

Original Paper

Hemoglobin A_{1c} and Weight Changes Associated With Grocery Delivery and Low-Carbohydrate Education in Adults With Type 2 Diabetes and Food Insecurity: Observational Quality Improvement Cohort Study

Marika Waselewski^{1*}, MPH; Eric Waselewski^{1,2*}, MD; Lauren Oshman³, MPH, MD; Kaitlyn Hatch⁴, BS; Tammy Chang³, MD, MPH, MS

¹Department of Family Medicine, University of Michigan, Ann Arbor, MI, United States

²Department of Internal Medicine, University of Michigan, Ann Arbor, MI, United States

³Department of Family Medicine, Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor, MI, United States

⁴Department of Clinical Quality, Michigan Medicine, Ann Arbor, MI, United States

*these authors contributed equally

Corresponding Author:

Marika Waselewski, MPH
Department of Family Medicine
University of Michigan
2800 Plymouth Rd Building 14-G128
Ann Arbor, MI 48109
United States
Phone: 1 7349987124
Email: marikag@med.umich.edu

Abstract

Background: Type 2 diabetes mellitus (T2D) is one of the most significant chronic health challenges in Michigan, especially for individuals with food insecurity. Improving nutrition, including lowering carbohydrate intake, is foundational to T2D prevention and management. Grocery delivery paired with low-carbohydrate education has the potential to reduce logistical barriers to dietary change but is not well understood in individuals with food insecurity.

Objective: The objective of our study was to evaluate changes in clinical metrics of hemoglobin A_{1c} (HbA_{1c}), weight, and diabetes medication use after a paired grocery delivery and low-carbohydrate education program.

Methods: The Healthy Eating Jumpstart Program (hereafter, Jumpstart) enrolled adult Michiganders with T2D and low income or food insecurity from 21 Michigan primary care practices between October 2022 and May 2023. Jumpstart was a 3-month, nonrandomized grocery delivery and low-carbohydrate education quality improvement program without a control group. Participants received US \$80 every month through Shipt to purchase eligible healthy foods, along with low-carbohydrate educational materials. Clinical metrics of HbA_{1c}, weight, and diabetes medication use were collected from medical records from 6 months before enrollment through 12 months after enrollment. Changes in HbA_{1c} and weight from baseline were evaluated at 3, 6, 9, and 12 months, with stratification by baseline glycemic control and glucagon-like peptide-1 receptor agonist (GLP-1 RA) medication use, respectively. Overall change was assessed with paired *t* tests comparing baseline values to each participant's latest value for HbA_{1c} and weight. Medication changes were assessed by comparing baseline and 12-month dosing to categorize changes as increased, decreased, eliminated, or unchanged.

Results: A total of 83 patients participated in Jumpstart. Participants were primarily female (57/79, 72%), White (70/79, 89%), and had a high school degree or less (35/79, 44%). At baseline, the average HbA_{1c} was 7.6% (SD 2%), average weight was 105 (SD 25.8) kg, and average BMI was 38.2 (SD 8.8) kg/m². The overall reduction in HbA_{1c} from baseline was 0.4% (SD 1.4%; *P*=.02; *n*=68), and this reduction was greater when limited to individuals with uncontrolled HbA_{1c} at baseline (mean 0.7%, SD 1.8; *P*=.02; *n*=38). The overall percent reduction in weight from baseline was 1.7% (SD 4.4%; *P*=.002; *n*=66), but this change was not significant when limited to non-GLP-1 RA users. Most medications had no change in dosing (77/166, 46%), and slightly more medications were increased or added (*n*=52, 31%) than decreased or discontinued (*n*=37, 22%).

Conclusions: The results from this clinical evaluation suggest that the Jumpstart quality improvement program was associated with improvements in HbA_{1c} that persisted beyond 6 months and small reductions in weight among participants. A low-burden program such as Jumpstart may be a feasible approach to support long-term dietary change in patients with T2D and food insecurity or low income.

JMIR Form Res 2026;10:e89459; doi: [10.2196/89459](https://doi.org/10.2196/89459)

Keywords: type 2 diabetes; hemoglobin A_{1c}; HbA_{1c}; food insecurity; food is medicine; grocery delivery; low-carbohydrate diet; education

Introduction

Type 2 diabetes mellitus (T2D) remains one of the most significant chronic health challenges in the United States, with more than 26 million (8%) US adults having a T2D diagnosis [1]. In Michigan, rates of T2D are slightly higher, with 12% of adults having a diabetes diagnosis and an additional 35% estimated to have prediabetes [2]. T2D disproportionately impacts individuals with low income, who experience both a high prevalence of the disease and increased rates of diabetes-related morbidity, mortality, and health care costs. In particular, food insecurity and low income are closely linked to suboptimal diet quality, an elevated risk of developing T2D, poorer diabetes management and glycemic control, increased rates of complications, and higher health care use [3].

Improving nutrition is foundational to T2D prevention and management. Low-carbohydrate dietary patterns (LCDs) are specifically noted by the American Diabetes Association (ADA) Consensus Report on Nutrition Therapy for their effects in improving glycemic control, promoting weight loss, and optimizing lipid profiles [4]. Healthier diets may also reduce reliance on antihyperglycemic medications and, in some cases, support diabetes remission [4-6]. A variety of programs aim to improve food security and diet quality, including food-is-medicine programs (medically tailored meals, food pantries, and produce prescriptions), diabetes self-management education, and participation in the federally funded Supplemental Nutrition Assistance Program (SNAP) and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) [3]. However, such programs often do not address the logistical challenges of obtaining healthy food or the gaps in nutritional knowledge faced by individuals with T2D and low income.

The rise of online grocery purchasing and delivery services presents an opportunity to address these logistical barriers [7,8]. Grocery delivery services have the potential to save time, promote planned purchasing, and eliminate transportation barriers; however, these services are often not used by individuals with low income [9]. In the growing food-is-medicine landscape [10-13], implementing and evaluating the clinical impact of programs with pragmatic designs is important for supporting sustainable and scalable solutions. Healthy Eating Jumpstart is a food-is-medicine program designed to jumpstart dietary change through short-term access to healthy food via grocery delivery paired with patient-directed diabetes education. We aimed to evaluate changes in clinical metrics of glycemic control, weight, and

diabetes medication use after participation in the Healthy Eating Jumpstart quality improvement program among Michiganders with T2D and low income or food insecurity. We hypothesized that improving healthy food access through grocery delivery, combined with practical low-carbohydrate education, could reduce barriers to making dietary changes and support glycemic control and weight outcomes among adults with T2D experiencing food insecurity.

