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11-25-2021

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Recommended Citation

Gupta K, Viacava RC, Jain V, Kakar TS, Jesse M, and Virani SS. Trends in Patient-Recalled Targets for Cardiovascular Risk Factors in Ambulatory US Adults With Diabetes Mellitus (from National Health and Nutrition Examination Survey). Am J Cardiol 2021.

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Trends in Patient-Recalled Targets for Cardiovascular Risk Factors in Ambulatory US Adults With Diabetes Mellitus (from National Health and Nutrition Examination Survey)

Since 2010, there has been a decrease in blood pressure (BP) and glycemic control in patients with diabetes, which is a significant shift from the progress made in previous decades.¹ Guidelines recommend patient-centered team care for decision making and goal setting.² We conducted this study to estimate the proportion of patients with diabetes mellitus who recalled discussions on individual treatment targets with their health care provider.

We used data from adults aged ≥ 20 years with diagnosed diabetes mellitus in 4 cycles of the National Health and Nutrition Examination Survey: 2011 to 2012, 2013 to 2014, 2015 to 2016, and 2017 to March 2020 (Supplementary Figure 1). The primary objective of our study was to assess the proportion of respondents who recalled any glycated hemoglobin (HbA1c) target, BP target, or low-density lipoprotein-cholesterol (LDL-C) target individually across survey cycles. The secondary objective was to evaluate factors independently associated with recalling any HbA1c target in a multivariable logistic regression model consisting of age, gender, race, education, insurance, family income-to-poverty ratio, actual HbA1c, duration of diabetes mellitus, and insulin treatment. These risk factors were chosen a priori based on previous studies.^{3,4} Chi-square test was used to compare the group proportions between surveys. Proportions were weighted according to the survey weights provided with each survey (Supplementary Methods). Proportions were age-standardized using the 2000 Census Population.⁵

Across all surveys, mean age was approximately 60 years, most respondents were non-Hispanic Whites, and women constituted approximately 50% of the population (Supplementary Table 1). Most respondents (99.4%) had ≥ 1 doctor visit in the preceding

year. The mean duration of diabetes mellitus was around 10 years. Overall, $>80\%$ of respondents in each survey cycle reported a provider-specified glycemic target (Figure 1, Table 1). There was no change in this proportion over the 4 surveys ($p > 0.05$). There was no significant difference in recall proportions across the racial subgroups.

In the multivariable model, younger age, higher education status, higher family income-to-poverty ratio, higher current HbA1c, and insulin treatment were significantly associated with recalling a provider-specified glycemic target (Supplementary Table 2).

Response for BP target was available for 82.7% of respondents. Of these, approximately 50% in each survey cycle reported a provider-specified target, and this proportion increased significantly over the subsequent cycles (Figure 1, Table 1; $p < 0.05$). There was an increase in the proportion of Hispanics and non-Hispanic Black respondents reporting a BP target ($p > 0.05$) (Supplementary Table 3).

Response for LDL-C target was available in 47.3% of respondents. There was a decrease in the proportion of respondents recalling a provider-specified LDL-C target from 40.5% in 2011 to 2012 to 28.9% in 2017 to March 2020, but the difference was not statistically significant (Figure 1, Table 1). Across each cycle, non-Hispanic Black patients had the lowest recall rates for an LDL-C target, but the difference did not reach statistical significance (Supplementary Table 3).

In this analysis of non-institutionalized, ambulatory US adults with diagnosed diabetes mellitus and aged ≥ 20 years, we found that the proportion of patients recalling a glycemic or BP target remained similar but decreased for those recalling an LDL-C target from 2011–2012 to 2017–March 2020. More than 80% of respondents reported a glycemic target but $<50\%$ of respondents reported a provider-specified BP or LDL-C target. The proportions were comparable across races except for significantly lower reported recall rates for LDL-C among non-Hispanic Black respondents. Respondent's education and income level were independently associated with recalling a glycemic target.

Four key risk factors leading to adverse outcomes in patients with diabetes mellitus are hyperglycemia, high BP, dyslipidemia, and smoking.⁶ It is encouraging to know that $>80\%$ of respondents can recall a glycemic target and the trend is maintained across all surveys. However, recall rates for BP and LDL-C remain poor. This might be due to several reasons. First, patients may have a scheduled visit with a health care provider where HbA1c measurement and titration of antidiabetic medications may be the top priority, leaving little time to address other risk factors such as high BP and LDL-C. Second, due to the complex nature of recalling 2 values and visit-to-visit variability, patients may not be able to call their BP or LDL-C target.

