Telehealth and Medicare Type 2 Diabetes Care Outcomes

Evidence From Louisiana

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Background: At the onset of the COVID-19 pandemic, the Centers for Medicare and Medicaid Services broadened access to telehealth. This provided an opportunity to test whether diabetes, a risk factor for COVID-19 severity, can be managed with telehealth services.

Objective: The objective of this study was to examine the impacts of telehealth on diabetes control.

Research Design: A doubly robust estimator combined a propensity score–weighting strategy with regression controls for baseline characteristics using electronic medical records data to compare outcomes in patients with and without telehealth care. Matching on preperiod trajectories in outpatient visits and weighting by odds were used to ensure comparability between comparators.

Subjects: Medicare patients with type 2 diabetes in Louisiana between March 2018 and February 2021 (9530 patients with a COVID-19 era telehealth visit and 20,666 patients without one).

Measures: Primary outcomes were glycemic levels and control [ie, hemoglobin A1c (HbA1c) under 7%]. Secondary outcomes included alternative HbA1c measures, emergency department visits, and inpatient admissions.

Results: Telehealth was associated with lower pandemic era mean A1c values [estimate = −0.080%, 95% confidence interval (CI): −0.111% to −0.048%], which translated to an increased likelihood of having HbA1c in control (estimate = 0.013; 95% CI: 0.002–0.024; $P < 0.023$). Hispanic telehealth users had relatively higher COVID-19 era HbA1c levels (estimate = 0.125; 95% CI: 0.044–0.205; $P < 0.003$). Telehealth was not associated with differences in the likelihood of having an emergency department visits (estimate = −0.003; 95% CI: −0.011 to 0.004; $P < 0.351$) but was associated with more the likelihood of having an inpatient admission (estimate = 0.024; 95% CI: 0.018–0.031; $P < 0.001$).

Conclusion: Telehealth use among Medicare patients with type 2 diabetes in Louisiana stemming from the COVID-19 pandemic was associated with relatively improved glycemic control.

Key Words: diabetes, telehealth, Medicare, pandemic

(*Med Care* 2023;61: S77–S82)

Diabetes and its comorbidities are a major risk factor for COVID-19 diagnosis[1–4] and COVID-19-related death.[5–7] The pandemic also risks worsening diabetes outcomes through added stress and disruptions to routine care, diet, and physical activity.[8–10] At the same time, government officials encouraged the use of telehealth services during the pandemic to provide necessary patient care while minimizing transmission risk to health care personnel and patients.[11] The Centers for Medicare and Medicaid Services (CMS) broadened access to telehealth services, effective March 6, 2020,[12] spurring related reforms including pay parity with in-person care.[13] In Louisiana, the governor issued a proclamation to encourage telehealth use[14] as the Medicaid program expanded telehealth coverage and reimbursements and the State Board of Medical Examiners issued temporary permits to out-of-state professionals (http://www.lsbme.la.gov/licensure/index).

Previous clinical trials have supported the feasibility and effectiveness of telehealth in diabetes care.[15–17] The combination of telehealth with usual care has also been associated with improved glycemic control among patients with diabetes.[18–20] However, real-world evidence relating to the impact of telehealth in people with diabetes during the pandemic is limited. Recent studies have identified a large increase of telehealth use during the pandemic.[21–23] In Louisiana, while total weekly outpatient visits fell by roughly 23% between May 20, 2020 and June 16, 2020 (https://files.pelicanpolicy.org/wp-content/uploads/2021/04/Telehealth-Reforms-to-Expand-Access-FULL-1.pdf) telehealth visits accounted for about 16% of total outpatient care.[24] Given this marked increase in the share of telehealth use and its high

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Supported by a Patient-Centered Outcomes Research Institute (PCORI) cooperative agreement (NEN-1508-32257) as part of Natural Experiments for Translation in Diabetes 2.0 (NEXT-D2) and was conducted in partnership with Research Action for Health Network (REACHnet, funded by PCORI RI-CRN-2020-008). REACHnet is a partner in PCORnet, the National Patient-Centered Clinical Research Network, which was developed with funding from PCORI. The content of this report is solely the responsibility of the author(s) and does not necessarily represent the views of other organizations participating in, collaborating with, or funding REACHnet or PCORnet, or of PCORI.

The authors declare no conflict of interest.

