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Re-Think the Strip: de-implementing a low value practice in primary care

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Abstract

Background Self-monitoring of blood glucose (SMBG) is a low value health care practice that does not benefit most patients with non-insulin treated type 2 diabetes (T2DM). This paper evaluates Re-Think the Strip (RTS), a multi-component study aimed at de-implementing SMBG among non-insulin treated T2DM patients in primary care.

Methods This study used a pre-post design to evaluate the effectiveness and implementation of Re-Think the Strip in 20 primary care clinics with a comparison group of 34 clinics within one health system. De-implementation strategies were implemented over 12 months and practices were followed for 18 months.

Results There was an overall decrease in the odds of receiving a prescription for diabetes testing supplies (i.e., test strips and/or lancets) between the baseline and 12-month intervention follow-up for intervention and comparison clinics (OR 0.96, 95% CI 0.94, 0.98). However, there was no statistically significant difference in prescribing between the intervention and comparison clinics. In sensitivity analyses, a small intervention effect was observed for those patients newly diagnosed with T2DM or newly assigned to a study clinic (OR = 0.97, 95% CI 0.95, 1.00).

Conclusions De-implementation strategies are feasible in primary care practices. Although prescriptions for SMBG decreased in intervention practices, they also decreased in the comparison practices. Newly diagnosed patients or new patients may be more receptive to de-implementation. Other factors, including the COVID-19 pandemic and baseline prescribing rates may have limited the effectiveness of the RTS de-implementation strategy.

Keywords Practice-based research, De-implementation, Glucose monitoring, Implementation and dissemination, Diabetes

Background

Overtreatment, or provision of health care to patients who do not receive a benefit, costs the US healthcare system $226 billion annually [1]. For patients with type 2 diabetes (T2DM) treated with insulin, self-monitoring of blood glucose (SMBG) is a recommended daily practice; however, only 26% of patients with T2DM use insulin [2]. For much of the remaining 74%, SMBG is a low value practice providing no clear clinical or psychological benefit [3–9]. Several randomized trials have shown minimal clinical utility of routine SMBG in noninsulin-treated patients [10–13]. The largest US randomized trial to date of SMBG in primary care patients with non-insulin treated T2DM with moderately controlled A1c levels found no differences in blood glucose management, quality of life, or adverse events between patients who did or did not engage in daily SMBG [12]. Nationally there is a

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push to reduce unnecessary SMBG testing as evidenced by the Choosing Wisely campaign [14] as well as the American Diabetes Association [15] which discourages routine SMBG among patients with non-insulin treated T2DM with moderately controlled A1c levels. Reducing the frequency of low value testing is one way to combat rapidly increasing healthcare costs and undue burden on patients and providers [16].

De-implementation strategies are an emerging approach that can reduce inappropriate healthcare interventions [17]. De-implementing SMBG for patients with T2DM not using insulin has the potential to minimize monetary and psychological costs of SMBG overtreatment [18]. De-implementation may also provide more time for clinicians and patients to focus on other treatments with proven effectiveness for addressing T2DM.

The primary objective of this study was to evaluate Re-Think the Strip (RTS), a multi-component strategy to de-implement SMBG among non-insulin treated T2DM patients in primary care.

Methods

This study used a pre-post design to evaluate the implementation and effectiveness of RTS on SMBG prescribing in 20 primary care clinics with a comparison group of 34 clinics in the same academic integrated health care system [19]. The design and evaluation of RTS were guided by the RE-AIM framework [20]. All patient data were electronic health record (EHR) data managed by the University of North Carolina at Chapel Hill's Carolina Data Warehouse for Health.

De-implementation strategy

To develop the multicomponent RTS de-implementation strategy, we engaged an advisory board of individuals with T2DM and representatives from the National Diabetes Education Program, American Association of Diabetes Care and Education Specialists, American Diabetes Association, and leadership from clinical networks with whom the RTS strategy was tested. Guided by Niven et al.'s multistep de-adoption process [21], we worked with the advisory board to identify barriers to de-implementation and then designed and pilot tested de-implementation strategies to address those barriers. The five strategies selected included practice facilitation, audit and feedback, practice champions, educational meetings, and educational materials. Each approach is described briefly below and on the RTS website (https://rethinkthestrip.sites.unc.edu/). De-implementation strategies were implemented over 12 months and practices were followed for 18 months.