Methods

Program Overview

The Healthy Eating Jumpstart Program (hereafter, Jumpstart) was developed as a quality improvement initiative to address food access barriers among individuals with T2D and low income or food insecurity, recognizing that limited access to affordable, healthy foods may hinder implementation of recommended dietary changes. The program enrolled individuals with T2D and low income or food insecurity in a 3-month, nonrandomized grocery delivery and educational quality improvement program without a control group. Enrollment occurred between October 2022 and May 2023. The sample size was determined based on participant flow, budgetary constraints, and guidelines for feasibility pilot studies. Details of the program protocol are published elsewhere [14,15].

As a quality improvement evaluation, the program was assessed using a pragmatic pre-post design to evaluate changes in clinical outcomes. The evaluation is focused on within-participant changes rather than estimating causal effects. This manuscript follows the SQUIRE 2.0 (Standards for Quality Improvement Reporting Excellence) checklist [16] and is limited to the clinical metrics noted in the original protocol; other program measures will be published separately.

Ethical Considerations

This program was developed for quality improvement purposes and was designated as not regulated by the University of Michigan Medical School Institutional Review Board (HUM00217985). After receiving an explanation of the program details, participants were asked to verbally confirm their interest in the program during enrollment and were prompted to sign a medical record release to allow access to their clinical data. Study IDs were assigned to participants to deidentify data for analysis. All data were collected and stored via secure university-approved iterations of Qualtrics (Qualtrics Inc) or REDCap (Vanderbilt University), phone

calls, and printed surveys and were stored in the protected health information-compliant Michigan Medicine SharePoint [14]. Participants did not receive compensation for participating in the program beyond food credits (US \$240 over 3 months) and a free 1-year Shipt membership.

Program Setting

Participants were recruited from 21 primary care practices engaged in the Michigan Collaborative for Type 2 Diabetes (MCT2D), a statewide collaborative quality initiative focused on improving care for T2D [15]. The existing infrastructure of primary care teams, including case managers, social workers, and other team members at each participating practice, identified and recruited patients meeting inclusion criteria. The physician or advanced practice provider responsible for the patient's care attested that the patient was safe to enroll in a low-carbohydrate dietary program.

Participants

Individuals were eligible to enroll if they met the following criteria: age ≥ 18 years, a diagnosis of T2D, residence within a Shipt delivery zone, and at least one of the following indicators of low income—Medicaid insurance status, a positive screen for food insecurity, or self-reported household income $< 150\%$ of the federal poverty level, based on household income and the number of people in the household. Diagnosis of type 1 diabetes, active pregnancy or breastfeeding, or use of a sodium-glucose cotransporter-2 inhibitor were reasons for exclusion.

Intervention

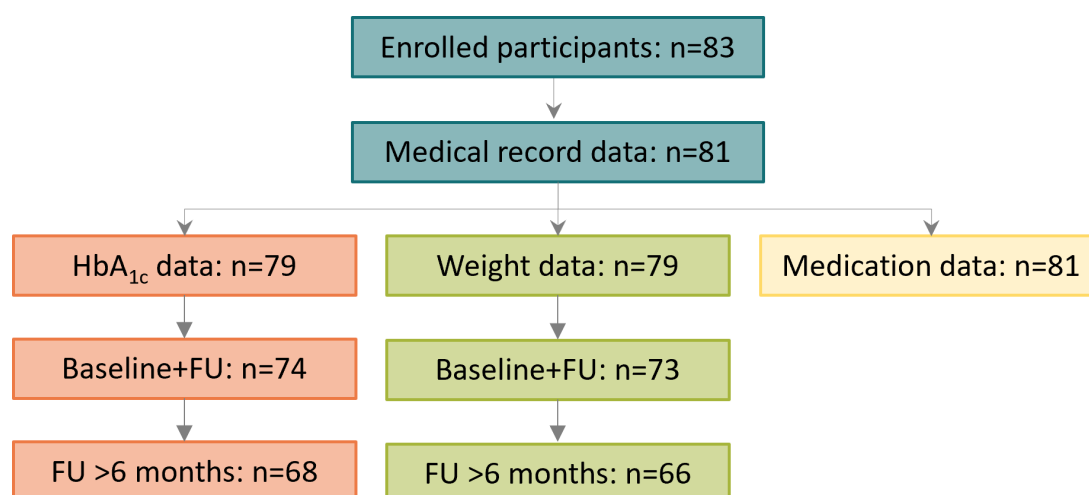
Grocery delivery was selected for this intervention because transportation limitations, competing priorities, and

affordability barriers may restrict access to healthy foods among individuals experiencing food insecurity. Participants received a 3-month Healthy Choice Allowance (US \$80 per month) through the grocery delivery service Shipt to purchase healthy foods and have them delivered to their homes. Healthy Choice Allowance-eligible foods included fruits, vegetables, proteins, canned goods, and dairy and excluded items such as ice cream, pop, and candy. Participants also received low-carbohydrate educational materials during the program, including a comprehensive packet on nutrition skills, the basics of low-carbohydrate meal planning, and grocery shopping recommendations, as well as weekly e-newsletters highlighting recipes, nutrition information, and seasonal tips. All materials are publicly available online [14].

Data Collection

Participants' clinical data were abstracted from medical records at the primary care practice from 6 months prior to enrollment through 12 months after enrollment. Hemoglobin A_{1c} (HbA_{1c}), weight, and glucose-lowering medications were reviewed and abstracted into a REDCap database for analysis. Because this program was implemented as a quality improvement initiative within routine primary care, participants were not expected to collect additional HbA_{1c} or weight measurements beyond routine care. Therefore, the data available and timing of measurements varied between individuals. Across all metrics, participants were excluded from the analysis if a baseline measurement was not available (Figure 1). All participants were eligible for data collection, and none requested to be unenrolled from the program during the evaluation period.

Figure 1. Flow diagram of participant medical record data availability. FU: follow-up; HbA_{1c}: hemoglobin A_{1c}.