It is well known that diabetes disproportionately affects the racial minorities and populations with lower income.⁴ The same subgroups, especially non-Hispanic Black respondents, were more likely to not recall a target for risk factor control in our study.

To the best of our knowledge, this is the first study that used data from ambulatory US adults with diabetes mellitus to report the proportion of patients who recalled glycemic, BP, and/or LDL-C targets. We believe that recall rates provide a useful surrogate to gauge patient participation in the management of chronic medical conditions such as diabetes mellitus. The findings are based on survey data and limitations due to recall bias apply. The targets for risk factors were recalled by the respondent and may differ from the actual targets discussed at the time of a medical encounter. Despite this, the significant observed differences in glycemic versus BP or LDL-C target in our study would unlikely be differentially affected by recall bias.

In conclusion, although $>80\%$ of respondents with diagnosed diabetes mellitus recalled a glycemic target, there was a high proportion of respondents who did not recall any BP or LDL-C target despite a high frequency of contact with their health care providers. Efforts are needed to understand the drivers of this and to improve patient understanding of comprehensive risk factor management in diabetes mellitus.

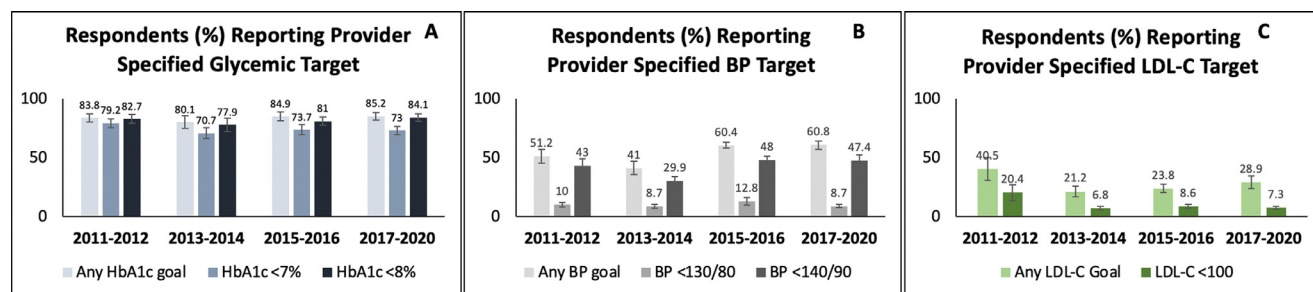


Figure 1. Bar graph depicting age-standardized proportion of respondents reporting provider-specified glycemic (Panel A), blood pressure (Panel B) and LDL-C (Panel C) Target on y-axis across the NHANES survey cycles from 2011-2012 to 2017-March 2020 on x-axis. Hba1c; % glycosylated hemoglobin, BP, blood pressure in mmHg, LDL-C, Low-density lipoprotein cholesterol in mg/dL.

Table 1

Distribution of glycaemic, blood pressure and LDL-C target in the overall population, men, and women across the 4 NHANES cycles