Practice Facilitation

Practice facilitation is an evidence-supported strategy that is typically delivered by a nurse or other professional trained to serve in the role of "practice facilitator" (PF) or "quality improvement coach" [22]. Facilitation was provided in person or virtually monthly by a PF nurse with long-standing professional relationships with many of the intervention clinics as well as extensive practice facilitation experience.

Audit and feedback [23]

Data were collected on clinic- and provider-level prescription rates for blood glucose strips and lancets. The PF provided quarterly feedback to each clinic on T2DM prescribing rates stratified by provider.

Practice champions [24]

Together with practice staff, the PF identified a primary care provider and practice manager within each clinic to serve as the primary study contact and promote (i.e., "champion") SMBG de-implementation.

Educational meetings [25]

Two physicians with training in family medicine and endocrinology led lunch-time educational meetings for providers and staff at each practice and an additional meeting with diabetes care and education specialists working in the practices. Participants were offered Continuing Medical Education (CME) credits.

Educational materials [26]

We developed a one-page document for providers outlining common reasons patients may be reluctant to discontinue SMBG and suggested provider responses. For patients, we developed an infographic to prompt them to begin a conversation with their healthcare provider about whether it was time to Re-Think SMBG (https://rethinkthestrip.sites.unc.edu/healthcare-system-resources/educational-materials/).

Setting and sample

Twenty family medicine and internal medicine practices from a healthcare system in North Carolina participated. These intervention practices were compared with the other 34 primary care practices within the same health system during the study period for secular trends.

The PF invited staff and clinical care providers from intervention clinics to participate in a 1-hour lunch and learn session—date of this training defined the clinic's "baseline" date. Of the 20 intervention clinics, 15 (75%) were enrolled after February 1, 2020, the date when the World Health Organization (WHO) declared SARS-CoV-2 a global health emergency. The baseline date for comparison clinics was set at the median date between

the first and last lunch and learn sessions—March 12, 2020.

Measures

The primary outcome was prescription of diabetes testing supplies (test strips or lancets) in the electronic health record. Secondary outcomes included elements assessing the RE-AIM components of Reach, Adoption, Implementation, and Maintenance. We conceptualized Reach as the number and representativeness of non-insulin treated T2DM patients seen at participating practices and who were therefore exposed to the practice-level changes targeted by the intervention. Adoption was assessed for practices (number, proportion, and representativeness of eligible practices that agreed to participate in RTS) and care team members (provider and staff attendance at educational sessions and project champion contacts with the PF). We also assessed Implementation fidelity (implementation strategies delivered per protocol) and Maintenance (diabetes testing supplies at 18 months) (Table 1).

Patients

The initial patient cohort was identified using a previously validated T2DM phenotype [27]. To be eligible for inclusion in the analytic dataset an individual must have received care at one of the 54 UNC Health System primary care practices at least twice in the prior 18 months, be 18 years of age or older, and have an A1c test < 9.5. Individuals were excluded if they were prescribed insulin or a continuous glucose monitor at any point during the study period. Patients were assigned to a primary care provider based on which provider ordered their most recent A1c test. These criteria resulted in a sample of $N = 12{,}949$ adult patients seen by 394 providers. For the primary study outcome, the 12 months prior to a clinic's enrollment was considered the baseline period and the 12 months after enrollment was considered the post-test period. Maintenance was examined with the same parameters but using an 18-month timeframe.

Demographic variables were extracted from the EHR along with clinical variables of patient hemoglobin A1c, BMI, smoking status, diabetes medication and test strip/lancet national drug codes (NCDs). Additionally, for Adoption and Implementation fidelity, data were extracted from a log maintained by the practice facilitator.

