Paganelli MO, *et al*. Impact of Pharmaceutical Care on the clinical and healthcare parameters of individuals with type 2 Diabetes mellitus in primary care within Brazilian Public Health System. J Hosp Pharm Health Serv. 2025;16(3):e1341. DOI:10.30968/jhphs.2025.163.1341.

JHPHS
Journal of Hospital Pharmacy and Health Services

Original Paper

Open Access

Impact of Pharmaceutical Care on the clinical and healthcare parameters of individuals with type 2 Diabetes mellitus in primary care within Brazilian Public Health System

Maria Ondina PAGANELLI, Marília Silveira ALMEIDA-CAMPOS, Leonardo Régis LEIRA-PEREIRA

Faculdade de Ciências Farmacêuticas de Ribeirão Preto, Universidade de São Paulo, São Paulo, Brasil.

Corresponding author: Paganelli MO, ondina.mop@gmail.com

Submitted: 26-03-2025 Resubmitted: 01-09-2025 Accepted: 02-09-2025

Double blind peer review

Abstract

Objective: To evaluate the impact of Pharmaceutical Care (PC) on the control of clinical and healthcare parameters in patients with type 2 diabetes mellitus (T2DM) treated in Primary Care within the Brazilian Unified Health System (SUS) in the municipality of Curitiba, Paraná. **Methods:** A quasi-experimental before-and-after study was conducted, including patients diagnosed with T2DM, aged 18 years or older, who attended at least four pharmaceutical consultations at Curitiba Health Units between April 2014 and November 2018. Data were extracted from the E-Saúde electronic system and statistically analyzed using SPSS software. Healthcare outcomes such as the frequency of consultations and hospitalizations were assessed, along with clinical parameters including glycated hemoglobin, fasting blood glucose, and lipid profiles. **Results:** A total of 93 patients were included in the study, the majority being elderly and female. Pharmacotherapeutic follow-up lasted an average of 16 months, and patients attended approximately eight pharmaceutical consultations. During the intervention period, there was a significant increase in the number of medical and nursing consultations, as well as improvements in clinical parameters, such as a reduction of 40 mg/dL ($p \leq 0.005$) in fasting blood glucose in the PC Period compared to the Pre-PC Period. Glycated hemoglobin decreased by 0.70% ($p=0.039$) in the PC Period versus the Pre-PC Period, and by 1.56% ($p=0.026$) in the Post-PC Period versus the PC Period. No significant difference was observed in mean total cholesterol during the PC and Post-PC periods; however, reductions were noted among patients who initially presented with higher levels. **Conclusion:** PC represents a relevant strategy in the management of T2DM in Primary Care within the SUS. In addition to contributing to glycemic and lipid profile control, its implementation demonstrated potential to strengthen care coordination, fostering integrated collaboration among different healthcare professionals. These findings highlight the importance of multiprofessional collaboration and continuous patient counseling, both of which are essential for preventing T2DM complications and ensuring sustained adherence to therapeutic plans.

Keywords: Pharmaceutical Services, Pharmacists, Diabetes Mellitus, Primary Health Care, Public Health Infrastructure.

Impacto do Cuidado Farmacêutico nos parâmetros clínicos e assistenciais de pessoas com Diabetes mellitus tipo 2 na atenção primária no SUS.