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Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's website, www.lww-medicalcare.com.

ISSN: 0025-7079/23/6104-S77

TABLE 1. Baseline Characteristics for Final Sample Versus Initial Sample, by Pandemic Telehealth Status

	Telehealth			Nontelehealth		
Variables	**Final sample**	**Full sample**	**SMD (%)**	**Final sample**	**Full sample**	**SMD (%)**
Age <65	0.212	0.226	3.4	0.148	0.170	5.9
Age 65–74	0.451	0.441	−2.1	0.443	0.420	−4.7
Age 75–84	0.257	0.251	−1.3	0.304	0.298	−1.3
Age > 84	0.080	0.082	0.7	0.105	0.113	2.5
Female	0.589	0.587	−0.6	0.527	0.531	0.9
White non-Hispanic	0.524	0.533	1.7	0.550	0.550	−0.1
White Hispanic	0.023	0.021	−1.3	0.028	0.023	−3.2
Black non-Hispanic	0.425	0.412	−2.7	0.388	0.380	−1.7
Others	0.027	0.03	1.6	0.033	0.039	3.0
Cardiometabolic disease	0.990	0.960	−19.2	0.985	0.875	−44.3
Lung disease	0.318	0.304	−3.0	0.237	0.210	−6.5
Alzheimer	0.017	0.016	−0.7	0.018	0.017	−0.6
Depression	0.299	0.276	−5.2	0.196	0.149	−12.6
Cancer	0.128	0.130	0.6	0.099	0.092	−2.3
Chronic kidney disease	0.474	0.444	−6.0	0.423	0.352	−14.8
Arthritis	0.510	0.471	−7.9	0.372	0.290	−17.6
Osteoporosis	0.118	0.109	−3.1	0.091	0.065	−9.5
Outpatient visits per month	1.165	1.035	−10.6	0.539	0.350	−23.7
Have any ED visits	0.420	0.397	−4.7	0.338	0.307	−6.6
Have any inpatient visits	0.265	0.259	−1.2	0.228	0.219	−2.3
Have any telehealth services	0.025	0.022	−1.6	0.028	0.020	−5.3
No. A1c tests	3.824	3.641	−9.1	3.237	2.903	18.5
Mean A1c (%)	6.87	6.88	0.7	6.89	6.91	1.2
LDL (mg/dL)	88.63	88.60	−0.1	88.71	88.73	0.1
DBP (mm Hg)	72.85	72.97	1.5	73.17	73.13	−0.6
SBP (mm Hg)	133.03	133.38	2.8	133.47	134.89	10.1
BMI (kg/m^2)	32.54	32.35	−2.6	31.32	31.24	−1.2
Continuity of care index	0.147	0.162	9.3	0.204	0.226	9.8
N	10,988	14,262		20,666	39,631	

Variables are shares of the main population included in that group unless otherwise specified.
BMI indicates body mass index; DBP, diastolic blood pressure; ED, emergency department; LDL, low-density lipoprotein; SBP, systolic blood pressure; SMD, standardized mean difference.

prevalence of diabetes,[25,26] Louisiana presents a suitable setting to evaluate the efficacy of telehealth in diabetes care during a pandemic. Accordingly, this study focused on the impact of telehealth use during the COVID-19 pandemic on clinical outcomes and health care utilization among patients with type 2 diabetes mellitus.

METHODS

Data

The data used in this study were electronic medical records (EMRs) data from Research Action for Health Network (REACHnet).[27] The cohort was selected using the SUPREME-DM algorithm based on diagnosis codes, medications, and lab tests.[28] To obtain community characteristics, the EMR data were linked with 2019 American Community Survey (ACS) data at the patient residence zip code level.

Study Cohort

We included patients who had any encounters captured in the EMR in the 3-year study period (March 2018 through February 2021) with the postperiod defined as after CMS broadened access to telehealth services (March 6, 2020). Overall, 63,190 Medicare patients diagnosed with type 2 diabetes mellitus were assessed for study inclusion. Patients were excluded due to missing baseline characteristics (n = 22,239), outpatient visit outcomes which are required to evaluate differences between prepandemic and pandemic era values (n = 801), having a home zip code outside of Louisiana (n = 8496), or having an inpatient admission or emergency department (ED) visit in the COVID-19 era but before the first telehealth visit (1458). The resulting final sample of 30,196 encompassed 9530 patients with at least 1 pandemic era telehealth visit and 20,666 patients with none (Appendix Fig. A1, Supplemental Digital Content 1, http://links.lww.com/MLR/C458). A comparison of population baseline characteristics separated by initial and final research samples and reported by pandemic era telehealth status can be found in Table 1. Below, we also describe our approach to dealing with missing data.