Analysis

We characterized the sample and identified differences between intervention and comparison clinics by estimating means and proportions of baseline patient, provider, and clinic variables, stratified by clinic. We used generalized estimating equations (GEEs) to model the primary outcome, with time period (baseline vs. 12 months or baseline vs. 18 months; Level 1) and accounting for nesting of patients within providers/clinic (Level 2). Using both unadjusted and adjusted models, we examined whether odds of prescription for blood glucose testing supplies decreased between baseline and follow-up and whether they differed between intervention and comparison clinics. Because unadjusted and adjusted estimated are largely comparable, unadjusted parameter estimates for the 12-month timeframe are reported unless otherwise noted.

In secondary analyses we examined how turnover of providers/staff and care team adoption affected prescriptions of diabetes testing supplies. Turnover was measured by the number of new providers to the practice who replaced providers who left, if one of those providers who left was the practice champion or medical director, and if they had one or more new practice managers during the study. Analyses were conducted using Stata 15. All study procedures were approved by the UNC Institutional Review Board (#18-3319).

Table 1 Study measures guided by the RE-AIM framework

Dimension	Metrics assessed in this study	Data source
Reach	Number and representativeness of non-insulin dependent T2DM patients seen at participating practices	EHR
Effectiveness	Decrease in SMBG prescriptions (baseline to 12-months)	EHR
Adoption	Number, proportion, and representativeness of eligible practices that agreed to participate in RTS	EHR
Implementation	De-implementation strategies delivered per protocols	Practice facilitator log
	Staff and provider perceptions of and engagement in RTS	Survey and Practice facilitator log
	Determinants of implementation success: Staff and provider turnover Exploration of other factors	Practice facilitator log Key informant interviews with practice staff
Maintenance	18-month data on decrease in test strip prescriptions	EHR

Abbreviation: RE-AIM-Reach, Effectiveness, Adoption, Implementation, Maintenance

Available from http://www.re-aim.org

Results

Reach

In the intervention practices, eligible patients ($n = 3,807$) had an average age of 67.3 years, and 55.2% were female, 34.1% were Black, 4.3% were Latane/Hispanic; the average BMI was 33.4 kg/m^2. Patients in comparison clinics were comparable in age and BMI, but a lower proportion of patients were female (53.1%), Black (24.8%), and Latine/Hispanic (2.9%) (Table 2). A total of 132 providers were associated with an intervention clinic, of which 71.2% were female, 60.3% were physicians, (usually family medicine physicians; 66.7%) (Table 3). At baseline, patients in comparison practices' receipt of test strips was lower than the intervention practices (27.5% vs. 30.5%, $p < 0.001$).

Effectiveness/maintenance

Test strip/lancet prescriptions

There were significant main effects for both time (baseline vs. 12 months post-test) and intervention condition (intervention vs. comparison clinics) in the models (Table 4). That is, there was a decrease in odds of prescription receipt from baseline to 12 months posttest across intervention and comparison clinic practices (OR 0.96, 95% CI 0.94, 0.98). However, a non-significant two-way interaction between time and intervention indicated the difference in prescribing between intervention and comparison groups did not change over time (OR 1.01, 95% CI 1.00, 1.02).

In sensitivity analyses examining the potential moderating effect of patient cohort type on the effect of the intervention, we tested a three-way interaction between