Resumo

Objetivo: Avaliar o impacto do CF no controle de parâmetros clínicos e assistenciais em pacientes com DM2 atendidos na Atenção Primária do Sistema Único de Saúde (SUS) no município de Curitiba/PR. **Métodos:** Foi realizado estudo quase experimental do tipo antes-e-depois, abrangendo pacientes diagnosticados com DM2, com idade igual ou superior a 18 anos, que participaram de pelo menos quatro consultas farmacêuticas nas Unidades de Saúde de Curitiba entre abril de 2014 e novembro de 2018. Os dados foram extraídos do sistema informatizado E-Saúde e analisados estatisticamente utilizando o software SPSS. Foram avaliados desfechos assistenciais, como a frequência de consultas e internações, e parâmetros clínicos, incluindo hemoglobina glicada, glicemia de jejum e perfis lipídicos. **Resultados:** 93 pacientes foram incluídos no estudo, sendo a maioria idosos e do sexo feminino. O acompanhamento farmacoterapêutico teve duração média de 16 meses, e os pacientes participaram de aproximadamente oito consultas farmacêuticas. Durante o período de intervenção, observou-se um aumento significativo no número de consultas médicas e de enfermagem, bem como uma melhoria nos parâmetros clínicos, como redução de 40 mg/dL ($p \leq 0,005$) da glicemia em jejum no Período CF em comparação com o Período Pré-CF. Enquanto, a hemoglobina glicada apresentou redução de 0,70% ($p=0,039$) no Período CF *versus* Pré-CF, e redução de 1,56% ($p=0,026$) no Período Pós-CF *versus* CF. Nos períodos CF e Pós-CF não houve diferença significativa na média do colesterol total, porém observou-se redução dos valores entre os pacientes que inicialmente apresentavam níveis mais elevados.

Conclusão: O CF constitui uma estratégia relevante no manejo do DM2 na AP do SUS. Além de contribuir para o controle glicêmico e do perfil lipídico, sua implementação evidenciou potencial para fortalecer a articulação da assistência, promovendo a coordenação integrada entre os diferentes profissionais de saúde. Esses achados ressaltam a importância da colaboração multiprofissional e da orientação contínua aos pacientes, aspectos fundamentais tanto para a prevenção de complicações do DM2 quanto para a adesão sustentada ao plano terapêutico.

Palavras-chave: Cuidado Farmacêutico, Diabetes Mellitus, Atenção Primária à Saúde, Sistema Único de Saúde.

Introduction

Health systems worldwide are experiencing demographic and epidemiological transitions, including in Brazil, where the epidemiological profile is characterized by the coexistence of infectious and parasitic diseases, maternal and child health issues, and external causes (accidents, falls, poisonings), alongside the predominance of chronic diseases and their risk factors[1]. Furthermore, changes in age groups are observed, with a trend of increase in the population aged over 65 years (from 7.40% to 26.80%) and a decline in the age groups up to 14 years (21.10%–14.72%) and 15 to 64 years (69.38%–59.80%) between 2019 and 2060[2].

In this context, comprehensive, integrated, and continuous care for chronic health conditions prioritizes the coordination of actions, with changes in the pattern of healthcare service utilization and increased expenditures, considering the need for technological incorporation for treatment. These aspects pose significant challenges for health system managers, both in terms of individual responsibility and shared responsibility across different levels of government, aiming to improve health policies to address ongoing transitions[3,4].

Diabetes Mellitus (DM) stands out in the phenomenon of epidemiological transition. The estimated global prevalence of DM in the population aged 20–79 years was 589 million in 2024, and this number is projected to reach 853 million by 2050[5]. In Brazil, in 2024, the population of patients with DM was 16.6 million, with a projection of 24 million by 2050[6]. However, it is known that this number is underestimated, as between 32% and 42.5% of adult DM cases remain undiagnosed[5]. Economically, DM represents a significant burden, both in terms of direct costs to the healthcare system and society, and indirect costs attributable to premature mortality and temporary or permanent disability resulting from its complications[7]. Global expenditures on DM in 2024 were estimated at USD 1.015 trillion, projected to reach USD 1.043 trillion by 2050[5]. For Brazil, costs were estimated at USD 45 billion in 2024, with a projection of USD 52 billion for 2050[5]. Brazilian estimates of outpatient treatment costs for individuals with DM in the Unified Health System (SUS) were approximately USD 2,108 per individual, of which USD 1,335 (63.3%) were direct costs[8].

Type 2 Diabetes Mellitus (T2DM) is a chronic health condition with high prevalence and difficult management, mainly due to incomplete adherence to non-pharmacological treatment, such as increased physical activity, dietary modifications, and cognitive-behavioral therapy to maintain normal blood glucose levels[9]. If non-pharmacological treatment fails to achieve acceptable glycemic control, pharmacological therapy is required. In this context, pharmacists have played a fundamental role in promoting treatment adherence and managing diabetes control[10,11].