Study Outcomes

We assessed hemoglobin A1c (HbA1c) levels, as well as the percent of patients with levels in control (defined as under 7%), during COVID-19 as our primary outcomes. Secondary outcomes included alternative measures of HbA1c (ie, under 8%, under 9%, and within patient declines in HbA1c of $\leq$0.5%, 0.3%, 0.2%, and 0.1%) and the probability of an inpatient or ED visit. Tertiary outcomes, reported in the Appendix (Supplemental Digital Content 1, http://links.lww.com/MLR/C458), included the percent of patients with physiological measures within normal ranges [ie, low-density

TABLE 2. TH and HbA1c

Variable/Statistic	Value	Share <9%	Share <8%	Share <7%
Mean post-A1c				
TH	−0.080***; −0.111 to −0.049; <0.001	0.010*; 0.003–0.018; 0.010	0.015**; 0.006–0.025; 0.002	0.013*; 0.002–0.024; 0.023
Mean	6.93	0.92	0.84	0.63
% Impact	−1.15	1.13	1.81	2.07
	Share ≥0.5%	Share ≥0.3%	Share ≥0.2%	Share ≥0.1%
Decline of HbA1c				
TH	0.013*; <0.001–0.025; 0.046	0.016*; 0.003–0.029; 0.014	0.021***; 0.009–0.033; 0.001	0.020***; 0.011–0.029; <0.001
Mean	0.19	0.27	0.33	0.40
% Impact	6.6	6.0	6.3	5.0

Regressions controlled for baseline characteristics and included facility fixed effects. SEs were clustered at the facility level. SEs were clustered at the facility level. Means are the pandemic-era sample outcome average value in the control group. % Impact refers to the estimated value divided by the mean multiplied by 100.

CI indicates confidence interval; HbA1c, hemoglobin A1c; TH, telehealth.

Estimates followed by 95% CI and *P*-value.

*$P < 0.05$.

**$P < 0.01$.

***$P < 0.001$.

lipoprotein (LDL), blood pressure (BP), body mass indices (BMIs)]. We also included Bice-Boxerman Continuity of Care (COC) indices which range from 0 (low continuity) to 1 (high continuity) and incorporate the number of unique providers and the number and distribution of primary care visits.[29]

Covariates

We included baseline individual level covariates such as race and ethnicity, age as of March 2020, chronic conditions at baseline, health care utilization, and several diabetes biomarkers. We also included controls for zip code-level community characteristics, such as internet use rate, computer use rate, and telephone ownership rate (Table 1).

Analytical and Statistical Approaches

Generally, we employed a quantitative doubly robust estimator approach to measure associations between telehealth use and diabetes control. To do this, we matched the telehealth cohort with the nontelehealth cohort according to baseline characteristics, generated propensity scores across the cohorts, and then conducted a weighted linear regression to implement the doubly robust estimator by controlling the same set of variables used in the matching step. The set of analyses compared patients with any telehealth visit during COVID-19 (since March 2020) to propensity score–weighted patients without telehealth visits. Included in our baseline characteristics were 3 indicator variables (ie, trajectory groups 1, 2, and 3) which group the sample according to similar trends in outpatient visits at baseline.

More precisely, we obtained a probability of using telehealth (ie, the propensity score) in the COVID-19 era for each observation using preperiod data (including membership in one of the aforementioned outpatient trajectory groups) by estimating a probit regression model. Weighting by odds was then used for group matching due to the large number of variables relative to the number of observations in the underlying dataset. Each telehealth beneficiary was assigned a weight of 1 and each nontelehealth user was assigned a weight of propensity score/(1−propensity score). To verify the comparability of the treatment and control groups on observables, we assessed the standardized mean differences (SMDs) on each preperiod variable. We deemed the groups appropriately balanced when the SMDs were each below 10%. In the final analysis step, we used linear regression to assess the impact of telehealth receipt on patient outcomes using the weights described above and controlling for all covariates listed in Table 1.