Data Analysis

Data management and preparation, including summary statistics, were conducted using Microsoft Excel for Microsoft 365 MSO (version 2606; Microsoft Corp). Statistical analyses were performed using SAS (version 9.4; SAS Institute Inc).

Analyses were designed to evaluate changes associated with participation in Jumpstart. As a nonrandomized quality improvement initiative without a comparison group, analyses focused on within-participant changes between baseline and follow-up. Findings are interpreted as associations rather than causal effects solely attributable to the intervention.

Glycemic Control

Participant glycemic control was evaluated using HbA_{1c} measurements. HbA_{1c} data were only included in the analysis if the participant had a baseline HbA_{1c} as well as 1 additional measurement after enrollment (N=74). Participants were categorized as having controlled diabetes at baseline if their HbA_{1c} was <7% and uncontrolled diabetes if their HbA_{1c} was ≥7%. Glycemic control cutoffs were updated from 8% in the original protocol design to 7% to align with clinical metrics recommended by the ADA [17].

To evaluate changes in HbA_{1c}, individual participant data were assigned to time points based on their enrollment date. Baseline HbA_{1c} was the closest data point to their enrollment date within 21 days after enrollment. Values for 3, 6, 9, and 12 months were selected as the latest laboratory value within each time frame. Longitudinal change in HbA_{1c} was calculated as the absolute percentage-point difference between each time point and baseline at 3, 6, 9, and 12 months. Change in HbA_{1c} was averaged for each time point across the cohort. These results were then stratified by baseline HbA_{1c} control status as an exploratory analysis because participants with HbA_{1c} ≥7% have greater potential for glycemic improvement.

An overall change in HbA_{1c} was also assessed. Each participant's change in HbA_{1c} was calculated using their latest HbA_{1c} value, at or after 6 months, minus their baseline value. This approach was selected to reflect the pragmatic nature of the program evaluation, in which follow-up measurements were obtained through routine clinical care rather than at prespecified research visits. Statistical significance was then assessed using a paired *t* test ($\alpha=.05$, 2-tailed). This test was repeated with stratification by baseline HbA_{1c} control status. A negative value for change in HbA_{1c} indicates a reduction in HbA_{1c}. Normality of the difference scores was assessed using descriptive indices. Although data demonstrated some deviation from normality (skewness=-1.6; kurtosis=4.1), paired *t* tests were used due to their general robustness to moderate departures from normality given our sample size (N=68). Nonparametric methods (Wilcoxon signed-rank tests) were additionally conducted as sensitivity analyses.

Weight and BMI

Participant weight and BMI were evaluated using height and weight measurements. Weight data were only included in the analysis if the participant had a baseline weight as well as 1 additional measurement after enrollment (n=73).

To evaluate changes in weight, individual participant data were assigned to time points based on their enrollment date. Baseline weight was the closest data point to their enrollment date within 21 days after enrollment. Values for 3, 6, 9, and 12 months were selected as the latest value within each time frame. Longitudinal change in weight was calculated as the percent change at 3, 6, 9, and 12 months, using the time

point value minus the baseline value, divided by the baseline value. Percent change in weight was averaged for each time point across the cohort. These results were then stratified by glucagon-like peptide-1 receptor agonist (GLP-1 RA) status as an exploratory analysis due to their highly effective use for weight management. Participants were considered to be on a GLP-1 RA if they had any GLP-1 RA use documented during the 12-month program follow-up.

An overall percent change in weight was also assessed. Each participant's percent change in weight was calculated using their latest weight value, at or after 6 months, as the latest value minus their baseline value, divided by baseline value. As with HbA_{1c}, follow-up measurements reflected routine clinical care and therefore were not collected at uniform research-defined time points. Statistical significance was then assessed using a paired *t* test ($\alpha=.05$, 2-tailed). This test was repeated with stratification by GLP-1 RA use. The percentage difference scores were approximately normally distributed (skewness=-0.2; kurtosis=0.6) for the full dataset. Consequently, paired *t* tests were used for the primary analyses, with nonparametric methods (Wilcoxon signed-rank tests) conducted as sensitivity analyses.

Medication Use

Medications were categorized as active or inactive at baseline and consolidated into their medication classes. For example, basal and bolus insulin were consolidated into a category of insulin therapy, with total daily units calculated. Medication dosing at 12 months was compared to baseline, and the changes were categorized as increased, decreased, eliminated, or unchanged [18]. The addition of a new medication was considered an increased dose. Changes within the GLP-1 RA class were assessed using dose equivalencies between medications [19]. Participants whose medical records included no specified medication use were assumed to be taking no glucose-lowering medications. The percentage of medications with increased, decreased, eliminated, or unchanged dose over the evaluation period was then assessed across the cohort and by medication category.

Results

Overview

We enrolled a total of 83 participants between October 2022 and May 2023, with the program concluding at the end of July 2023. Participants primarily identified as female, White, and having a high school degree or less. At baseline, the mean HbA_{1c} was 7.6% (SD 2%), and the average weight was 105 (SD 25.8) kg. Participants primarily had a BMI ≥30.0 kg/m², with a mean BMI of 38.2 (SD 8.8) kg/m². Demographic characteristics of participants are reported in Table 1. All participants successfully placed at least 1 grocery order during the program and received mailed educational materials at their home.

Table 1. Demographic and clinical characteristics of program participants (N=83)^a.

Characteristics	Participants ^b
Age (years) (n=81), mean (SD) ^a	56.8 (13.5)
Gender identity (n=79), n (%)	
Female	57 (72)
Male	22 (28)
Race (n=79), n (%)	
Black	4 (5)
Mixed race	1 (1)
Native American	1 (1)
Other	2 (3)
White	70 (89)
Hispanic (n=77), n (%)	
Yes	3 (4)
No	74 (96)
Education level (n=79), n (%)	
High school graduate or less	35 (44)
Some college or technical school	25 (32)
Associate's or technical degree	8 (10)
Bachelor's degree or higher	11 (14)
Food insecurity, n (%)	
Yes	67 (81)
No	16 (19)
Baseline HbA _{1c} (%) (n=79), mean (SD)	7.6 (2)
Baseline HbA _{1c} control (n=79), n (%)	
Yes (<7%)	37 (47)
No (≥7%)	42 (53)
Baseline weight (kg; n=79), mean (SD)	105 (25.8)
Baseline BMI (kg/m ² ; n=79), mean (SD)	38.2 (8.8)
Baseline BMI category (n=79), n (%)	
Healthy weight (BMI 18.0-24.9 kg/m ²)	3 (4)
Overweight (BMI 25.0-29.9 kg/m ²)	15 (19)
Obese (BMI ≥30.0 kg/m ²)	61 (77)
Baseline number of glucose-lowering medications (n=81), mean (SD)	1.8 (1.2)

^aNot all data were available for all participants; where data were missing, appropriate sample size is specified.