From this perspective, pharmaceutical care (PC) is considered a health technology capable of improving the management of chronic diseases and reducing associated morbidities, including T2DM[12-15]. Despite the predominance of pharmacists working in isolation within primary care, the strengthening of their integration into healthcare teams has been driven by institutional and regulatory changes at the national level[16]. Consequently, there remains a need to systematize the pharmacist's experience in primary care and establish a consolidated healthcare model that supports the planning of PC within SUS[17].

However, these national-level changes have not been sufficient to support the planning and implementation of this pharmaceutical practice in SUS, possibly due to the absence of an evaluation model capable of economically justifying the application of health technologies like PC, let alone consolidating the economic return on such investment[17]. In this context, a clinical analysis of PC in the pharmacotherapeutic management of patients within SUS becomes essential. Therefore, the present study evaluated the impact of PC on the control of clinical and care parameters in patients with T2DM attended in Primary Care within SUS in the municipality of Curitiba, Paraná, Brazil.

Methods

Study Design and Period

This is a quasi-experimental before-and-after study conducted with individuals with T2DM receiving PC in Primary Health Units (US) in Curitiba, between April 2014 and November 2018.

Study Setting

The health system in the municipality of Curitiba, Paraná, consists of a network of municipal services, including US, Secondary Care, Psychosocial Care Centers, Emergency Care Units (UPA), hospitals, and the Municipal Laboratory. The US are staffed by multidisciplinary teams composed of physicians, nurses, nutritionists, physiotherapists, psychologists, and physical education professionals. Additionally, Family Health teams receive matrix support from the Family Health Support Center (NASF), including pharmacists.

In 2014, the Department of Pharmaceutical Assistance and Strategic Inputs of the Ministry of Health (DAF/MS), in partnership with the Municipal Health Department of Curitiba, implemented PC in the US with the goal of attending to patients diagnosed with chronic health conditions.

Participants

Pharmaceutical consultations were conducted by 32 NASF pharmacists across 62 of the 109 US in Curitiba. Pharmacists involved in implementing PC in Primary Care were trained in the clinical method. PC was incorporated as part of the clinical activities of Pharmaceutical Assistance in municipal Primary Care, including patients with chronic health conditions aged 18 years or older, of both sexes. For the purposes of this study, patients specifically diagnosed with T2DM, aged 18 years or older, of both sexes, who had participated in at least four pharmaceutical consultations within the PC program in Curitiba US were selected. This criterion was based on previous studies, such as Strand et al. (2004) [18], which demonstrated positive outcomes in identifying and resolving pharmacotherapy problems after four pharmaceutical consultations. Records of pregnant patients with T2DM were excluded from the study.

Intervention

PC integrates health education actions, including continuous education for the healthcare team and general health promotion activities, in addition to promoting the rational use of medicines through clinical and technical-pedagogical activities[19]. The clinical activity, performed at care points, includes services provided by pharmacists, which may be offered individually or in shared consultations with other healthcare team members. Complementary technical-pedagogical activities aim to educate and empower the healthcare team and the community to promote the Rational Use of Medicines[20,21].

In this context, PC consisted of pharmaceutical consultations in which the pharmacist applies the clinical method to identify actual or potential pharmacotherapy-related problems and develops a therapeutic plan to resolve them through clinical activities, such as pharmacotherapeutic follow-up. In the present study, the clinical method followed this sequence: the patient profile was organized by collecting information on medication management ability, social and family history, risk factors, and access to medications. A complete medication history was constructed, assessing the patient's knowledge, adherence, and suspected adverse drug reactions. Subsequently, a clinical history was developed, classifying the current clinical status of each existing health problem. Based on this information, a global assessment of the patient's health condition was conducted. Identified pharmacotherapy-related problems guided pharmaceutical interventions and supported the development of the care plan, established collaboratively with the patient. Patient records were documented using the SOAP format (Subjective: patient complaints and information provided by relatives or companions; Objective: physical examination findings and complementary tests; Assessment and Plan), with explanations provided to the patient. Therapeutic guidance was delivered using patient counseling techniques. Finally, the outcomes of the care process were recorded in the pharmaceutical consultation notes in the patient records[18-20].