Table 2 Baseline patient characteristics, $N = 12,949$

Characteristic	Total (N = 12,949)	Comparison practices ($n = 9,142$)	Intervention practices ($n = 3,807$)	*p* value
	N (%)	N (%)	N (%)	
Patient type				**< 0.001**
Existing T2DM patients	9,647 (74.5)	6,925 (75.7)	2,722 (71.5)	
New T2DM patients or new to practice	3,302 (25.5)	2,217 (24.3)	1,085 (28.5)	
Age (mean, SD)	67.35 ± 12.47 *range [19–105]*	67.38 ± 12.40 *range [20–101]*	67.27 ± 12.65 *range [19–105]*	0.649
Gender				**0.028**
Female	6,960 (53.7)	4,857 (53.1)	2,103 (55.2)	
Male	5,989 (46.3)	4,285 (46.9)	1,704 (44.8)	
Race				**< 0.001**
White	8,417 (65.0)	6,286 (68.8)	2,131 (56.0)	
Black or African American	3,565 (27.5)	2,268 (24.8)	1,297 (34.1)	
Asian	346 (2.7)	211 (2.3)	135 (3.5)	
American Indian, Alaska Native, Native Hawaiian, or Pacific Islander	63 (0.5)	39 (0.4)	24 (0.6)	
Other or unknown	558 (4.3)	338 (3.7)	220 (5.8)	
Ethnicity, Latino Hispanic				**< 0.001**
Latino or Hispanic	429 (3.3)	264 (2.9)	165 (4.3)	
Non-Latino/Hispanic or Unknown	12,520 (96.7)	8,878 (97.1)	3,642 (95.7)	
Body Mass Index (BMI)	33.55 ± 7.43	33.61 ± 7.44	33.42 ± 7.41	0.196
Smoking status				.078
Smoker	1,697 (13.1)	1,238 (13.5)	459 (12.1)	
Mean baseline A1c*	6.86 ± 0.87	6.86 ± 0.87	6.87 ± 0.86	0.492
Receipt of lancet or test strip Rx, baseline*	3,835 (29.6)	2,789 (30.5)	1,046 (27.5)	**0.001**
Medication				
Sulfonylurea or glinide	2,591 (20.0)	1,824 (20.0)	767 (20.1)	.800
GLP-1 analog, SGLT 2 inhibitor, or DPP-IV	3,061 (23.6)	2,123 (23.2)	938 (24.6)	.084
Some other oral medication	7,200 (55.6)	4,984 (54.5)	2,216 (58.2)	**<.001**
No oral medication	4,932 (38.1)	3,602 (39.4)	1,330 (34.9)	**<.001**
Insurance at baseline				.307
Commercial	2,184 (16.9)	1,530 (16.7)	654 (17.2)	
Blue Cross Blue Shield	3248 (25.1)	2,318 (25.3)	930 (24.4)	
Medicaid	477 (3.7)	317 (3.5)	160 (4.2)	
Medicare	6,833 (52.8)	4,831 (52.8)	2,002 (52.6)	
None, self-pay, or unknown	207 (1.6)	146 (1.6)	61 (1.6)	

*baseline defined as 18 months prior to intervention period

Table 3 Provider characteristics

Provider characteristics	Total providers (*N* = 394)	Comparison providers (*n* = 262)	Intervention providers (*n* = 132)	*p* value
	N (%)	*N* (%)	*N* (%)	
Provider gender				0.056
Female	255 (64.7)	161 (61.5)	94 (71.2)	
Male	139 (35.3)	101 (38.5)	38 (28.8)	
Provider type				0.277
MD	237 (60.2)	166 (63.4)	71 (54.2)	
DO	27 (6.9)	19 (7.3)	8 (6.1)	
NP	74 (18.8)	44 (16.8)	29 (22.1)	
PA	52 (13.2)	30 (11.5)	22 (16.8)	
PharmD	4 (1.0)	3 (1.1)	1 (0.8)	
Provider specialty				
Family Medicine	279 (70.8)	191 (72.9)	88 (66.7)	0.199
Internal Medicine	115 (29.2)	71 (27.1)	44 (33.3)	

time, intervention group, and cohort type (i.e., existing T2DM patients vs. new T2DM patients, which was significant (OR 0.97, 95% CI: 0.95, 1.00). As observed in Fig. 1, the difference between the intervention and control groups stayed equivalent across the two time periods; however, this was not the pattern observed for the new patient cohort (newly diagnosed or new to practice). Average rates of prescribing were lower in the new cohort at both time points as compared to the original cohort. Notably, there was a significant three-way interaction between cohort, time, and intervention condition such that the decrease in rates of prescribing between baseline and posttest is slightly greater for the intervention group (20.9–16.6%) in the new cohort as compared to the control group (19.3–16.7%) in the new cohort ($p < 0.05$) (Fig. 1). At 18 months, this new cohort difference remained borderline significant (OR 0.96, 95% CI 0.93, 1.00, $p < 0.08$).