^bValues are presented as mean (SD) for continuous variables and n (%) for categorical variables.

Medical records were obtained for 81 (98%) of the 83 participants (Figure 1), including data from 1228 clinical encounters (excluding emergency medicine visits), 205 diabetes medications, 278 HbA_{1c} measurements, and 590 weight measurements. Encounter data included social work, care management, nutrition group classes, dietitian visits, diabetes education, podiatry, endocrinology, and primary care, among others.

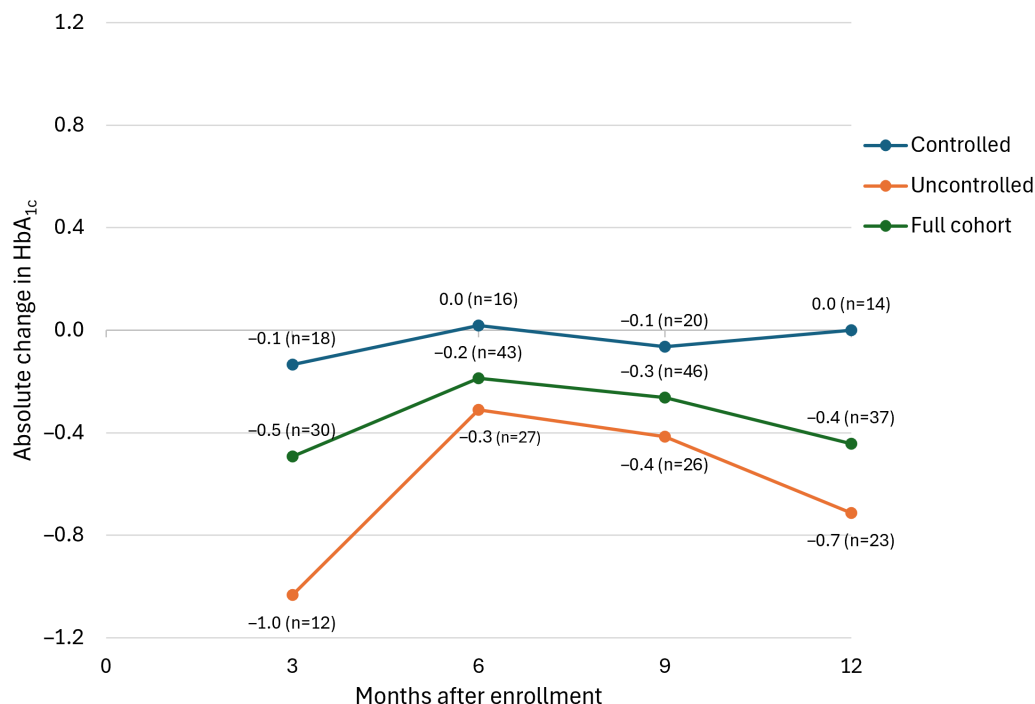
Glycemic Control

HbA_{1c} follow-up data were available for 74 program participants; 55% (n=41) were categorized as having uncontrolled diabetes at baseline (HbA_{1c} ≥7%), and the mean HbA_{1c} was 7.7% (SD 2%) at baseline for this subset. At the end of follow-up, 54% (37/68) of individuals were categorized as having uncontrolled diabetes. Figure 2 (Multimedia Appendix 1) shows the average change in HbA_{1c} over time

for the full cohort at each time point, as well as changes stratified by baseline HbA_{1c} control status.

The average overall reduction in HbA_{1c} from baseline was 0.4% (SD 1.4%; mean 7.7%, SD 2% to mean 7.3%, SD 1.6%; $t_{67}=-2.4$; $P=.02$; $d=-0.3$; $n=68$). The mean interval from baseline to the latest HbA_{1c} measurement was 271 (SD 58, range 164-357) days. Individuals who were categorized as uncontrolled at baseline (n=38) had an average HbA_{1c} reduction of 0.7% (SD 1.8%; mean 8.9%, SD 1.9% to mean 8.2%, SD 1.5%; $t_{37}=-2.4$; $P=.02$; $d=-0.4$). Individuals categorized as controlled at baseline (n=30) had a limited HbA_{1c} reduction of 0.1% (SD 0.8%; mean 6.2%, SD 0.5% to mean 6.1%, SD 0.9%; $t_{29}=-0.7$; $P=.51$; $d=-0.1$). These results were similar in sensitivity analyses with nonparametric testing (signed-rank P values of .02, .04, and .20, respectively).

Figure 2. Change in hemoglobin A_{1c} (HbA_{1c}) from baseline at 3, 6, 9, and 12 months for the full cohort and stratified by baseline glycemic control (HbA_{1c} <7%). Values are plotted as the absolute change from baseline, averaged across the cohort. N values at each time point indicate the number of participants with available data. No statistical comparisons were conducted.