Patients were identified through active searches conducted by pharmacists and referrals from the healthcare team. The initial consultation was scheduled following direct contact between the pharmacist or the requesting team professional and the patient. Follow-up consultations were pre-scheduled by the pharmacist according to the patient's needs, usually within 30 to 90 days after the initial consultation. The duration of follow-up and the criteria for discharge from the service were flexible, depending on each patient's needs and agreements with the healthcare team. Furthermore, information collected during consultations, both medical and non-medical, was integrated across the three levels of healthcare (primary, secondary, and tertiary) through the municipality's E-Health Information System[20-22].

Data Collection

The study was divided into three periods:

1. Pre-PC Period (Pre-PC): data collected correspond to the 12 months prior to the implementation of Pharmaceutical Care in the US.
2. PC Period (PC): data collected correspond to the period during which patients were followed under the Pharmaceutical Care program.
3. Post-PC Period (Post-PC): data collected correspond to up to 12 months after discharge or discontinuation of Pharmaceutical Care.

Demographic data (age and sex) and information for the analysis of clinical and care outcomes were collected from patient records for the three periods mentioned above. Care outcomes included medical and non-medical consultations (nurse, pharmacist, physiotherapist, nutritionist, psychologist, among others) in the US, as well as specialized consultations in cardiology, endocrinology, ophthalmology, and nephrology, as recommended by the Brazilian Diabetes Society for managing chronic DM complications[23], visits to Emergency Care Units, hospital admissions, and outpatient procedures (APAC) recorded in the E-Health System.

Clinical parameters analyzed included glycated hemoglobin (HbA1c), fasting glucose, triglycerides, total cholesterol, low-density lipoprotein (LDL), and high-density lipoprotein (HDL). In the Post-PC group, HbA1c was evaluated considering two distinct intervals: 0–90 days and 91–365 days after discharge or discontinuation of Pharmaceutical Care. For the analysis of clinical outcomes related to glycemic and lipid control, therapeutic targets recommended by the Brazilian Diabetes Society[23] and the Brazilian Society of Cardiology[24] were adopted. Glycemic control targets were defined as HbA1c < 7% and fasting glucose ≤ 130 mg/dL. For the lipid profile, the targets were: total cholesterol < 200 mg/dL, LDL < 100 mg/dL, HDL > 40 mg/dL, and triglycerides < 150 mg/dL.

Additionally, data on the use of oral antidiabetic medications and NPH and Regular insulin were collected using the Prescribed Daily Dose (PDD) and Drug Load (DL), including information on the prescription of antihypertensives, statins, and/or insulin.

Data collection from patient records was performed by a pharmacist specialized in Clinical Pharmacy, who did not provide pharmaceutical consultations during the implementation of Pharmaceutical Care in Curitiba.

Data Analysis

Data analysis was conducted using the Statistical Package for the Social Sciences® (SPSS, version 21.0). Quantitative data were summarized as mean and standard deviation (SD), while qualitative data were presented as absolute (n) and relative (%) frequencies. Comparisons of quantitative data means across the three periods (Pre-PC, PC, and Post-PC) were performed using repeated measures ANOVA, followed by Bonferroni post hoc tests.

JHPHS Journal of Hospital Pharmacy and Health Services

To verify whether ANOVA assumptions were met, the Shapiro-Francia test, Levene's test, and Mauchly's test of sphericity were conducted to assess normality within each group, homogeneity of variance, and sphericity, respectively[25]. The significance level was set at 5%.

Ethical Aspects

The study was approved by the National Research Ethics Commission (CONEP), under protocol number CAAE N°5440114.0.0000.0008. In accordance with CNS Resolution No. 466/2012, participant identification was conducted exclusively through codes, ensuring confidentiality and privacy. Data were presented in an aggregated and summarized form, preventing individual identification and ensuring compliance with applicable ethical principles.

Results

During the study period, approximately 18,421 pharmaceutical consultations were recorded in the E-Health System, of which 737 (4.0%) corresponded to 106 patients with T2DM who received four or more pharmaceutical consultations. Of these, 93 were included in the study, as two patients were under 18 years of age and 11 patients were excluded due to missing data in their medical records.

