American Journal of Preventive Cardiology 16 (2023) 100608

Contents lists available at ScienceDirect

American Journal of Preventive Cardiology

journal homepage: www.journals.elsevier.com/american-journal-of-preventive-cardiology

A system approach to improving guideline-directed therapy for cardio-renal-metabolic conditions: The "beyond diabetes" initiative

Benjamin J. Hirsh [a,b,†], Jamie S. Hirsch [c,d,e,†], Hosam Hmoud [f], Spencer Weintraub [e], Agnes Cha [g], Martin Lesser [d,h], Xueqi Huang [h], Yan Yan Sally Xie [i], Rachel Nahrwold [j], John Joshua [k], Jennifer Scanlon [k], Thomas Galella [l], Varinder Singh [b,j], Eugenia Gianos [b,j,*]

[a] Department of Cardiology, Sandra Atlas Bass Heart Hospital, Manhasset, NY, United States
[b] Department of Cardiology, Donald and Barbara Zucker School of Medicine at Hofstra/ Northwell, Hempstead, NY, United States
[c] Division of Kidney Diseases and Hypertension, Department of Medicine, Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, Hempstead, NY, United States
[d] Institute of Health System Science, Feinstein Institutes for Medical Research, Northwell Health, Manhasset, NY, United States
[e] North Shore University Hospital, Manhasset, NY, United States
[f] Lenox Hill Hospital, New York, NY, United States
[g] Department of Ambulatory Pharmacy Services, Northwell Health, Lake Success, NY, United States
[h] Biostatistics Unit, Office of Academic Affairs, Northwell Health, New York, NY, United States
[i] Division of Endocrinology, Department of Medicine, Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, Hempstead, NY, United States
[j] Department of Cardiology, Lenox Hill Hospital, New York, NY, United States
[k] Global Strategic Partnerships, Northwell Health, New York, NY, United States
[l] Department of Healthcare Delivery Analytics, Northwell Health, New York, NY, United States

ARTICLE INFO

Keywords:
Diabetes mellitus
Cardiovascular
Kidney
Outcomes
Systems-based
Initiative
Guideline-directed
Pharmacy
Electronic health record
Preventive medicine

ABSTRACT

Objective: Despite demonstrating improvements in cardiovascular disease, kidney disease, and survival outcomes, guideline-directed antihyperglycemic medications such as sodium-glucose cotransporter 2 inhibitors (SGLT2i) and glucagon-like-peptide-1 receptor agonists (GLP1-RA), are underutilized. Many obstacles constrain their use including lack of systematic provider and patient education, concern for medication side effects, and patient affordability.

Methods: We designed a multimodality, systems-based approach to address these challenges with the goal of increasing medication utilization across the largest healthcare system in New York State. This multispecialty collaborative included provider and patient education, an electronic health record-enabled platform to identify eligible patients, and access to pharmacists for medication guidance and addressing insurance coverage barriers. Surveys were administered following grand rounds lectures and knowledge-based questionnaires were given before and after case-based sessions for housestaff, with results analyzed using a two-sided Student's *t*-test. Rates of first prescriptions of SGLT2i/GLP1-RA in combined and individual analyses were compared between the pre- and post-education periods (6 months prior to 3/31/2021 and 6 months post 8/19/2021), and the change in prescriptions per 100 eligible-visits was assessed using the incidence density approach.

Results: Among grand rounds participants, 69.3% of respondents said they would make changes to their clinical practice. Knowledge increased by 14.7% (p-value <0.001) among housestaff following case-based sessions. An increase in SGLT2i/GLP1-RA prescribing was noted for eligible patients among internal medicine, cardiology, nephrology, and endocrinology providers, from 11.9 per 100 eligible visits in the pre-education period to 14.8 in the post-education period (absolute increase 2.9 [24.4%], incidence risk ratio 1.24 [95% CI 1.18–1.31]; p-value <0.001). Increases in prescribing rates were also seen among individual medical specialties.

* Corresponding author at: Professor of Cardiology, Zucker School of Medicine, System Director, Cardiovascular Prevention, Northwell Health, Director, Western Region, Katz Institute Women's Heart Program, Director, Women's Heart Program, Lenox Hill Hospital, 110 East 59th Street, New York, NY 10022, United States.
E-mail address: egianos@northwell.edu (E. Gianos).
† The two co-first authors contributed equally to this study and manuscript.

https://doi.org/10.1016/j.ajpc.2023.100608
Received 24 July 2023; Received in revised form 29 August 2023; Accepted 24 September 2023
Available online 26 September 2023

Conclusions: Our "Beyond Diabetes" initiative showed an improvement in provider knowledge-base and was associated with a modest, but statistically significant increase in the use of SGLT2i and GLP1-RA throughout our healthcare system.