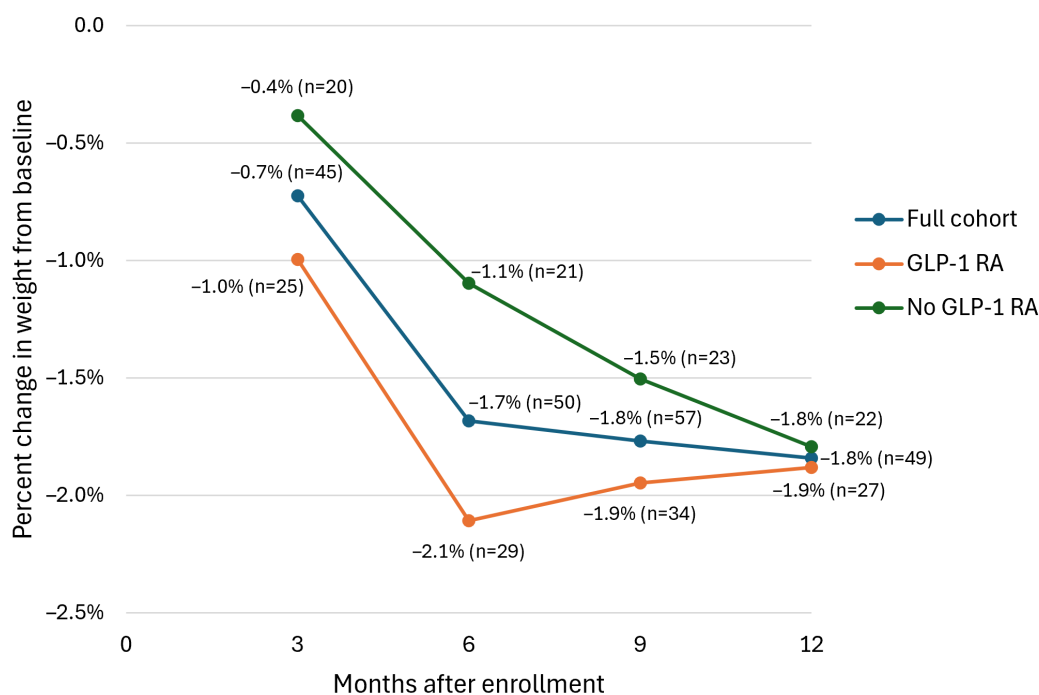


Weight and BMI

Weight follow-up data were available for 73 program participants; 78% (n=57) had a BMI ≥ 30.0 kg/m² (defined as obesity) at baseline, and 60% (n=44) were prescribed a

GLP-1 RA medication at some point during the evaluation period. Figure 3 (Multimedia Appendix 2) shows the change in weight over time for the full cohort, as well as changes stratified by GLP-1 RA use.

Figure 3. Percent change in weight from baseline at 3, 6, 9, and 12 months for the full cohort and stratified by glucagon-like peptide-1 receptor agonist (GLP-1 RA) use during the program. Values are plotted as the percent change from baseline, averaged across the cohort. N values at each time point indicate the number of participants with available data. No statistical comparisons were conducted.

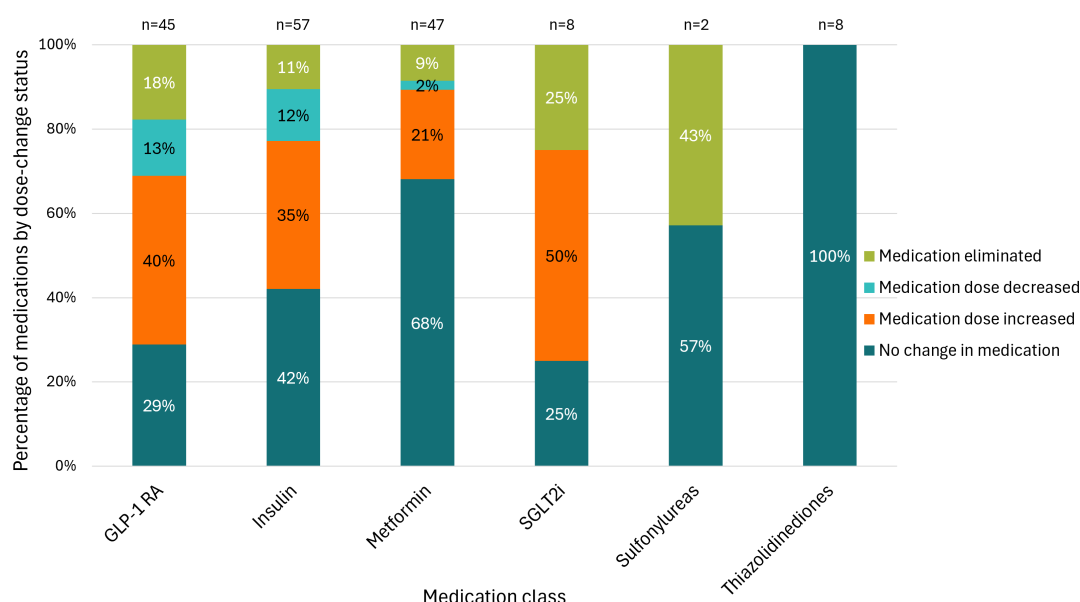


The overall reduction in weight from baseline was 1.7 (SD 4.3, range -11.6 to 6) kg, which corresponded to a 1.7% (SD 4.4%) reduction (mean 105, SD 24.6 kg to mean 103.3, SD 24.8 kg; $t_{65}=-3.2$; $P=.002$; $d=-0.4$; $n=66$). The mean interval from baseline to the latest weight measurement was 301 (SD 49, range 177-363) days. Individuals who had no GLP-1 RA use during the evaluation period had no detectable weight reduction during the evaluation, with a 1.1% (SD 4.4%) reduction (mean 99, SD 23.7 kg to mean 97.9, SD 23.5 kg; $t_{28}=-1.3$; $P=.19$; $d=-0.2$; $n=29$), while those with GLP-1 RA use experienced statistically significant weight loss of 2.2% (SD 4.3%; mean 109.7, SD 24.6 kg to mean 107.5, SD 25.3 kg; $t_{36}=-2.2$; $P=.004$; $d=-0.5$; $n=37$). These results were similar in sensitivity analyses with nonparametric testing (signed-rank P values of .005, .28, and .004, respectively).

Medication Use

At program enrollment, 72 (89%) of the 81 participants with medical record data were taking ≥ 1 glucose-lowering medication. At the end of the follow-up, 71 (88%) participants were taking glucose-lowering medications. Across the 74 participants who took 1 or more glucose-lowering medications during the program period, no change in dosing was most frequently observed (77/166, 46%), and slightly more medications were increased or added ($n=52$, 31%) than decreased or discontinued ($n=37$, 22%). Separating medication use by class, Figure 4 shows medication numbers and modifications during the evaluation period across these 74 patients (Multimedia Appendix 3).

Figure 4. Medication use and dose modifications by medication class. Stacked bars represent the total number of users per class, with segments indicating dose changes from baseline to 12 months after enrollment. Totals are shown above each bar. No statistical comparisons were conducted. GLP-1 RA: glucagon-like peptide-1 receptor agonist; SGLT2i: sodium-glucose cotransporter 2 inhibitor.