Among the 93 patients included in the study, 64 (68.8%) were female, with a mean age of 66 years (SD: 9.5; range: 41–91), and 83.9% were elderly. Pharmacotherapeutic follow-up had a mean duration of 16 months (SD: 10.6), ranging from 1 to 53 months, with a median of 14 months. The mean number of pharmaceutical consultations per patient was approximately 8 (SD: 5.6), ranging from 4 to 36 consultations.

Statistical assumptions were verified prior to analysis. The Shapiro-Francia test indicated that all variables presented a distribution compatible with normality ($p > 0.05$). Homogeneity of variances between groups was confirmed by Levene's test ($p > 0.05$). For repeated measures models, sphericity was evaluated using Mauchly's test, with no violation observed ($p > 0.05$). Thus, all requirements for the application of parametric tests were met.

Table 1 presents data regarding the profile of consultations performed by patients across different healthcare services, including Primary Care, Secondary Care, UPA, hospitalizations, and outpatient procedures (APAC). In Primary Care, a significant increase was observed in the number of medical and nursing consultations during the PC Period compared to the Pre-PC Period ($p < 0.05$ for both), as well as compared to the Post-PC Period ($p < 0.05$ for both). Regarding other Primary Care professionals, such as nutritionists, physiotherapists, psychologists, and physical educators, no significant differences were observed between periods, except for nutritionists, where the PC Period showed a significant increase compared to the Post-PC Period ($p = 0.014$).

Table 1. Profile of consultations in Primary Care, Secondary Care, visits to Emergency Care Units, hospitalizations, and outpatient procedures (APAC).

	Pre-PC Period (n = 93) Mean ± SD	PC Period (n = 93) Mean ± SD	Post-PC Period (n = 93) Mean ± SD	p-value (PC vs. Pre-PC)	p-value (PC vs. Post-PC)
Primary Care Consultations					
Physician	6.88±4.54	9.63±8.99	5.14±3.43	0.001*	0.0001#
Nurse	6.19±4.93	10.03±10.18	5.00±4.48	0.001*	0.0001#
Nutritionist	0.20±0.62	0.4301±1.17	0.08±0.30	0.275	0.014#
Physiotherapist	0.16±0.47	0.42±1.00	0.16±0.56	0.071	0.108
Psychologist	0.05±0.34	0.11±0.54	0.02±0.14	0.833	0.264
Physical Educator	0.00±0.00	0.05±0.27	0.01±0.10	0.175	0.135
Secondary Care Consultations					
Cardiology	0.10±0.49	0.19±0.66	0.18±0.55	0.572	1.000
Endocrinology	0.12±0.46	0.18±0.61	0.09±0.28	0.827	0.353
Nephrology	0.09±0.32	0.14±0.35	0.04±0.20	0.595	0.058
Ophthalmology	0.34±0.54	0.60±0.77	0.19±0.42	0.02*	0.0001#
Other Services					
Emergency Care Unit (UPA)	1.06±1.98	1.26±2.63	0.63±1.20	0.923	0.083
Hospitalization	0.16±0.47	0.21±0.60	0.16±0.53	1.000	1.000
Outpatient Procedure (APAC)	0.21±0.69	0.34±1.00	0.37±1.08	0.96	1.000

Legend: All values are presented as mean ± standard deviation (SD); Adjustment for multiple comparisons: Bonferroni; PC = Pharmaceutical Care; SD: Standard Deviation. * Significant difference at the 0.05 level between the PC group and the Pre-PC group. # Significant difference at the 0.05 level between the PC group and the Post-PC group.

JHPHS Journal of Hospital Pharmacy and Health Services

In Secondary Care, only ophthalmology consultations showed a significant increase during the PC Period compared to the Pre-PC Period (p = 0.02) and the Post-PC Period (p < 0.0001). For other services, such as visits to UPAs, hospitalizations, and APAC procedures, there was a trend toward increased use during the PC Period compared to other periods, but these differences were not statistically significant.