1. Introduction

Although lifestyle change remains the cornerstone of therapy for the prevention and treatment of atherosclerotic cardiovascular disease (ASCVD) and type 2 diabetes mellitus (T2DM), sodium-glucose cotransporter 2 inhibitors (SGLT2i) and glucagon-like-peptide 1 receptor agonists (GLP1-RA) demonstrate significant benefits beyond glycemic control and are now standard of care for suitable patients. SGLT2i reduce major adverse cardiovascular events (MACE) and mortality in patients with T2DM and ASCVD and improve outcomes in patients with heart failure with reduced ejection fraction (HFrEF) and heart failure with preserved ejection fraction (HFpEF) [1–3]. At the time the initiative began, this was also the only class of medications, beyond angiotensin-converting-enzyme inhibitors (ACEi) and angiotensin receptor blockers (ARBs), proven to reduce progression of chronic kidney disease (CKD) [4–6]. GLP1-RA have also demonstrated reductions in MACE, all-cause mortality, nonfatal myocardial infarction, and nonfatal stroke among patients with T2DM [7–9], and have demonstrated improvements in other cardiometabolic measures, non-alcoholic fatty liver disease, and weight reduction for eligible patients with obesity [10–12].

This evidence base is supporting a paradigm shift in the management of T2DM beyond glycemic control to a broader, comprehensive strategy of cardiovascular and kidney risk reduction. Promoting greater use of these medications is becoming increasingly necessary. However, their use in clinical practice has been limited by many factors, including the uncertainties of prescribing a medication with glucose-lowering effects among cardiologists, nephrologists, and other healthcare providers [13–16]. A study by Gao et al. reported that 88% of endocrinologists and 50% of primary care physicians (PCPs) prescribed SGLT2i or GLP1-RA at least 6 times a year, whereas less than 7% of cardiology providers prescribed either drug class [16]. Major barriers to prescribing these agents include cost, difficulty with obtaining insurance authorizations, and lack of comfort with treating T2DM, particularly among cardiologists [13]. More recently, the demand of the Glp-1 RA class has also created a supply issue.

Given the challenges in widespread uptake and utilization of these medications with significant cardio-renal-metabolic benefits, our health system undertook a multidisciplinary educational approach to improve utilization of these medications, and created an initiative termed "Beyond Diabetes". The term 'Beyond Diabetes" was chosen to indicate a more current approach to diabetic medication selection with outcomes benefits at the forefront beyond glucose lowering. Herein we describe the multimodal approach taken and the impact on provider knowledge and medication utilization across the core specialties of internal medicine, cardiology, nephrology, and endocrinology.

2. Methods

In May 2019, a multidisciplinary group of physicians from internal medicine, cardiology, nephrology, and endocrinology, alongside pharmacists designed and implemented a multi-modality health system quality improvement initiative across the largest healthcare system in New York State, with 23 hospitals and over 800 ambulatory locations. The group collaborated closely with our medical informatics, strategic planning, and population health departments. The primary goal of the Beyond Diabetes initiative was to increase prescriptions of SGLT2i/GLP1-RA for eligible patients. Core components of the initiative included:

1 Educational sessions, including grand rounds series and case-based lectures
2 Practice support tools, including centralized resources of relevant information and secure pharmacy chat
3 Patient-specific point-of-care dashboard of relevant clinical information embedded within the electronic health record (EHR)
4 Patient education materials provided in four languages

Provider education was delivered through 7 continuing medical education (CME) grand rounds lectures and conference sessions. These were administered via teleconferencing for attendings, housestaff, and advanced care practitioners (ACP) across several departments and divisions, including internal medicine, cardiology, nephrology, and endocrinology. The content provided the evidence-base for prescribing, mechanism of actions, common side effects, guideline recommendations, and a system algorithm for prescribing among different patient groups (Figure S1). The lectures also covered resources available through the Beyond Diabetes initiative to facilitate appropriate prescribing. Following each lecture, a multi-specialty panel answered questions from audience members. Four of the lectures were also made available via a CME on-demand portal for later viewing. Standard post-CME questions, including assessment of bias and attainment of learning objectives, were administered.

Case-based educational sessions were provided system-wide to residency and fellowship programs (3 internal medicine, 3 cardiology, 2 nephrology, and 2 endocrinology). These 1-hour virtual sessions highlighted clinical indications, dosing, contraindications, adverse effects, monitoring, counseling, common prescription insurance questions, and a demonstration of using the Beyond Diabetes resources to overcome barriers to prescribing. Knowledge was assessed via a pre-/post-session questionnaire (Figure S2), with results analyzed using a two-sided Student's *t*-test with equal variance for determination of statistical significance.

The Microsoft Teams application is currently used by our institution for clinical care, communication, operations, and research. We utilized this program as a platform to store and deliver multiple clinician support tools, including a dedicated Beyond Diabetes portal to access provider and patient educational resources and centralize evidence updates and available resources.

A resource (clinical "cheat sheet") guiding appropriate medication selection based on patient-specific comorbidities including T2DM, heart failure, and CKD was developed (Figure S3) and posted on the portal. Medication dosing considerations, indications, contraindications, monitoring frequency, side effects, cardiovascular and kidney outcomes benefits, and patient counseling points were also included. A list of common insurance plans with corresponding preferred drugs for manufacturer copay assistance was also made available and updated quarterly by collaborating pharmacists.

A dedicated, easily accessible Health Insurance Portability and Accountability Act-compliant chat was created for all staff in relevant disciplines (including 2100 clinicians with 1600 physicians and nurse practitioners) to communicate directly with clinical pharmacists for medication-related or insurance coverage questions (Figure S4). The pharmacists provided individual patient recommendations on dosing, drug interactions, adverse effects, and therapeutic substitutions or formulary guidance.