	2011–2012	2013–2014	2015–2016	2017–2020
Overall	342	426	524	1,056
Any HbA1c target	83.8 (74.6, 90.1)	80.1 (66.1, 89.3)	84.9 (75.0, 91.4)	85.2 (77.4, 90.6)
Target HbA1c <7.0%	79.2 (70.6, 85.7)	70.7 (59.9, 79.5)	73.7 (63.3, 82.0)	73.0 (64.7, 80.0)
Target HbA1c <8.0%	82.7 (73.2, 89.3)	77.9 (63.3, 87.8)	81.0 (72.5, 87.3)	84.1 (76.1, 89.9)
Any BP target*	51.2 (39.0, 63.2)	41.0 (29.6, 53.5)	60.4 (55.3, 65.3)	60.8 (53.5, 67.7)
Target BP <130/80 mm Hg	10.0 (6.5, 15.0)	8.7 (6.1, 12.4)	12.8 (7.4, 21.3)	8.7 (6.3, 11.7)
Target BP <140/90 mm Hg	43.0 (31.8, 54.9)	29.9 (22.2, 38.9)	48.0 (40.8, 55.3)	47.4 (37.7, 57.3)
Any LDL-C target	40.5 (22.7, 61.2)	21.2 (13.1, 32.3)	23.8 (17.1, 32.0)	28.9 (19.1, 41.1)
Target LDL-C <100 mg/dL	20.4 (9.7, 37.9)	6.8 (4.1, 11.1)	8.6 (5.6, 13.0)	7.3 (4.6, 11.3)
Men	181 (52.9)	203 (47.7)	283 (54.0)	573 (54.3)
Any HbA1c target	82.6 (66.6, 91.8)	92.4 (88.7, 95.0)	88.4 (78.6, 94.1)	90.0 (82.5, 94.6)
Target HbA1c <7.0%	77.1 (65.2, 85.8)	73.4 (55.6, 85.9)	73.7 (59.5, 84.2)	77.1 (63.4, 87.2)
Target HbA1c <8.0%	82.4 (66.5, 91.7)	88.0 (80.0, 93.0)	84.6 (76.7, 91.0)	89.0 (81.6, 93.6)
Any BP target*	57.1 (43.5, 69.6)	48.0 (28.8, 67.8)	57.9 (50.8, 64.8)	69.5 (53.7, 81.7)
Target BP <130/80 mm Hg	9.8 (6.3, 14.9)	6.5 (3.4, 12.1)	6.9 (3.0, 15.2)	9.7 (5.8, 15.8)
Target BP <140/90 mm Hg	46.8 (33.5, 60.6)	30.1 (18.1, 45.6)	42.4 (31.3, 54.4)	57.7 (40.6, 73.1)
Any LDL-C target	55.9 (38.6, 71.9)	35.3 (21.8, 51.5)	21.2 (13.3, 32.1)	41.5 (28.4, 56.0)
Target LDL-C <100 mg/dL	32.9 (23.2, 44.3)	5.4 (8.8, 10.2)	9.6 (6.1, 14.9)	10.5 (5.7, 18.5)
Women	161 (47.1)	223 (52.3)	241 (46.0)	483 (45.7)
Any HbA1c target	85.3 (74.5, 92.0)	68.7 (63.0, 73.9)	80.7 (66.0, 90.1)	82.8 (73.1, 89.5)
Target HbA1c <7.0%	81.9 (72.0, 88.8)	67.5 (61.4, 73.1)	72.3 (60.6, 81.6)	70.8 (60.4, 79.4)
Target HbA1c <8.0%	83.2 (72.5, 90.3)	67.6 (61.5, 73.2)	76.8 (65.4, 85.2)	81.7 (72.0, 88.6)
Any BP target*	44.3 (31.3, 58.2)	36.1 (27.8, 45.4)	63.2 (55.3, 70.4)	54.1 (44.7, 63.3)
Target BP <130/80 mm Hg	9.9 (5.6, 17.0)	10.7 (6.8, 16.6)	19.7 (10.3, 34.5)	7.5 (4.4, 12.5)
Target BP <140/90 mm Hg	38.1 (27.2, 50.5)	29.5 (20.7, 40.1)	52.3 (42.7, 61.7)	39.0 (26.9, 52.6)
Any LDL-C target	22.4 (14.7, 32.6)	17.3 (11.2, 25.7)	22.3 (14.4, 32.9)	21.3 (11.2, 36.6)
Target LDL-C <100 mg/dL	4.6 (1.7, 12.1)	8.2 (4.1, 15.7)	6.6 (2.6, 15.8)	4.4 (2.0, 9.6)

HbA1c: glycosylated hemoglobin, BP: blood pressure; LDL-C Low density lipoprotein- cholesterol. Data presented as n (%) for sample size across each NHANES cycle & proportion with 95% CI for distribution

* p-trend <0.05.

Disclosures

The authors have no conflicts of interest to declare.

Funding

None.

Supplementary materials

Supplementary material associated with this article can be found in the

online version at <https://doi.org/10.1016/j.amjcard.2021.10.019>.

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12 October 2021

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<https://doi.org/10.1016/j.amjcard.2021.10.019>