Higher odds of blood glucose testing supply prescriptions were seen in female patients (OR 1.04, 95% CI 1.03, 1.06), older patients (OR 1.001, 95% CI 1.003, 1.002), and Black patients (OR 1.04, 95% 1.02, 1.06), having Medicaid (OR 1.17, 95% CI: 1.12, 1.22) or Medicare (OR 1.12, 95% CI: 1.08, 1.14). Higher odds of blood glucose testing supply prescriptions were observed in patients receiving diabetes medications including sulfonylureas (OR 1.07, 95% CI: 1.05, 1.09), GLP1a, SGLT2i or DPP IVs (OR 1.09, 95% CI: 1.07, 1.11) or other oral diabetes medication (OR 1.05, 95% CI 1.02, 1.09).

Adoption

Practices

We approached 37 practices and 20 agreed to participate, resulting in a 54% participation rate. Reasons for choosing not to participate included competing projects, understaffing, and passive refusal. Primary care practices included a total of 132 providers in the intervention clinics. The practices have a median of 5 clinicians (range: 2–11) and 11practices had dieticians. All intervention practices were located in urban areas, with 50% in large, 35% in medium and 15% in small metro areas.

Care team members

Attendees at educational meetings included a total of 165 providers, clinical staff, and administrative staff. Attendance at educational meetings averaged 64% of providers per practice (range 10–100%). Clinics with higher adoption scores had marginally higher odds of prescriptions for test strips/lancets (OR 1.12, 95% CI: 0.99–1.26, $P = 0.068$) but no significant effect over time.

Implementation fidelity

Practice facilitation was delivered per protocol (monthly emails and telephone calls to practices, and as requested). A practice champion was designated for each practice and participated in facilitation contacts. Based on practice feedback, we revised the format of facilitation to include more phone call contacts and fewer in-person facilitation visits. During COVID-19, facilitation was almost exclusively done by phone. Audit and feedback reports were provided quarterly to practice champions. Health care providers asked for individual reports with patient lists to better identify those prescribed strips. Educational meetings based on health care provider input and materials were developed and disseminated to practices.

Turnover

\There was no association between clinic turnover and odds of prescription, nor differences in the link between turnover and odds of prescription across the two time periods ($p > 0.05$).

Discussion

RTS was successfully implemented as evidenced by high levels of fidelity to implementation strategies and care team participation in training and practice facilitation in 20 practices with reach to a diverse population of patients with well controlled T2DM. Although there was a decrease in odds of prescriptions over time for intervention practices, comparison practices also decreased their prescribing. However, for new patients or newly diagnosed patients in the intervention clinics, there was a decrease in prescribing testing supplies compared with non-intervention practices.

De-implementation of best practices takes time. Prior recommendations for cervical cancer screening and thyroid screening provide examples of slow adoption of

Table 4 Generalized estimating equation (GEE) model results predicting receipt of blood glucose testing supplies prescription at 12 months pre-test and posttest, $N = 12{,}949$ patients