A point-of-care, patient-level decision support dashboard ("Snapshot") embedded in the EHR allowed clinicians to quickly review patient comorbidities, relevant risk factors, and clinical indices for cardiovascular and kidney risk assessment. The existing tool was customized to

present cardiometabolic measures relevant to the Beyond Diabetes initiative for each specialty including measurements, lab results, and a 10-year pooled cohort ASCVD risk calculation (Figure S5). These measures were intended to support implementation of best practices including non-pharmacologic therapies and optimization of appropriate therapy. It also included patient eligibility for SGLT2i or GLP1-RA and other evidence-based therapies based on relevant disease states.

A system-wide educational handout was developed and disseminated to practices for the education of patients on the importance of managing T2DM with lifestyle change as well as newer therapeutics, including on the potential benefits of SGLT2i/GLP1-RA. In addition to English, the handout was translated into the 3 most common languages spoken in our health system, including Spanish, Hindi, and Chinese (Figure S6). To provide additional education on proper administration of subcutaneous injection of GLP1-RA, a patient-friendly set of instructions were created by our pharmacy team (Figure S7).

The educational portion of the initiative occurred during the period of 3/31/2021 to 8/19/2021. The pre-education period was the interval 6 months prior to commencement and the post-education period was 6 months following. We examined the number of initial prescriptions in the pre- and post-education periods, overall and by specialty, and the number of providers prescribing these medications. McNemar's test for paired binary data was used to compare the proportion of providers who prescribed at least one of these medications in the pre period with the proportion in the post period. This comparison assumed that each provider was "at risk" for prescribing in both the pre and post periods, thus creating matched pairs corresponding to each provider.

The primary analysis compared the rates of first prescriptions of either SGLT2i or GLP1-RA in total (objective 1) and separately (objectives 2 and 3) between the pre-and post-education periods. The analysis was performed to measure the change in prescriptions per 100 eligible visits overall and for each specialty, including internal medicine, cardiology, nephrology, and endocrinology. Eligible visits were defined as visits where the patients met criteria for prescription of these medications, as outlined in Table S1, and who had not been prescribed one of the medications on a prior visit.

We counted the number of times a SGLT2i or GLP1-RA was prescribed during visits on or after the date the patient became eligible. We used the incidence density approach to compare prescribing rates between the pre- and the post-education periods, representing the number of initial prescriptions per number of eligible patient visits. Standard Chi-square analysis for 2×2 tables was carried out for the comparison of incidence rates for pre vs. post education visits.

This analysis was done accordingly for each of the three objectives (SGLT2i/GLP1-RA combined; SGLT2i separate; and GLP1-RA separate). Results were reported as the change in prescription rates per 100 eligible visits as well as the incidence risk ratio (IRR) with 95% confidence intervals (CI), the latter providing an estimate of how many times more likely an eligible patient visit in the post period contained an initial prescription as compared with those visits in the pre period.

See the Appendix Methods for additional details.

All analyses were performed using SAS software, version 9.4 (Cary, NC), and the R programming language, version 4.2.0 (R Foundation for Statistical Computing, Vienna, Austria), with figures developed using the latter. This study was deemed exempt by the Feinstein Institutes for Medical Research at Northwell Health's Institutional Review Board.

3. Results

Within our health system, there were 957 internal medicine providers (attending physicians, nurse practitioners, and housestaff), and 511 cardiology, 67 nephrology, and 95 endocrinology providers active in our most commonly used EHR during the period of this study. Prescribing rates in the six months prior to the inception of the Beyond Diabetes initiative demonstrated that these medications were mostly prescribed by endocrinology providers, followed by internal medicine and cardiology providers, while nephrology providers prescribed them the least (Fig. 1). Overall utilization across all specialties was low, highlighting an opportunity for improvement. Among the 1630 providers encompassing the included specialties, 1102 (67.6%) never initiated a new prescription for either SGLT2i or GLP1-RA (1222 [75.0%] for SGLT2i and 1201 [73.7%] for GLP1-RA) (Fig. 2).

CME was provided at three grand rounds for the different specialties and one cardiovascular CME conference, reaching a total number of 746 unique logged in attendees. Based on standardized post-lecture CME surveys completed by 377 participants (50.1%), 92.4% reported that the objectives of the lecture were met, 98.0% reported there was no program bias, and 69.0% reported that they would make changes to their clinical practice as a result of the education provided.

The knowledge survey was administered to 418 residents and fellows. One-hundred nineteen housestaff (28.5%) completed the pre-test, and 63 (52.9% of those completing the pre-test) completed the post-test. Among all disciplines ($n = 119$ pre/63 post), the average increase in percentage answered correctly was 14.7% (p-value <0.001; Table 1). The cardiology fellows showed the greatest improvement in their overall scores with an increase in knowledge score of 16.7%. While endocrinology fellows had the least improvement (5.6%), they also had the highest baseline scores.

In the 6 months preceding the initiative, there were a total of 4213 new prescriptions for SGLT2i (1761) and GLP1-RA (2452) throughout our health system compared to a total of 6243 new prescriptions in the 6-month post-intervention period (2598 and 3645, respectively), with increases seen across all specialties (Fig. 1). The number of providers who had prescribed a SGLT2i or GLP1-RA increased from 528 (32.4%) during the pre-intervention period to 666 (40.9%) in the post-intervention period (p-value <0.001), with increases seen for individual medications and across all specialties (Fig. 2).