Discussion

Principal Findings

Overall, several evaluated clinical metrics improved over the course of the program in line with our hypothesis. These changes were observed through up to 9 months of follow-up after the intervention period. The most significant clinical improvement was observed in glycemic control, with a small but statistically significant reduction in weight, and medications largely remained unchanged. These data suggest that the Jumpstart program supported participants in improving health outcomes through the provision of healthy foods and low-carbohydrate education.

The HbA_{1c} reduction of 0.4% at 6 to 12 months observed in our program is comparable to prior clinical trial data on LCDs, which reported reductions ranging from 0.09% to 0.61% at 3 to 6 months compared to controls [20,21].

However, prior meta-analyses indicate that these improvements are not sustained at 12 and 24 months [20,21], with HbA_{1c} values often returning toward baseline. In contrast, we did not observe evidence of an HbA_{1c} rebound after 6 months among participants with available data. The worsening of glycemic control in historical studies may partly reflect the highly restrictive clinical trial environment, resulting in low adherence to the intervention in the longer term [21-23]. The pragmatic design of the Jumpstart quality improvement program, emphasizing education to guide a shift toward a lower-carbohydrate dietary pattern rather than immediate adoption of a strict very low-carbohydrate diet, may have contributed to the absence of an observed HbA_{1c} rebound in our population. Participants with uncontrolled baseline HbA_{1c} had a larger observed reduction of 0.67%, suggesting that patients with higher baseline HbA_{1c} may experience greater improvement.

The change in weight after the Jumpstart program is less clear. Although a significant but small reduction in weight was noted across the full cohort, this result was attenuated when participants were stratified by GLP-1 RA use. This could indicate that GLP-1 RA use is a major contributor to weight loss rather than dietary changes. However, this stratification does not account for the duration of GLP-1 RA use, and individuals in the GLP-1 RA group could have been on the medication for more than 12 months (weight loss may have plateaued [24]) or may have taken only 2 doses during the evaluation period (which may not have been long enough to reach a therapeutic dose and influence weight [25]). Prior research has also noted suboptimal dietary intake among individuals taking GLP-1 RAs, suggesting that dietary interventions such as Jumpstart may complement pharmacotherapy and support healthier long-term eating patterns [26-28]. These findings do not rule out weight loss as a possible benefit of this program, but a more rigorous evaluation with a larger cohort would provide more information to isolate medication effects from dietary effects.

Beyond clinical impact, this program has several important strengths to note. The Healthy Eating Jumpstart provides insights into the impact and implementation of a pragmatic intervention in a high-risk population with low income and/or food insecurity that is often underrepresented in dietary intervention research. This program, administered through provider referrals at primary care clinics across the state of Michigan, suggests a feasible model for scaling combined food-is-medicine programs (food delivery+behavioral education) in the clinical setting. Successful implementation of food-is-medicine initiatives in the clinical setting is limited [12], despite the growing movement toward implementation. Pragmatic programs such as Jumpstart are needed. Health systems and community programs could consider evaluating similar dual-component interventions as a strategy to support clinical outcomes in highly vulnerable populations with diet-sensitive conditions. Additionally, this program was designed to be very low burden for patients, who simply receive access to food and educational content in their homes, without the need for additional clinic visits or counseling sessions.

Limitations

The limitations of this program and its analysis are largely related to the observational design, limited sample size, and a lack of a control group in the cohort-based implementation.

Funding

Support for Healthy Behavior Optimization for Michigan and the Michigan Collaborative for Type 2 Diabetes is provided by Blue Cross Blue Shield of Michigan (BCBSM) as part of the BCBSM Value Partnerships program. The funders had no role in the study design, data collection, analyses, interpretation of findings, or the decision to submit the manuscript for publication.

Data Availability

The datasets generated or analyzed during this study are available from the corresponding author upon request.

Authors' Contributions

Conceptualization: MW, LO, TC

Data curation: MW, EW

Formal analysis: MW, KH

Because of these limitations, causal inference and generalizability are limited, and we were unable to more rigorously assess and control for medication changes or time-varying factors in our analyses. No adjustment was made for multiple testing, and findings with statistical significance should also be interpreted cautiously given the potential for type I error. The timing of the follow-up data points varied across participants because data were collected during routine clinical care. Consequently, the paired analyses are heterogeneous and reflect change from baseline to each participant's latest available measurement rather than change at a standardized follow-up interval.

Clinic-specific variation in staffing, referral processes, and patient support may also influence program engagement and participant characteristics. Detailed food purchasing data and dietary intake were not captured in this manuscript, which limits a more direct connection between these factors and clinical metrics; however, all participants did use grocery credits during the program. No formal assessment of unintended consequences, such as participant burden or adverse dietary effects, was conducted. Additionally, although medical records included data from more than 1000 encounters, data from outside the primary care setting were limited, and records may have been incomplete, which could have resulted in missed medication changes, weight measurements, or laboratory values that would influence results. A larger-scale implementation with clinical evaluation beyond 12 months would help provide additional context on the sustainability of this program.

Conclusions

The results from this clinical evaluation suggest that the Jumpstart quality improvement program was associated with improvements in HbA_{1c} beyond 6 months and small reductions in weight among participants with available follow-up data. Because this evaluation was observational and lacked a control group, causal effects of the program cannot be determined, and medication-related influences on weight and glycemic outcomes could not be fully isolated. A low-burden program such as Jumpstart may be a feasible approach to support long-term dietary change in patients with T2D and food insecurity or low income. Similar programs may also be beneficial in conjunction with medications for glycemic control and weight loss to support sustainable lifestyle changes and long-term health goals.

Funding acquisition: MW, TC
Methodology: MW, EW, KH, LO, TC
Project administration: MW
Supervision: LO, TC
Visualization: MW
Writing—original draft: MW, EW
Writing—review and editing: KH, LO, TC

Conflicts of Interest

None declared.