	Intercept only & unadjusted model estimates			Adjusted model estimates		
	OR		95% CI	OR		95% CI
Intercept	1.32		1.31, 1.32	1.00		0.90, 1.10
Provider Characteristics (Level 3)						
Rethink the Strip intervention condition	0.97	**	0.96, 0.99	.		.
Patient cohort						
Original patient cohort (ref)	.		.	.		.
New patient cohort	0.88	**	0.87, 0.90	.		.
Provider Gender						
Male (ref)	.		.	.		.
Female	1.01		1.00, 1.02	1.00		0.99, 1.02
Provider type						
MD or DO (ref)	.		.	.		.
NP	1.01		0.99, 1.03	1.01		0.99, 1.03
PA	0.97	*	0.95, 0.99	1.00		0.98, 1.02
PharmD	0.86		0.71, 1.03	0.92		0.77, 1.10
Provider specialty						
Family medicine (ref)	.		.	.		.
Internal medicine	0.98	*	0.96, 1.00	0.97	*	0.96, 0.99
Rural-urban status						
Metro– Counties in metro areas of 1 million population or more (ref)	.		.	.		.
Metro– Counties in metro areas of 250,000 to 1 million population	1.03	*	1.01, 1.04	1.02	*	1.00, 1.04
Metro– Counties in metro areas of fewer than 250,000 population	1.00		0.98, 1.02	1.00		0.98, 1.02
Nonmetro– Urban population of 20,000 or more, adjacent to a metro area	1.03		0.99, 1.07	1.02		0.98, 1.06
Nonmetro– Urban population of 20,000 or more, not adjacent to a metro area	1.13	**	1.06, 1.21	1.09	*	1.02, 1.16
Patient Characteristics (Level 2)						
Gender						
Male (ref)	.		.	.		.
Female	1.05	**	1.04, 1.07	1.04	**	1.03, 1.06
Age, in years	1.004	**	1.004, 1.005	1.001	*	1.0003, 1.002
Race						
White (ref)	.		.	.		.
Black or African American	1.02	*	1.00, 1.04	1.04	**	1.02, 1.06
Other race	0.97	*	0.94, 1.00	1.03		0.99, 1.06
Ethnicity						
Latino or Hispanic (ref)	.		.			
Non-Latino/Hispanic	1.05	*	1.01, 1.10	1.01		0.97, 1.06
Body mass index						
Underweight	1.13		0.97, 1.31	1.12		0.97, 1.30
Normal weight (ref)	.		.	.		.
Overweight	0.98		0.95, 1.01	0.99		0.96, 1.02
Obese	0.97	*	0.94, 0.99	0.98		0.96, 1.01
A1C, most recent	1.02	**	1.01, 102	1.01	*	1.00, 1.02
Smoking status						
Never smoker (ref)	.		.	.		.
Past smoker	1.02	*	1.00, 1.04	1.01		0.99, 1.02
Passive smoker (secondhand smoke)	1.00		0.85, 1.17	1.01		0.86, 1.18
Smoker	0.98	*	0.96, 1.00	0.99		0.97, 1.01
Unknown	0.82	†	0.66, 1.02	0.84		0.68, 1.04
Non-insulin diabetes medication (oral or injectable)						
Sulfonylurea or glinide	1.13	**	1.11, 1.15	1.07	**	1.05, 1.09
GLP-1 analog, SGLT 2 inhibitor, or DPP-IV	1.10	**	1.09, 1.12	1.09	**	1.07, 1.11
Some other oral medication	1.07	**	1.05, 1.08	1.05	*	1.02, 1.09

Table 4 (continued)

	Intercept only & unadjusted model estimates			Adjusted model estimates		
	OR		95% CI	OR		95% CI
No oral medication (ref)	0.92	**	0.91, 0.94	1.02		0.99, 1.06
Insurance status						
Commercial (ref)	.		.	.		.
Blue Cross Blue Shield, commercial	0.98	†	0.95, 1.00	0.98		0.96, 1.00
Blue Cross Blue Shield, state health plan	1.06	**	1.03, 1.10	1.04	*	1.01, 1.07
Medicaid	1.16	**	1.11, 1.21	1.17	**	1.12, 1.22
Medicare	1.15	**	1.12, 1.17	1.12	**	1.09, 1.14
Other	0.98		0.92, 1.04	0.99		0.93, 1.05
Time (Level 1)						
Time period						
12 months prior to intervention (ref)	.		.	.		.
12 months post-intervention	0.96	**	0.95, 0.96	.		.
Interaction						
Rethink the Strip Intervention	0.96	**	0.94, 0.98	0.96	**	0.94, 0.98
Time	0.95	**	0.94, 0.96	0.95	**	0.94, 0.96
Cohort	0.86	**	0.84, 0.88	0.90	**	0.88, 0.92
Rethink the Strip Intervention x Time	1.01		1.00, 1.02	1.01		1.00, 1.02
Rethink the Strip Intervention x Cohort	1.06	*	1.02, 1.10	1.04	*	1.00, 1.08
Cohort x Time	1.03	**	1.01, 1.04	1.03	**	1.01, 1.04
Rethink the Strip Intervention x Time x Cohort	0.97	*	0.95, 1.00	0.97	*	0.95, 1.00

Note: Note: †$p < 0.08$; *$p < 0.05$, **$p < 0.001$; OR = odds ratio; CI = confidence interval

Adjusted model estimates are generated from a single model that includes all variables listed as model covariates

best-practice guidelines over the course of years [28–30]. Despite this pace, newer patients may provide an opportunity to improve de-implementation efforts. RTS may have had less impact on the discontinuation of existing prescriptions for SMBG but seemed to help clinicians minimize new prescriptions. It is possible that clinicians find the process of de-implementing SMBG to be easier with new patients.