Combined SGLT2i/GLP1-RA prescription rates per 100 eligible visits increased from 11.9 to 14.8 among all providers (absolute increase of 2.9 [24.4%], IRR 1.24 [95% CI, 1.18–1.31]; p-value <0.001), with an increase in prescription rates seen across all specialties (Table 2 and Fig. 3). SGLT2i rates per 100 eligible visits increased across all specialties (from 9.3 to 12.8; absolute increase of 3.5 [37.4%], IRR 1.37 [95% CI, 1.25–1.51]; p-value <0.001), although only significant for cardiology (from 8.3 to 14.0; absolute increase of 5.7 [68.6%], IRR 1.69 [95% CI, 1.44–1.98]; p-value < 0.001) and nephrology (from 9.4 to 17.9; absolute increase of 8.5 [90.1%], IRR 1.9 [95% CI, 1.35–2.68]; p-value < 0.001). Rates of GLP1-RA prescribing per 100 eligible visits similarly increased across all specialties (from 12.8 to 14.7; absolute increase of 1.9 [14.6%], IRR 1.15 [9%% CI, 1.08–1.22]; p-value <0.001), and significant for internal medicine (from 12.1 to 13.7; absolute increase of 1.6 [12.9%], IRR 1.13 [95% CI, 1.01–1.26]; p-value = 0.034) and endocrinology (from 25.1 to 31.6; absolute increase of 6.5 [25.7%], IRR 1.26 [95% CI, 1.12–1.41]; p-value <0.001).

4. Discussion

The Beyond Diabetes initiative was developed to promote the use of novel antihyperglycemic agents which demonstrate improved outcomes among select patients with and without T2DM. Our multidisciplinary team provided system-wide education, raised awareness, and provided numerous resources to facilitate the utilization of these medications. To overcome obstacles in prescribing, we provided access to various educational forums, pharmacists, reference materials, EHR-embedded dashboards, and patient handouts. Overall, we received positive feedback for our educational sessions, observed an increase in resident and fellow knowledge and an increase in the number of first-time prescribers, and measured a significant increase in the use of SGLT2i/GLP1-RA for eligible patients in our health system.

Our initiative was associated with in an increase in prescriptions of SGLT2i/GLP1-RA for eligible patients across internal medicine, cardiology, nephrology, and endocrinology. Among all providers, there was

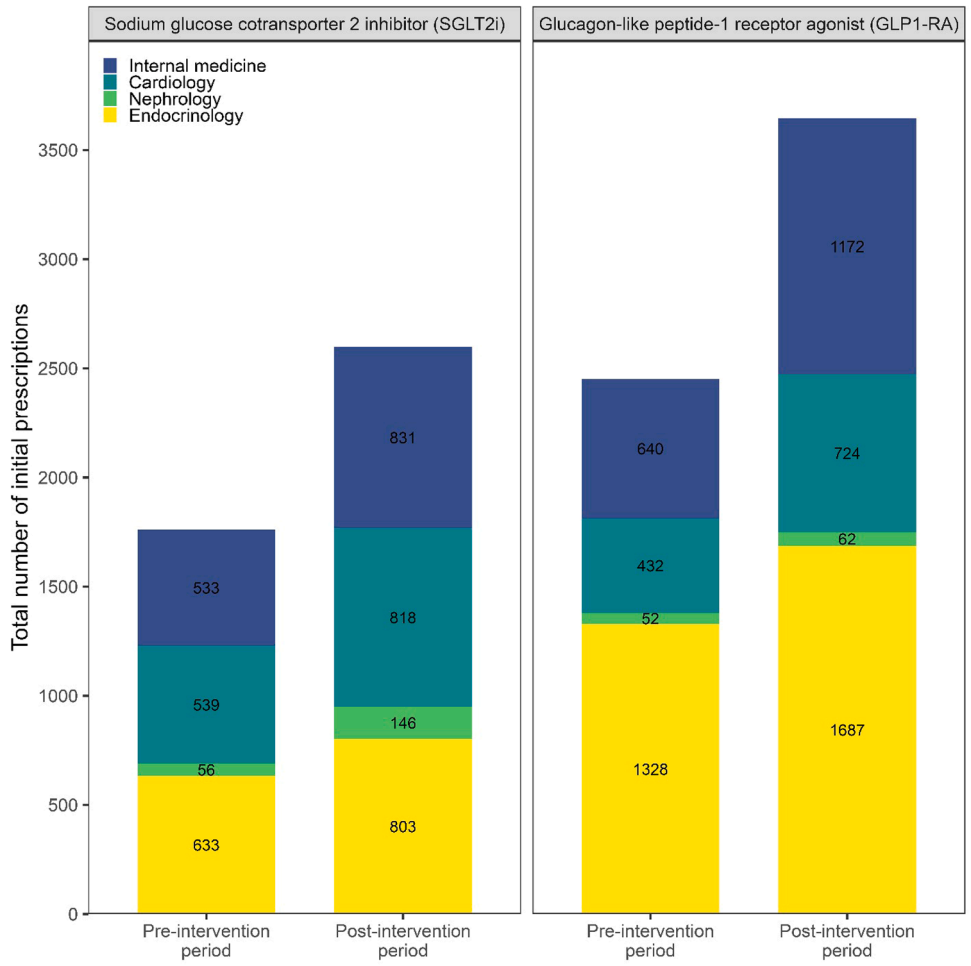

Fig. 1. Overall prescribing rates of SGLT2i and GLP1RA in the 6-month pre-intervention period and the 6-month post-intervention period. The total number of new prescriptions increased in the post-intervention period, with increases seen for both medications and across all specialties.