Multimedia Appendix 1

Average change (mean, SD) in hemoglobin A_{1c} from baseline to follow-up, stratified by baseline control status.
[\[DOCX File \(Microsoft Word File\), 23 KB-Multimedia Appendix 1\]](#)

Multimedia Appendix 2

Average percent change (mean, SD) in weight from baseline to follow-up, stratified by any glucagon-like peptide-1 receptor agonist use during the evaluation period.
[\[DOCX File \(Microsoft Word File\), 22 KB-Multimedia Appendix 2\]](#)

Multimedia Appendix 3

Medication classes and changes from baseline to 12 months of follow-up (n=74).
[\[DOCX File \(Microsoft Word File\), 23 KB-Multimedia Appendix 3\]](#)

References

1. Statistics about diabetes. American Diabetes Association. URL: <https://diabetes.org/about-diabetes/statistics/about-diabetes> [Accessed 2026-09-09]
2. The burden of diabetes in Michigan. American Diabetes Association. URL: https://diabetes.org/sites/default/files/2023-09/ADV_2023_State_Fact_sheets_all_rev_Michigan.pdf [Accessed 2026-09-09]
3. Levi R, Bleich SN, Seligman HK. Food insecurity and diabetes: overview of intersections and potential dual solutions. *Diabetes Care*. Sep 1, 2023;46(9):1599-1608. [doi: [10.2337/dci23-0002](https://doi.org/10.2337/dci23-0002)] [Medline: [37354336](https://pubmed.ncbi.nlm.nih.gov/37354336/)]
4. Evert AB, Dennison M, Gardner CD, et al. Nutrition therapy for adults with diabetes or prediabetes: a consensus report. *Diabetes Care*. May 2019;42(5):731-754. [doi: [10.2337/dci19-0014](https://doi.org/10.2337/dci19-0014)] [Medline: [31000505](https://pubmed.ncbi.nlm.nih.gov/31000505/)]
5. Goldenberg JZ, Day A, Brinkworth GD, et al. Efficacy and safety of low and very low carbohydrate diets for type 2 diabetes remission: systematic review and meta-analysis of published and unpublished randomized trial data. *BMJ*. Jan 13, 2021;372:m4743. [doi: [10.1136/bmj.m4743](https://doi.org/10.1136/bmj.m4743)] [Medline: [33441384](https://pubmed.ncbi.nlm.nih.gov/33441384/)]
6. Hu Y, Liu G, Yu E, et al. Low-carbohydrate diet scores and mortality among adults with incident type 2 diabetes. *Diabetes Care*. Apr 1, 2023;46(4):874-884. [doi: [10.2337/dc22-2310](https://doi.org/10.2337/dc22-2310)] [Medline: [36787923](https://pubmed.ncbi.nlm.nih.gov/36787923/)]
7. Charts of note: nearly 20 percent of U.S. shoppers bought groceries online in 2022. USDA Economic Research Service. 2024. URL: <https://www.ers.usda.gov/data-products/charts-of-note/chart-detail?chartId=108618> [Accessed 2026-09-09]
8. Grocers see record-high 80M households buy groceries online in February. Grocery Dive. 2025. URL: <https://www.grocerydive.com/news/online-grocery-sales-february-delivery-pickup-service/742246> [Accessed 2026-09-09]
9. Online grocery shopping statistics (2026): yearly data & summary. WAVE Grocery. URL: <https://www.wavegrocery.com/blogpost/online-grocery-shopping-statistics-latest-data-summary> [Accessed 2026-09-09]
10. Food is Medicine. URL: <https://odphp.health.gov/foodismedicine> [Accessed 2026-09-09]
11. Barnidge EK, Stenmark SH, DeBor M, Seligman HK. The right to food: building upon “food is medicine”. *Am J Prev Med*. Oct 2020;59(4):611-614. [doi: [10.1016/j.amepre.2020.04.011](https://doi.org/10.1016/j.amepre.2020.04.011)] [Medline: [32800425](https://pubmed.ncbi.nlm.nih.gov/32800425/)]
12. Houghtaling B, Short E, Shanks CB, et al. Implementation of food is medicine programs in healthcare settings: a narrative review. *J Gen Intern Med*. Nov 2024;39(14):2797-2805. [doi: [10.1007/s11606-024-08768-w](https://doi.org/10.1007/s11606-024-08768-w)] [Medline: [38662283](https://pubmed.ncbi.nlm.nih.gov/38662283/)]
13. Ridberg R, Sharib JR, Garfield K, Hanson E, Mozaffarian D. ‘Food is medicine’ in the US: a national survey of public perceptions of care, practices, and policies. *Health Aff (Millwood)*. Apr 2025;44(4):398-405. [doi: [10.1377/hlthaff.2024.00585](https://doi.org/10.1377/hlthaff.2024.00585)] [Medline: [40071742](https://pubmed.ncbi.nlm.nih.gov/40071742/)]
14. Oshman L, Waselewski M, Hisamatsu R, et al. Grocery delivery to support individuals with type 2 diabetes: protocol for a pilot quality improvement program. *JMIR Res Protoc*. May 15, 2024;13:e54043. [doi: [10.2196/54043](https://doi.org/10.2196/54043)] [Medline: [38748461](https://pubmed.ncbi.nlm.nih.gov/38748461/)]