TABLE 3. Telehealth and Utilization Measures

Variable/ Statistic	Any ED	Any Inpatient Admission
TH	−0.003; −0.011 to 0.004; 0.351	0.024***; 0.018–0.031; <0.001
Mean	0.16	0.08
% Impact	−2.16	30.79

Baseline characteristics and facility fixed effect were controlled in regressions. SEs were clustered at facility level. Means are the pandemic-era sample outcome average value in the control group. % Impact refers to the estimated value divided by the mean multiplied by 100.

CI indicates confidence interval; ED, emergency department; TH, telehealth.

No. control = 20,663; no. treated = 9524. Estimates followed by 95% CI and *P*-value.

***$P < 0.001$.

Heterogeneity of Treatment Effects

We conducted a series of heterogenous association analyses for our primary outcomes. These were analogous to the primary analysis but included indicator variables for the group of interest and its interaction with the treatment variable. The comparisons were Black versus White, Hispanic versus White, and age 75 and older versus age 65–74.

Sensitivity Analyses

Among those using telehealth in the COVID-19 era, about half used it only once (Appendix Fig. A2, Supplemental Digital Content 1, http://links.lww.com/MLR/C458). Accordingly, we further considered a potential dose-response association where a treatment group that received at least 2 telehealth visits was compared with a control group with only 1 telehealth visit. We also compared those with 3 or more telehealth visits to those with only 1 telehealth visit.

To assess the potential role of missing data, we conducted a multiple imputation analysis using the chained equation approach for imputing missing baseline characteristics and missing pandemic-era outcomes (ie, primary outcomes of mean HbA1c and share of patients with HbA1c < 7%, and secondary outcomes of LDL, BMI, systolic BP, major adverse cardiac events, any ED, any inpatient admission, and COC index). We then estimated the impact of the regressors on their respective outcomes using each of the 10 respective imputed complete datasets and then combined these estimates to account for variability in the imputation procedure. The main results are, however, based on complete cases.

RESULTS

Primary Outcome Measures

Samples were balanced after weighting, with SMD weights being below 10% for each variable in all specifications (see Appendix Table A1 for an illustrative example, Supplemental Digital Content 1, http://links.lww.com/MLR/C458). Overall, telehealth was associated with lower pandemic era mean A1c values [estimate = −0.080%, 95% confidence interval (CI): −0.111% to −0.049%, impact relative to sample mean = −1.2%]. Pandemic era HbA1c was also more likely to be in control for those using telehealth (estimate = 0.013; 95% CI: 0.002–0.024; $P < 0.023$, impact relative to sample mean = 2.0%) (Table 2).

Secondary Outcome Analyses

Telehealth was associated with lower and declining HbA1c levels in the COVID-19 era compared with those not receiving it. The proportion of the population with mean COVID-19 era A1c shares below 8% or 9% or with declines in HbA1c levels of at least 0.5%, 0.3%, 0.2%, or 0.1% were all higher after telehealth receipt and these changes were statistically significant at the 95% confidence level (Table 2). The likelihood of having an ED visit were not statistically significantly different among telehealth-users (estimate = −0.003; 95% CI: −0.011 to 0.004; $P < 0.351$) while the likelihood of having an inpatient admission were relatively higher (estimate = 0.024; 95% CI: 0.018–0.031; $P < 0.001$) (Table 3).

Tertiary Outcome Analyses

Telehealth was also associated with lower LDL and BP levels, more instances of normal BMI, and lower COC indices during the COVID-19 era. Full details for these tertiary results can be found in the Appendix in Tables A2 through A6 (Supplemental Digital Content 1, http://links.lww.com/MLR/C458).

Heterogeneity of Treatment Effects

Hispanic patients who used telehealth in the COVID-19 period had relatively higher HbA1c levels (estimate = 0.125; 95% CI: 0.044–0.205; $P < 0.003$). Black patients (estimate = −0.009; 95% CI: −0.143 to 0.125; $P < 0.894$) and younger patients (estimate = −0.016; 95% CI: −0.103 to 0.071; $P < 0.717$) using telehealth were not associated with different HbA1c-related outcomes relative to their respective comparators (Table 4).