Fig. 2. Percentage of providers, per specialty and per medication (SGLT2i or GLP1RA), who had ever written an initial prescription for these medications. There was an increase overall and for all specialties and medications in the number and percentage of providers who ever initiated a prescription versus not having ever written one. (SGLT2i, sodium glucose cotransporter 2 inhibitor; GLP1-RA, glucagon-like peptide-1 receptor agonist.).

Table 1
Pre-test and post-test scores on the knowledge-based assessment surveys provided before and after case-based educational sessions demonstrate consistent improvements in knowledge scores for all specialties. P-values were only calculated for the aggregate total due to insufficient sample size to obtain accurate data from the individual specialties.

Provider Specialty	Pre-test (%)	Post-test (%)	Change	P-value
Overall (all specialties combined)	60.9	75.7	14.7	<0.001
Internal Medicine	57.7	72.4	14.7	
Cardiology	66.7	83.3	16.7	
Nephrology	68.2	80.0	11.8	
Endocrinology	83.3	88.9	5.6	

an increase in prescribing of both medications by 24.4% (SGLT2i 37.4% and GLP1-RA 14.6%). For each specialty, there was a significant increase in the overall prescribing of these medications. While the increase may be a result of other factors, our analysis specifically captured the number of prescriptions written per eligible encounter in the timeframe immediately prior to and following the Beyond Diabetes initiative to best represent the efforts of the initiative.

SGLT2i prescribing had the greatest increase for cardiology and nephrology (69% and 90%, respectively), two fields with previously low uptake and where robust new supporting data were being published. Conversely, GLP1-RA showed the largest increase among endocrinologists (26%), perhaps because this medication has potent glucose-lowering effect, weight loss benefits, and greater endocrinology comfort with injectable medications.

The educational case-based sessions resulted in measurable and significant increases in knowledge among our housestaff. The feedback provided for the CME lectures was largely positive, and most providers

Table 2
Change in combined prescription rates for novel antihyperglycemic medications (SGLT2i and GLP1-RA) during the pre- and post-education periods, by medication and specialty, per 100 eligible visits.

Provider Specialty	Pre-education prescription rates	Post-education prescription rates	Absolute change	Percent change	IRR (95% CI)	P-value
All specialties combined						
Overall	11.9	14.8	2.9	24.4	1.24 (1.18–1.31)	<0.001
SGLT2i	9.3	12.8	3.5	37.4	1.37 (1.25–1.51)	<0.001
GLP1-RA	12.8	14.7	1.9	14.6	1.15 (1.08–1.22)	<0.001
Internal Medicine						
Overall	10.8	12.6	1.8	17.1	1.17 (1.07–1.28)	0.001
SGLT2i	8.4	9.7	1.3	15.4	1.15 (0.98–1.36)	0.081
GLP1-RA	12.1	13.7	1.6	12.9	1.13 (1.01–1.26)	0.034
Cardiology						
Overall	9.8	12.9	3.1	32.2	1.32 (1.22–1.44)	<0.001
SGLT2i	8.3	14.0	5.7	68.6	1.69 (1.44–1.98)	<0.001
GLP1-RA	10.1	11.1	0.9	9.2	1.09 (0.99–1.21)	0.083
Nephrology						
Overall	8.9	13.7	4.8	54.0	1.54 (1.21–1.96)	<0.001
SGLT2i	9.4	17.9	8.5	90.1	1.90 (1.35–2.68)	<0.001
GLP1-RA	8.0	8.9	0.9	11.6	1.12 (0.79–1.58)	0.533
Endocrinology						
Overall	22.4	27.5	5.1	23.0	1.23 (1.11–1.36)	<0.001
SGLT2i	14.9	16.1	1.2	7.8	1.08 (0.87–1.33)	0.493
GLP1-RA	25.1	31.6	6.5	25.7	1.26 (1.12–1.41)	<0.001

Abbreviations: SGLT2i, sodium glucose cotransporter 2 inhibitor; GLP1-RA, glucagon-like peptide-1 receptor agonist; IRR, incidence risk ratio.