This work occurred during the COVID-19 pandemic when it was difficult to access healthcare. During the height of the pandemic, patients were seen less frequently by their providers and had less frequent A1c testing [31]. Without intermittent monitoring, patients were left to employ SMBG or have no sense of their glycemic control. To understand the potential impact of health care access during that time, we conducted exploratory post hoc analyses to determine whether T2DM patients new to receiving diabetes care in the health system receive the de-implementation approach in a timelier way compared to those already receiving care. We indeed found a modest difference between the two patient care cohorts, with average rates of prescribing lower in the new cohort at both time points. De-implementation requires mutual trust between patient and provider, which was hard to build during the pandemic without regular visits. Despite these factors, our intervention practices (and non-intervention practices) showed modest decreases in prescribing of SMBG supplies for both new and existing patient cohorts.

Another interesting finding was that patients taking T2DM medications were more likely to receive SMBG prescriptions than their counterparts. It is not surprising that patients who are using sulphonylureas, medications that have the potential to cause hypoglycemia, are more likely to have received SMBG supplies. However, other medications used to treat T2DM are not generally associated with hypoglycemia (e.g., DPP-IV, SGLT2i, GLP1a). Patients often have high copayments for these agents and could cut their costs by eliminating unnecessary SMBG from their daily routine.

This study was intentionally designed to be pragmatic and is a major strength. In our healthcare system, only 29.6% of patients were testing when prior estimates over 60% several years ago [32]; thus there was not much room for de-implementation.

There are several limitations. People can purchase non-prescription test strips that are not measured in our data. EHR data accuracy depends upon the medication lists being updated and we cannot confirm this was done. Comparison clinics were part of the same health system and may have been exposed to MONITOR trial results. This would result in comparison clinics de-implementing SMBG for patients who are not using insulin. Finally, due to the pandemic, the healthcare system did not function in the manner in which we were expecting