TABLE 4. Interaction Associations for Mean Post-HbA1c <7%

	Age 65–74 vs. Age > 74		Hispanic vs. White		Black vs. White	
Variable/statistic	**Value**	**HbA1c < 7%**	**Value**	**HbA1c < 7%**	**Value**	**HbA1c < 7%**
Group × TH	−0.016; −0.103 to 0.071; 0.717	0.006; −0.028 to 0.039; 0.729	0.125**; 0.044–0.205; 0.003	0.008; −0.123 to 0.139; 0.902	−0.009; −0.143 to 0.125; 0.894	−0.009; −0.037 to 0.019; 0.522
Group	0.005; −0.053 to 0.063; 0.863	< 0.001; −0.019 to 0.019; 0.996	0.064; −0.157 to 0.286; 0.564	−0.018; −0.126 to 0.090; 0.742	0.073; −0.041to 0.187; 0.206	−0.004; −0.017 to 0.009; 0.515
TH	−0.052; −0.105 to 0.002; 0.057	0.013; −0.007 to 0.034; 0.196	−0.070**; −0.118 to −0.023; 0.005	0.015; −0.004 to 0.033; 0.121	−0.078**; −0.128 to −0.028; 0.003	0.016; −0.002 to 0.034; 0.088
Mean	6.83	0.65	6.82	0.65	6.88	0.64
% Impact	−0.23	0.89	1.83	1.24	−0.13	−1.4
No. interaction = 0	14,703	14,703	12,641	12,641	17,532	17,532
No. interaction = 1	3958	3958	225	225	3203	3203

Baseline characteristics and facility fixed effects were controlled. SEs were clustered at the facility level. Means are the pandemic-era sample outcome average value in the control group. % Impact refers to the estimated value divided by the mean multiplied by 100.

CI indicates confidence interval; HbA1c, hemoglobin A1c; TH, telehealth.

Estimates followed by 95% CI and *P*-value.

*$P < 0.05$.

**$P < 0.01$.

***$P < 0.001$.

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TABLE 5. Sensitivity Analyses for Mean Post-HbA1c

	Any TH		2+ vs. 1 Visit		3+ vs. 1 Visit	
Variable/statistic	**Value**	**HbA1c < 7%**	**Value**	**HbA1c < 7%**	**Value**	**HbA1c < 7%**
Estimate	−0.080***; −0.111 to −0.049; <0.001	0.013*; 0.002 to 0.024; 0.023	−0.100**; −0.167 to −0.032; 0.004	0.013; −0.003 to 0.029; 0.102	−0.133***; −0.209 to −0.058; <0.001	0.011; −0.011 to 0.033; 0.330
Mean	6.93	0.63	6.89	0.64	6.89	0.64
% Impact	−1.15	2.07	−1.45	2.1	−1.93	1.69
No. control	20,666	20,666	4017	4017	4013	4013
No. treatment	9530	9530	3741	3741	2000	2000

Baseline characteristics and facility fixed effects were controlled. SEs were clustered at the facility level. % Impact refers to the estimated value divided by the mean multiplied by 100.

CI indicates confidence interval; HbA1c, hemoglobin A1c; TH, telehealth.

Estimates followed by 95% CI and *P*-value.

*$P < 0.05$.

**$P < 0.01$.

***$P < 0.001$.

Sensitivity Analyses

Patients with multiple telehealth visits compared with those with just 1 telehealth visit were associated with relatively lower HbA1c levels as well (estimate comparing 2+ to 1 visit = −0.100; 95% CI: −0.167 to −0.032; $P < 0.004$; estimate comparing 3+ to 1 visit = −0.133; 95% CI: −0.209 to −0.058; $P < 0.001$) (Table 5).

Multiple Imputation Analyses

For both of our primary outcome measures of HbA1c and share of HbA1c <7%, the estimates generated under multiple imputation were of the same signs and retained statistical significance as those used in the final study sample. For our representative tertiary outcomes measures, all estimates generated under multiple imputation similarly retained the same signs of those used in the final study sample save for ED visits which flipped signs from −0.003 to 0.004 (though, neither estimate was statistically significant). Two estimates (ie, systolic BP and major adverse cardiac events), however, newly gained statistical significance (Appendix Table A7, Supplemental Digital Content 1, http://links.lww.com/MLR/C458).