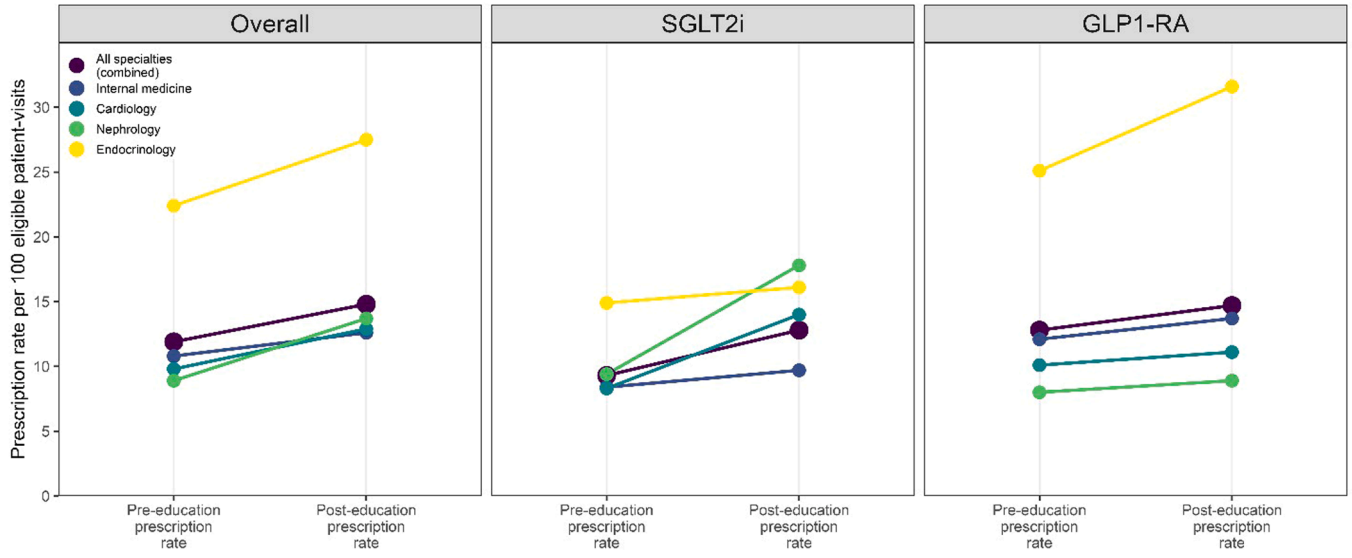

Fig. 3. Change in prescription rates for novel antihyperglycemic medications during the pre- and post-education periods, by medication and specialty, per 100 eligible visits. Across all providers statistically significant increases were seen in the prescribing of the combined SGLT2i and GLP1-RA. Shown also are the prescribing changes for individual medications and specialties.

felt the lectures were non-biased, informative, and would impact their clinical management. In a systematic review of 14 studies, similar educational efforts have been shown to be effective at changing general practitioner prescribing habits, particularly when information was practical, clinically relevant, and credible sources were provided [17].

A similar initiative was presented at the 2022 American College of Cardiology scientific sessions and demonstrated improvements in prescriptions of SGLT2i after education [18], paralleling our findings. The recently published COORDINATE trial, a cluster randomized trial including assessment of local barriers, coordination of care, development of clinical algorithms and tools, and provider education across cardiology clinics, found an odds ratio 3.11 for prescribing of SGLT2i/GLP1-RA [19].

As lack of provider comfort and insurance challenges are known barriers to prescribing, provision of direct access to pharmacy support via chat was an integral part of the initiative. The addition of pharmacy services has been shown to improve patient care [20–22]. Wei et al. demonstrated that the addition of a pharmacist to outpatient primary care clinics resulted in greater utilization of SGLT2i/GLP1-RA prescribing (from 11.6% to 15.0%) [23].

Our initiative also incorporated an automated EHR-embedded tool, allowing providers to quickly identify patient eligibility for therapy. Lan et al. evaluated the effectiveness of an EHR decision-based algorithm to improve lipid and glycemic management for patients with T2DM admitted for acute coronary syndrome and found an increased rate of glycemic control and SGLT2i prescriptions at discharge, but not prescription of non-statin therapies [24]. While our tool may have similarly facilitated an increase in prescription rates of SGLT2i/GLP1-RA, our study was not designed to evaluate specific strategies independently.

The multi-modality Beyond Diabetes initiative is an instructive model to develop strategies for large-scale implementation of quality improvement in a health system. Virtual grand rounds and lecture series provided to multiple disciplines in different locations facilitated system-level dissemination of knowledge, while housestaff case conferences translated knowledge of guideline-indicated therapy to practical approaches for prescribing. Informatics interventions, including our EHR-based tool highlighted eligible patients, and our pharmacy chat provided a cost-effective platform to overcome common prescribing barriers. Lastly, the provision of patient educational material supported patient engagement directly in their care. Given the complexity of managing projects across large health systems and between disciplines, systematic multi-modality implementation of provider education, eligible patient recognition, and provision of resources for overcoming prescribing obstacles can potentially improve the use of guideline directed therapies.

Our initiative has several limitations. It was implemented in multiple forums and shared with providers through various forums; however, we cannot be certain that everyone received equal education and support. Although the focus was on the aggregate benefit of a multi-modal approach, we could not assess the benefit of each individual component of the initiative.

We found an increase in the use of medications among eligible patients following the initiative. However, the initiative was implemented during the COVID-19 pandemic, which may have skewed the results. Additionally, evolving outcomes data, FDA label changes, and guidelines updates from professional societies may have independently affected the results. The prescribing rates evaluated were based upon the initial criteria created at the onset of the initiative, but these indications have since expanded, and prescribing behavior may have improved alongside these changes.