15. Oshman L, Bhomia N, Diez HL, et al. The Michigan Collaborative for Type 2 Diabetes (MCT2D): development and implementation of a statewide collaborative quality initiative. *BMC Health Serv Res.* Oct 17, 2024;24(1):1254. [doi: [10.1186/s12913-024-11520-z](https://doi.org/10.1186/s12913-024-11520-z)] [Medline: [39420291](https://pubmed.ncbi.nlm.nih.gov/39420291/)]
16. Ogrinc G, Davies L, Goodman D, Batalden P, Davidoff F, Stevens D. SQUIRE 2.0 (Standards for Quality Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process. *BMJ Qual Saf.* Dec 2016;25(12):986-992. [doi: [10.1136/bmjqs-2015-004411](https://doi.org/10.1136/bmjqs-2015-004411)] [Medline: [26369893](https://pubmed.ncbi.nlm.nih.gov/26369893/)]
17. American Diabetes Association Professional Practice Committee for Diabetes. 6. Glycemic goals, hypoglycemia, and hyperglycemic crises: Standards of Care in Diabetes-2026. *Diabetes Care.* Jan 1, 2026;49(Supplement_1):S132-S149. [doi: [10.2337/dc26-S006](https://doi.org/10.2337/dc26-S006)] [Medline: [41358894](https://pubmed.ncbi.nlm.nih.gov/41358894/)]
18. McKenzie AL, Hallberg SJ, Creighton BC, et al. A novel intervention including individualized nutritional recommendations reduces hemoglobin A1c level, medication use, and weight in type 2 diabetes. *JMIR Diabetes.* Mar 7, 2017;2(1):e5. [doi: [10.2196/diabetes.6981](https://doi.org/10.2196/diabetes.6981)] [Medline: [30291062](https://pubmed.ncbi.nlm.nih.gov/30291062/)]
19. GLP-1RA and dual GLP-1RA/GIP: conversions and therapy gap management guide. Beth Israel Lahey Health. URL: <https://www.bilhpn.org/wp-content/uploads/2022/12/BILH-GLP1RA-Conversion-Guide.pdf> [Accessed 2026-09-09]
20. Beretta MV, Flores CA, Colameo GF, Echabe LW, Busnello FM. Low-carbohydrate dietary interventions for metabolic control in individuals with type 2 diabetes mellitus: an overview of systematic reviews. *Nutr Rev.* Jul 1, 2025;83(7):e1677-e1692. [doi: [10.1093/nutrit/nuae123](https://doi.org/10.1093/nutrit/nuae123)] [Medline: [39298713](https://pubmed.ncbi.nlm.nih.gov/39298713/)]
21. Silverii GA, Botarelli L, Dicembrini I, et al. Low-carbohydrate diets and type 2 diabetes treatment: a meta-analysis of randomized controlled trials. *Acta Diabetol.* Nov 2020;57(11):1375-1382. [doi: [10.1007/s00592-020-01568-8](https://doi.org/10.1007/s00592-020-01568-8)] [Medline: [32638087](https://pubmed.ncbi.nlm.nih.gov/32638087/)]
22. Mirmiran P, Bahadoran Z, Gaeini Z. Common limitations and challenges of dietary clinical trials for translation into clinical practices. *Int J Endocrinol Metab.* 2021;19(3):e108170. [doi: [10.5812/ijem.108170](https://doi.org/10.5812/ijem.108170)] [Medline: [34567133](https://pubmed.ncbi.nlm.nih.gov/34567133/)]
23. Leidy HJ, Gooding R, Hicks-Roof K. Perspective: key considerations when developing and publishing dietary interventions for human clinical trials. *J Nutr.* Oct 2024;154(10):2904-2908. [doi: [10.1016/j.tjnut.2024.08.024](https://doi.org/10.1016/j.tjnut.2024.08.024)] [Medline: [39218398](https://pubmed.ncbi.nlm.nih.gov/39218398/)]
24. Wilding JP, Batterham RL, Calanna S, et al. Once-weekly semaglutide in adults with overweight or obesity. *N Engl J Med.* Mar 18, 2021;384(11):989-1002. [doi: [10.1056/NEJMoa2032183](https://doi.org/10.1056/NEJMoa2032183)] [Medline: [33567185](https://pubmed.ncbi.nlm.nih.gov/33567185/)]
25. Fornes A, Huff J, Pritchard RI, Godfrey M. Once-weekly semaglutide for weight management: a clinical review. *J Pharm Technol.* Aug 2022;38(4):239-246. [doi: [10.1177/87551225221092681](https://doi.org/10.1177/87551225221092681)] [Medline: [35832567](https://pubmed.ncbi.nlm.nih.gov/35832567/)]
26. Johnson BV, Milstead M, Green L, Kreider R, Jones R. Diet quality and nutrient distribution while using glucagon-like-peptide-1 receptor agonist: a secondary cross-sectional analysis. *Obes Pillars.* 2025;16:100195. [doi: [10.1016/j.obpill.2025.100195](https://doi.org/10.1016/j.obpill.2025.100195)] [Medline: [40852562](https://pubmed.ncbi.nlm.nih.gov/40852562/)]
27. Reiss AB, Gulkarov S, Lau R, et al. Weight reduction with GLP-1 agonists and paths for discontinuation while maintaining weight loss. *Biomolecules.* Mar 13, 2025;15(3):408. [doi: [10.3390/biom15030408](https://doi.org/10.3390/biom15030408)] [Medline: [40149944](https://pubmed.ncbi.nlm.nih.gov/40149944/)]
28. Budini B, Luo S, Tam M, et al. Trajectory of weight regain after cessation of GLP-1 receptor agonists: a systematic review and nonlinear meta-regression. *EClinicalMedicine.* Mar 2026;93:103796. [doi: [10.1016/j.eclinm.2026.103796](https://doi.org/10.1016/j.eclinm.2026.103796)] [Medline: [41938838](https://pubmed.ncbi.nlm.nih.gov/41938838/)]

Abbreviations

ADA: American Diabetes Association

GLP-1 RA: glucagon-like peptide-1 receptor agonist

HbA_{1c}: hemoglobin A_{1c}

LCD: low-carbohydrate diet

MCT2D: Michigan Collaborative for Type 2 Diabetes

SNAP: Supplemental Nutrition Assistance Program

SQUIRE 2.0: Standards for Quality Improvement Reporting Excellence

T2D: type 2 diabetes mellitus

WIC: Special Supplemental Nutrition Program for Women, Infants, and Children

Edited by Luke MacNeill; peer-reviewed by Santiago Navas-Carretero; submitted 12.Dec.2025; final revised version received 20.Aug.2026; accepted 24.Aug.2026; published 21.Sep.2026

Please cite as:

Waselewski M, Waselewski E, Oshman L, Hatch K, Chang T

Hemoglobin A_{1c} and Weight Changes Associated With Grocery Delivery and Low-Carbohydrate Education in Adults With Type 2 Diabetes and Food Insecurity: Observational Quality Improvement Cohort Study

JMIR Form Res 2026;10:e89459
URL: <https://formative.jmir.org/2026/1/e89459>
doi: [10.2196/89459](https://doi.org/10.2196/89459)

© Marika Waselewski, Eric Waselewski, Lauren Oshman, Kaitlyn Hatch, Tammy Chang. Originally published in JMIR Formative Research (<https://formative.jmir.org>), 21.Sep.2026. This is an open-access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Formative Research, is properly cited. The complete bibliographic information, a link to the original publication on <https://formative.jmir.org>, as well as this copyright and license information must be included.