data from Behavioral Risk Factor Surveillance System 1998–2001, found that individuals of lower socioeconomic status were at greater risk for not receiving preventive care regardless of race/ethnicity and those

without health insurance coverage were at the greatest risk for not receiving preventive services. Our findings are consistent with that study. In our model, lack of access to health care is a predictor for undetected diabetes regardless of race/ethnicity. Our study suggests that access to health care might be among the most important predictors for determining whether diabetes is/is not detected.

Our study has the following strengths: *1*) The data come from a nationwide survey; *2*) sampling weights were incorporated in the analysis so as to represent the adult U.S. population; *3*) sociodemographic, anthropometric, and health status variables were controlled for in our analyses; and *4*) two different approaches were used to examine two different populations, reducing the bias introduced by the effect of diabetes awareness on the willingness to acquire health care insurance. Our study has limitations as well. The major limitation is that the relatively small sample of subjects with undiagnosed diabetes makes it difficult to analyze differences by subgroup between the two sexes or between different race/ethnicity groups. Another limitation is that access to health care was measured by only two of five domains because of the limited availability of the survey data.

Our findings demonstrate that lack of access to health care may result in missed opportunities to detect diabetes. The detection of diabetes requires specific diagnostic tests, e.g., the fasting plasma glucose test or the oral glucose tolerance test (or both). These tests are commonly arranged within a comprehensive health care setting that recognizes the risk profiles of its patients. Without access to comprehensive health care, patients would be less likely to receive screening and diagnostic services, and, in the end, their diabetes may be missed by the health care system. When they are missed by the health care system, the problems caused by those "missed" cases do not disappear. On the contrary, as a study by Young and Mustard (27) indicated, they represent the unseen but clinically important burden of diabetes, with significant concurrent metabolic derangements and a long-term impact on use of health care.

With the increases in both the diabetic and the uninsured populations in the U.S., it seems very likely that the number of undetected cases of diabetes will increase in the future, with consequent increases in diabetes-related morbidity

and mortality. This trend cannot be reversed until we can increase access to health care for those Americans who need it most. Our analyses indicate that limited health care access, especially being uninsured and having a long period without insurance, is associated with being a "missed patient" with diabetes. Those making an effort to increase the timely detection of diabetes should consider issues related to health care access.

References
1. U.S. Department of Health and Human Services: National diabetes fact sheet: general information and national estimates on diabetes in the United States, 2005 [article online], 2005. Available from http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2005.pdf. Accessed 4 June 2007
2. American Diabetes Association: Screening for type 2 diabetes. *Diabetes Care* 27 (Suppl. 1):S11–S14, 2004
3. American Diabetes Association: Standards of medical care in diabetes-2007. *Diabetes Care* 30 (Suppl. 1):S4–S41, 2007
4. U.S. Census Bureau: Income, poverty, and health insurance coverage in the United States, 2005 [article online], 2007. Available from http://www.census.gov/hhes/www/hlthins/hlthin05.html. Accessed 4 June 2007
5. Ayanian JZ, Zaslavsky AM, Weissman JS, Schneider EC, Ginsburg JA: Undiagnosed hypertension and hypercholesterolemia among uninsured and insured adults in the Third National Health and Nutrition Examination Survey. *Am J Public Health* 93:2051–2054, 2003
6. Hadley J: Sicker and poorer: the consequences of being uninsured: a review of the research on the relationship between health insurance, medical care use, health, work, and income. *Med Care Res Rev* 60:S3–S75, 2003
7. Aday LA: *Access to Health care in America.* Washington, DC, National Academy Press, 1993
8. Moy E, Bartman BA, Weir MR: Access to hypertensive care: effects of income, insurance, and source of care. *Arch Intern Med* 155:1497–1502, 1995
9. Schoen C, DesRoches C: Uninsured and unstably insured: the importance of continuous insurance coverage. *Health Serv Res* 35:187–206, 2000

10. Sudano JJ Jr, Baker DW: Intermittent lack of health insurance coverage and use of preventive services. *Am J Public Health* 93:130–137, 2003

11. Ayanian JZ, Weissman JS, Schneider EC, Ginsburg JA, Zaslavsky AM: Unmet health needs of uninsured adults in the United States. *JAMA* 284:2061–2069, 2000

12. Weissman JS, Stern R, Fielding SL, Epstein AM: Delayed access to health care: risk factors, reasons, and consequences. *Ann Intern Med* 114:325–331, 1991

13. Ross JS, Bradley EH, Busch SH: Use of health care services by lower-income and higher-income uninsured adults. *JAMA* 295:2027–2036, 2006

14. DeVoe JE, Fryer GE, Phillips R, Green L: Receipt of preventive care among adults: insurance status and usual source of care. *Am J Public Health* 93:786–791, 2003

15. Baker DW, Sudano JJ, Albert JM, Borawski EA, Dor A: Lack of health insurance and decline in overall health in late middle age. *N Engl J Med* 345:1106–1112, 2001

16. Bindman AB, Grumbach K, Osmond D, Komaromy M, Vranizan K, Lurie N, Billings J, Stewart A: Preventable hospitalizations and access to health care. *JAMA* 274:305–311, 1995

17. Nelson KM, Chapko MK, Reiber G, Boyko EJ: The association between health insurance coverage and diabetes care: data from the 2000 Behavioral Risk Factor Surveillance System. *Health Serv Res* 40:361–372, 2005

18. The US Department of Health and Human Services: Diabetes detection initiative: finding the undiagnosed [article online], 2007. Available from http://ndep.nih.gov/ddi. Accessed 10 December 2007

19. Bourdel-Marchasson I, Helmer C, Barberger-Gateau P, Peuchant E, Fevrier B, Ritchie K, Dartigues JF: Characteristics of undiagnosed diabetes in community-dwelling French elderly: the 3C study. *Diabetes Res Clin Pract* 76:257–264, 2006

20. Wilder RP, Majumdar SR, Klarenbach SW, Jacobs P: Socio-economic status and undiagnosed diabetes. *Diabetes Res Clin Pract* 70:26–30, 2005

21. National Center for Health Statistics: National Health and Nutrition Examination Survey [article online], 2007. Available from http://www.cdc.gov/nchs/nhanes.htm. Accessed 20 November 2007

22. Frane J: *SUDAAN: Professional Software for Survey Data Analysis: Version 9.0.1.* Research Triangle Park, NC, Research Triangle Institute, 1989

23. Rice T, Lavarreda SA, Ponce NA, Brown ER: The impact of private and public health insurance on medication use for adults with chronic diseases. *Med Care Res Rev* 62:231–249, 2005

24. Institute of Medicine: Insuring American's health: principles and recommendations [article online], 2005. Available from http://books.nap.edu/catalog/10874.html. Accessed 10 January 2007

25. Agency for Healthcare Research and Quality: *2004 National Healthcare Disparities Report.* Rockville, MD, AHRQ Publication, 2004

26. Oladele CR, Barnett E: Racial/ethnic and social class differences in preventive care practices among persons with diabetes. *BMC Public Health* 6:259, 2006

27. Young TK, Mustard CA: Undiagnosed diabetes: does it matter? *CMAJ* 164:24–28, 2001