The knowledge-based survey we administered had a low response rate, and we were also unable to provide unique participant identifiers to facilitate pre/post assessments on an individual level. Nonetheless, the responses we did receive showed an aggregate improvement in knowledge following these sessions.

5. Conclusion

Our multi-component and multidisciplinary educational approach in the Beyond Diabetes initiative demonstrated a modest increase in knowledge and prescribing of SGLT2i and GLP1-RA in the largest health system in New York State. Given the importance of these medications for patients with cardio-renal-metabolic disease, the initiative will continue to expand utilization of available resources, including training site-specific champions responsible for educating teams of clinicians and improving the use of these therapies at time of hospital discharge. We believe that this comprehensive educational approach can inform future care delivery models for implementing new guideline directed therapies in large health care systems, potentially translating into improved clinical outcomes.

Funding

The Beyond Diabetes initiative was funded by an educational grant from AstraZeneca for the creation of educational materials to support the initiative.

Ethical considerations

Although the initiative was funded by an industry grant, the company was not involved in the development of the initiative nor the content of this manuscript. The focus of the initiative was to raise awareness and increase utilization of general classes of guideline directed medical therapy. Beyond the evidence base supporting class specific guideline-endorsed recommendations, no greater emphasis was given to any specific medication. The grant covered the cost of the creation of extensive educational content and no funding was paid directly to faculty.

Data availability

The data underlying this article will be shared on reasonable request (s) to the corresponding author.

Disclosures

JSH served on an advisory board for Boehringer Ingelheim and has provided consulting for Kinetix as part of a workgroup. EG received honorarium as moderator for AHA Satellite Symposium, Kaneka Corporation (LDL Apheresis) and NLA Satellite Symposium; honorarium as expert content reviewer and speaker for Educational Program on Familial Hypercholesterolemia – MedAxiom; received an educational grant for the Northwell Beyond Diabetes initiative (AstraZeneca) but did not receive any salary for these efforts as PI, serves on the Academic Steering Committee for the Cardiometabolic Center Alliance and was site PI for the COORDINATE trial. AC served as PI on a research project sponsored by Astra Zenica. RN has received honorarium as clinical content creator/editor for the National Lipid Association. JS has served on a project sponsored by Astra Zenica. All other authors declare no conflict of interest.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Eugenia Gianos reports financial support was provided by AstraZeneca Pharmaceuticals LP. Eugenia Gianos reports a relationship with Kaneka Pharma America LLC that includes: speaking and lecture fees. Eugenia Gianos reports a relationship with National Lipid Association that includes: speaking and lecture fees. Eugenia Gianos reports a relationship with MedAxiom that includes: speaking and lecture fees. Jamie S Hirsch reports a relationship with Boehringer Ingelheim Corp USA that

includes: board membership. Jamie S Hirsch reports a relationship with Kinetix that includes: consulting or advisory. Agnes Cha reports a relationship with AstraZeneca Pharmaceuticals LP that includes: funding grants. Rachel Nahrwold reports a relationship with National Lipid Association that includes: speaking and lecture fees. Jennifer Scanlon reports a relationship with AstraZeneca Pharmaceuticals LP that includes: funding grants. EG serves on the Academic Steering Committee for the Cardiometabolic Center Alliance and was site PI for the COORDINATE trial.

Acknowledgements

The authors thank Dr. Kainat Khalid for her assistance on the Beyond Diabetes project and Ms. Joanna Fishbein for her guidance with the statistical analyses. We'd also like to acknowledge the help of the Northwell pilot group of physicians who provided input and assisted in vetting the educational content.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ajpc.2023.100608.

References

[1] Solomon SD, Vaduganathan M, Claggett BL, et al. Baseline Characteristics of Patients With HF With Mildly Reduced and Preserved Ejection Fraction: DELIVER Trial. JACC Heart Fail Mar 2022;10(3):184–97. https://doi.org/10.1016/j.jchf.2021.11.006.

[2] Gerstein HC, Sattar N, Rosenstock J, et al. Cardiovascular and Renal Outcomes with Efpeglenatide in Type 2 Diabetes. N Engl J Med Sep 2 2021;385(10):896–907. https://doi.org/10.1056/NEJMoa2108269.

[3] McMurray JJV, Solomon SD, Inzucchi SE, et al. Dapagliflozin in Patients with Heart Failure and Reduced Ejection Fraction. N Engl J Med Nov 21 2019;381(21):1995–2008. https://doi.org/10.1056/NEJMoa1911303.

[4] Heerspink HJL, Stefánsson BV, Correa-Rotter R, et al. Dapagliflozin in Patients with Chronic Kidney Disease. N Engl J Med Oct 08 2020;383(15):1436–46. https://doi.org/10.1056/NEJMoa2024816.

[5] Kidney Disease: Improving Global Outcomes Diabetes Work G. KDIGO 2020 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease. Kidney Int Oct 2020;98(4S):S1–115. https://doi.org/10.1016/j.kint.2020.06.019.

[6] Blonde L, Umpierrez GE, Reddy SS, et al. American Association of Clinical Endocrinology Clinical Practice Guideline: Developing a Diabetes Mellitus Comprehensive Care Plan-2022 Update. Endocr Pract Oct 2022;28(10):923–1049. https://doi.org/10.1016/j.eprac.2022.08.002.