DISCUSSION

Among patients using telehealth in the COVID-19 pandemic era, about half used telehealth only once. After balancing on baseline covariates, telehealth was found to be associated with generally better patient outcomes (eg, better HbA1c control, lower LDL and BP levels, and more instances of normal BMI). A recent meta-analysis of telehealth randomized controlled trials in type 2 diabetes (T2D) concluded that telehealth is associated with similar improvements across various clinical outcomes (eg, HbA1c, BMI, body weight, and BP). The authors postulated that these results may have been mediated by improving self-management behavior and supporting provider engagement through things like real-time sharing of HbA1c results.[30] It is possible that these mechanisms are in effect in a real-world setting such as ours in this study.

While modest, our statistically significant HbA1c primary outcomes results may still be clinically meaningful. One paper assessing how clinicians interpret HbA1c readings found that the 7% cutoff was considered clinically meaningful by about a fifth of respondents and that a sustained level between 7% and 7.5% would prompt 87% of clinician respondents to consider changing therapy. This suggests that our modest finding of increasing the share of patients with HbA1c under control by about 2% may still be viewed as clinically meaningful by some clinicians. The study further found that for patients at the 9.0% HbA1c level, a 0.1 percentage point increase following a treatment adjustment would be sufficient to conclude that glucose regulation had worsened by about half of nurses and about 13% of doctors.[31] This small increase is comparable in magnitude to our measured difference of 0.08 percentage points.

The lower COC index result is, in part, mechanically driven as adding in a new telehealth provider to the patient's care team will directly increase the COC index. The higher inpatient admissions result is potentially inconsistent with the rest of these generally clinically positive results. However, it is also possible that this result is a blend of heterogenous effects. For instance, some patients may be identified through telehealth as needing to be admitted for inpatient care (ie, a clinically desirable outcome which could then result in earlier intervention, stabilization, and ultimately improved patient outcomes). Other patients may be less well monitored through telehealth necessitating avoidable inpatient care (ie, a clinically undesirable outcome). Given the generally improved set of clinical measures, it is plausible that the former is dominating the mix of effects. However, more research into this area is needed.

There were heterogenous associations by ethnicity, suggesting that there may be ethnicity-associated barriers to fully realizing improved outcomes through telehealth. One study interviewed Hispanic and Black patients who had declined participation, withdrew, or were nonadherent to a T2D home telemonitoring study protocol cited themes of disinterest and perceived inconvenience and lack of benefit.[32] There may be additional barriers for Hispanic populations such as language and discrimination that undermine the benefits of telehealth in T2D care. This is also an area ripe for further investigation.

Limitations

This analysis is not without limitations, chief among them being that telehealth visits were not randomly assigned and thus unobserved heterogeneity between treated and control groups may bias our estimates. The sample was comprised of patients in Louisiana and may not extend beyond the state where social and

institutional factors may meaningfully differ. HbA1c testing was limited due to the pandemic, which may introduce potential bias. For instance, the telehealth treatment group had an additional half test at baseline compared with 3 on average, which may bias results if the pandemic induced worse HbA1c levels generally and telehealth facilitated more testing and reporting. Finally, our analysis did not account for when the telehealth visit occurred during the postpolicy change window. For instance, a patient with a telehealth visit near the end of the observation window was counted as treated just as a patient with a telehealth visit near the beginning of the COVID-19 era observation window. This may introduce attenuation bias as some telehealth use in the treated group would have had less time to affect the measured outcomes.

Overall, our findings suggest that telehealth use in the COVID-19 era was not associated with worsening treatment or outcomes for diabetes and may be generally associated with mostly improved outcomes.

ACKNOWLEDGMENTS

The LEAD Study acknowledge the contributions of our partners. The success of this study depended on their ongoing support and expertise. These partners include Ochsner Health and the Ochsner Patient Research Advisory Board; Tulane Medical Center; University Medical Center New Orleans; Louisiana Public Health Institute, the REACHnet Coordinating Center, and their multistakeholder Diabetes Advisory Groups; Pennington Biomedical Research Center; Access Health Louisiana; EXCELth Inc.; Blue Cross and Blue Shield of Louisiana; and our patient partners Patricia Dominick and Cathy Glover. Accepted for a poster presentation within the poster session "Poster Session: Clinical Care Settings: Patient-level Interventions" at the Virtual D&I Conference, December 14-16, 2021.

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