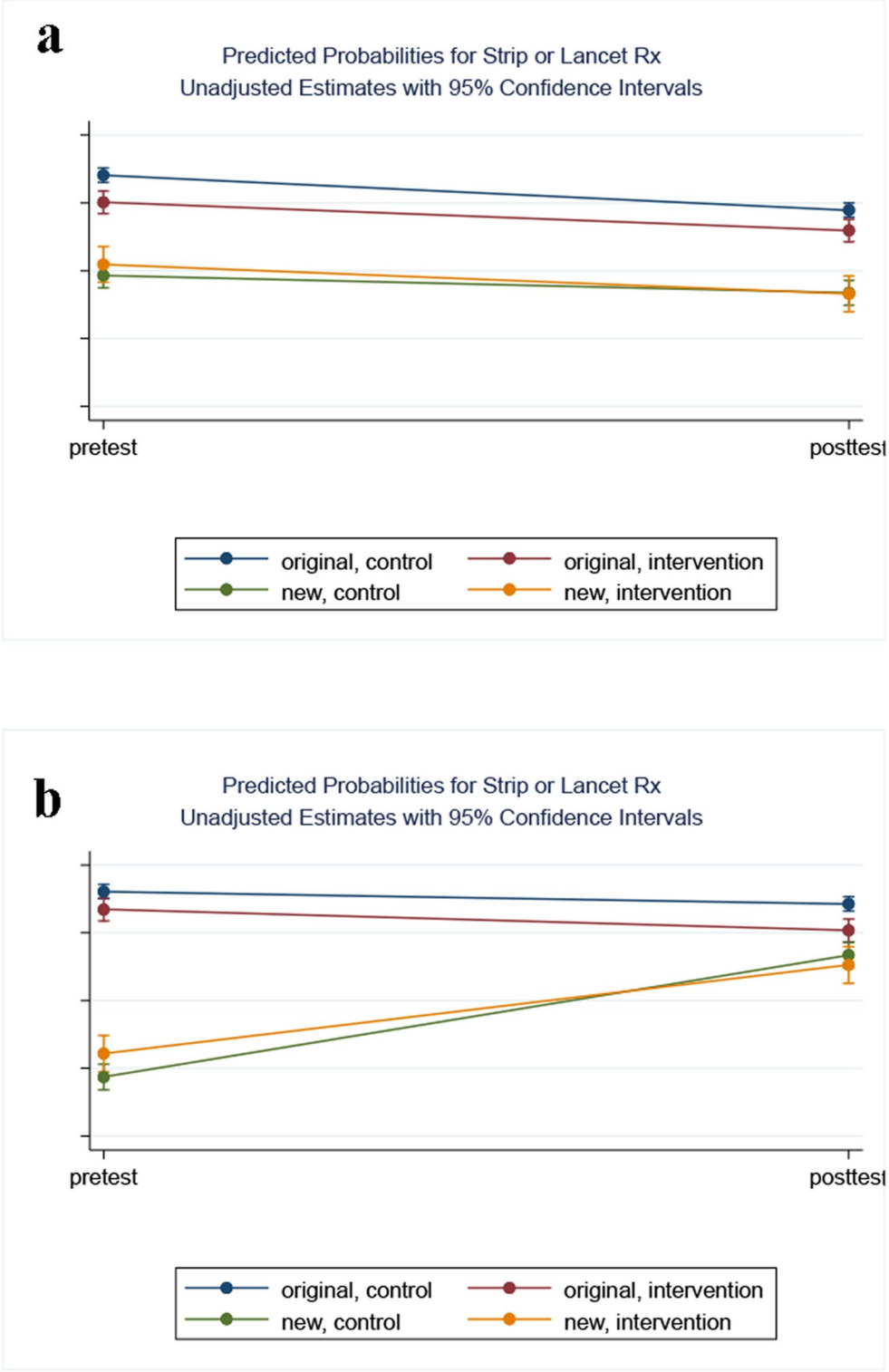

Fig. 1 Predicted probabilities[+] for strip/lancet Rx, 12- and 18-months for Original and New Patient Cohorts **a**. 12months **b**. 18months *New = patients new to the practice or newly diagnosed with T2DM [+]Predicted probabilities are the same as unadjusted predicted proportions

when we planned this project. Clinic visits did not occur as frequently as anticipated, glycemic control was not assessed by HgA1c due to access issues, and staff turnover was high. All of these issues could have played a significant role in how aggressively providers discussed the de-implementation of SMBG message for patients with non-insulin treated diabetes.

Conclusions

RTS is a feasible approach for de-implementation. New patients or newly diagnosed patients may be more amenable to change. Future efforts should include identifying practices and providers who are most ready for de-implementation and have higher rates of baseline SMBG strip and lancet prescriptions.

Abbreviations

T2DM	Type 2 diabetes
SMBG	Self monitoring of blood glucose
RTS	Re-Think the Strip

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12875-025-02781-6.

Supplementary Material 1

Supplementary Material 2

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Author contributions

KD, LY, JL were involved in the initial idea and design of the study.JR, MB, ER, MV, AJ, LS, KM, BC, AL Collected and analyzed the data.All authors (KD, MB, JL, JR, ER, KM, LS, MV, AR, HT, AL, AJ, RC, LY) contributed to the interpretation of the data and intellectual content of the paper.All authors have read and approved the final version of this manuscript.

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Data availability

The individual EHR (electronic health record) dataset (even de-identified) used and/or analyzed during the current study is not publicly available due to Carolina Data Warehouse (CDW-H) policies. Collaboration requests and data use agreements with CDH-W (https://tracs.unc.edu/index.php/services/informatics-and-data-science/cdw-h) are necessary to obtain access to the de-identified EHR data.

Declarations

Ethics approval and consent to participate

All study procedures were approved by the UNC Institutional Review Board (#18-3319). Informed consent was obtained from all human subjects involved this study. All methods were carried out in accordance with relevant guidelines and regulations or declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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