[7] Packer M, Anker SD, Butler J, et al. Cardiovascular and Renal Outcomes with Empagliflozin in Heart Failure. N Engl J Med Oct 8 2020;383(15):1413–24. https://doi.org/10.1056/NEJMoa2022190.

[8] Newman JD, Vani AK, Aleman JO, Weintraub HS, Berger JS, Schwartzbard AZ. The Changing Landscape of Diabetes Therapy for Cardiovascular Risk Reduction: JACC State-of-the-Art Review. J Am Coll Cardiol Oct 09 2018;72(15):1856–69. https://doi.org/10.1016/j.jacc.2018.07.071.

[9] Zinman B, Wanner C, Lachin JM, et al. Empagliflozin, Cardiovascular Outcomes, and Mortality in Type 2 Diabetes. N Engl J Med Nov 26 2015;373(22):2117–28. https://doi.org/10.1056/NEJMoa1504720.

[10] Frias JP, Bonora E, Nevarez Ruiz L, et al. Efficacy and Safety of Dulaglutide 3.0 mg and 4.5 mg Versus Dulaglutide 1.5 mg in Metformin-Treated Patients With Type 2 Diabetes in a Randomized Controlled Trial (AWARD-11). Diabetes Care Mar 2021;44(3):765–73. https://doi.org/10.2337/dc20-1473.

[11] Marso SP, Bain SC, Consoli A, et al. Semaglutide and Cardiovascular Outcomes in Patients with Type 2 Diabetes. N Engl J Med. Nov 10 2016;375(19):1834–44. https://doi.org/10.1056/NEJMoa1607141.

[12] Wilding JPH, 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. https://doi.org/10.1056/NEJMoa2032183.

[13] Bolge SC, Flores NM, Huang S, Cai J. Health Care Provider Experience with Canagliflozin in Real-World Clinical Practice: Favorability, Treatment Patterns, and Patient Outcomes. Int J Gen Med 2017;10:177–87. https://doi.org/10.2147/IJGM.S138583.

[14] Vaduganathan M, Sathiyakumar V, Singh A, et al. Prescriber Patterns of SGLT2i After Expansions of U.S. Food and Drug Administration Labeling. J Am Coll Cardiol Dec 25 2018;72(25):3370–2. https://doi.org/10.1016/j.jacc.2018.08.2202.

[15] Bruemmer D, Nissen SE. Prevention and Management of Cardiovascular Disease in Patients with Diabetes: Current Challenges and Opportunities. Cardiovasc Endocrinol Metab Sep 2020;9(3):81–9. https://doi.org/10.1097/XCE.0000000000000199.

[16] Gao Y, Peterson E, Pagidipati N. Barriers to Prescribing Glucose-Lowering Therapies with Cardiometabolic Benefits. Am Heart J Jun 2020;224:47–53. https://doi.org/10.1016/j.ahj.2020.03.017.

[17] Kunstler BE, Lennox A, Bragge P. Changing Prescribing Behaviours with Educational Outreach: An Overview of Evidence and Practice. BMC Med Educ Aug 14 2019;19(1):311. https://doi.org/10.1186/s12909-019-1735-3.

[18] Singhal P, Liu G, Nadeswaran P, et al. Improving Utilization of Sglt2 Inhibitors Via Education at a Single-Center Academic Safety-Net Hospital. J Am Coll Cardiol 2022;79(9_Supplement):1540. https://doi.org/10.1016/S0735-1097(22)02531-1.

[19] Pagidipati NJ, Nelson AJ, Kaltenbach LA, et al. Coordinated Care to Optimize Cardiovascular Preventive Therapies in Type 2 Diabetes: A Randomized Clinical Trial. JAMA 2023;329(15):1261–70. https://doi.org/10.1001/jama.2023.2854.

[20] Anderegg MD, Gums TH, Uribe L, et al. Pharmacist Intervention for Blood Pressure Control in Patients with Diabetes and/or Chronic Kidney Disease. Pharmacotherapy Mar 2018;38(3):309–18. https://doi.org/10.1002/phar.2083.

[21] De Barra M, Scott CL, Scott NW, et al. Pharmacist Services for Non-Hospitalised Patients. Cochrane Database Syst Rev Sep 04 2018;9(9):CD013102. https://doi.org/10.1002/14651858.CD013102.

[22] Kaboli PJ, Hoth AB, McClimon BJ, Schnipper JL. Clinical Pharmacists and Inpatient Medical Care: A Systematic Review. Arch Intern Med May 08 2006;166(9):955–64. https://doi.org/10.1001/archinte.166.9.955.

[23] Wei ET, Gregory P, Halpern DJ, et al. Impact of a Clinical Pharmacist on Provider Prescribing Patterns in a Primary Care Clinic. J Am Pharm Assoc (2003) 2022;62(1):209–13. https://doi.org/10.1016/j.japh.2021.10.007. e1.

[24] Lan NSR, Fegan PG, Rankin JM, Bell DA, Watts GF, Yeap BB. Implementing Simple Algorithms to Improve Glucose and Lipid Management in People with Diabetes and Acute Coronary Syndrome. Diabet Med Dec 2019;36(12):1643–51. https://doi.org/10.1111/dme.14095.