The profile of visits to UPA was analyzed across the three periods, with a total of 99 visits in the Pre-PC period, 117 in the PC period, and 59 in the Post-PC period. Among these visits, cases related to T2DM, including hypoglycemia, hyperglycemia, adverse drug reactions (ADR), or DM2-related complications, accounted for 46% (46) in the Pre-PC period, 39% (46) in the PC period, and 56% (33) in the Post-PC period.

Regarding the use of insulin, statins, and antihypertensive medications, Table 2 shows that prevalence of use was similar across groups. For the profile of oral antidiabetic medications and NPH and Regular insulin, Metformin showed a slight increase during the PC period, followed by a non-significant decrease in the Post-PC period. NPH insulin, however, exhibited a statistically significant increase during the PC period, followed by a significant decrease in the Post-PC period. For other medications, such as glibenclamide, gliclazide, and Regular insulin, no significant changes in dosages were observed across the analyzed periods (Table 3).

Table 4 presents the evolution of clinical parameters, showing a significant reduction of 40 mg/dL (p ≤ 0.005) in fasting glucose during the PC period compared to the Pre-PC period. Glycated hemoglobin (HbA1c) decreased by 0.7% (p = 0.039) in the PC period versus Pre-PC, and by 1.56% (p = 0.026) in the Post-PC period versus PC, considering the interval of 0–90 days after discharge or completion of Pharmaceutical Care.

Figure 1 presents boxplot graphs for six biochemical parameters evaluated across the Pre-PC, PC, and Post-PC periods. Regarding total cholesterol, the third quartile (Q3), which was above the desirable target in the Pre-PC period, decreased into the target range during the PC period, followed by a further reduction in the Post-PC period.

Table 2. Use of Insulin, Statins, and Antihypertensive Medications.

		Pre-PC period		PC period		Post-PC period	
Medications Used		n (93)	%	n (93)	%	n (93)	%
Insulin	Yes	78	83.9	79	84.9	75	80.6
	No	15	16.1	14	15.1	18	19.4
Statin	Yes	56	60.2	71	76.3	62	66.7
	No	37	39.8	22	23.7	31	33.3
Antihypertensive	Yes	74	79.6	80	86	75	80.6
	No	19	20.4	13	14	18	19.4

Table 3. Usage profile of oral hypoglycemic agents and insulins.

		Monotherapy PDD/DDD			Mean Difference PC vs. Pre-PC	*p*	Mean Difference PC vs. Post-PC	*p*	Mean Difference Pre-PC vs. Post-PC	*p*
Medication (n)	DDD mg/day	Mean ± SD	Mean ± SD	Mean ± SD						
		Pre-PC	PC	Post-PC						
Metformin 850 mg (45)	2000	1.079 ± 0.27	1.13 ± 0.24	1.15±0.21	0.055	0.029*	(-)0.19	1.000	(-)0.74	0.128
Metformin XR 500 mg (4)	2000	0.81 ± 0.24	0.85 ± 0.12	0.9375 ± 0.12	0.043	1.000	(-)0.083	0.768	(-)0.125	1.000
Glibenclamide 5 mg (4)	10	1.12 ± 0.48	1.12 ± 0.48	1.12 ± 0.48	NC	NC	NC	NC	NC	NC
Gliclazide 60 mg (8)	60	1.73 ± 0.66	1.58 ± 0.73	1.55±0.47	(-)0.145	0.264	0.031	1.000	0.176	1.000
NPH Insulin (65)	40	1.20 ± 0.66	1.44 ± 0.63	1.54±0.70	0.237	0.002*	(-)0.099	0.44	(-)0.336	0.001*
Regular Insulin (24)	40	0.38 ± 0.22	0.40 ± 0.23	0.44 ± 0.33	0.023	1.000	(-)0.041	1.000	(-)0.063	0.838
Total Drugload		2.77 ± 1.54	2.92 ± 1.32	2.88 ± 1.32	0.143	1.000	0.037	1.000	(-)0.107	1.000

Legend: All values are presented as mean ± standard deviation (SD). DDD: Defined Daily Dose; PDD: Prescribed Daily Dose; NC: Not Calculated; SD: Standard Deviation. PC: Pharmaceutical Care. p-values are derived from the Bonferroni post hoc test. *The mean difference is significant at the 0.05 level.

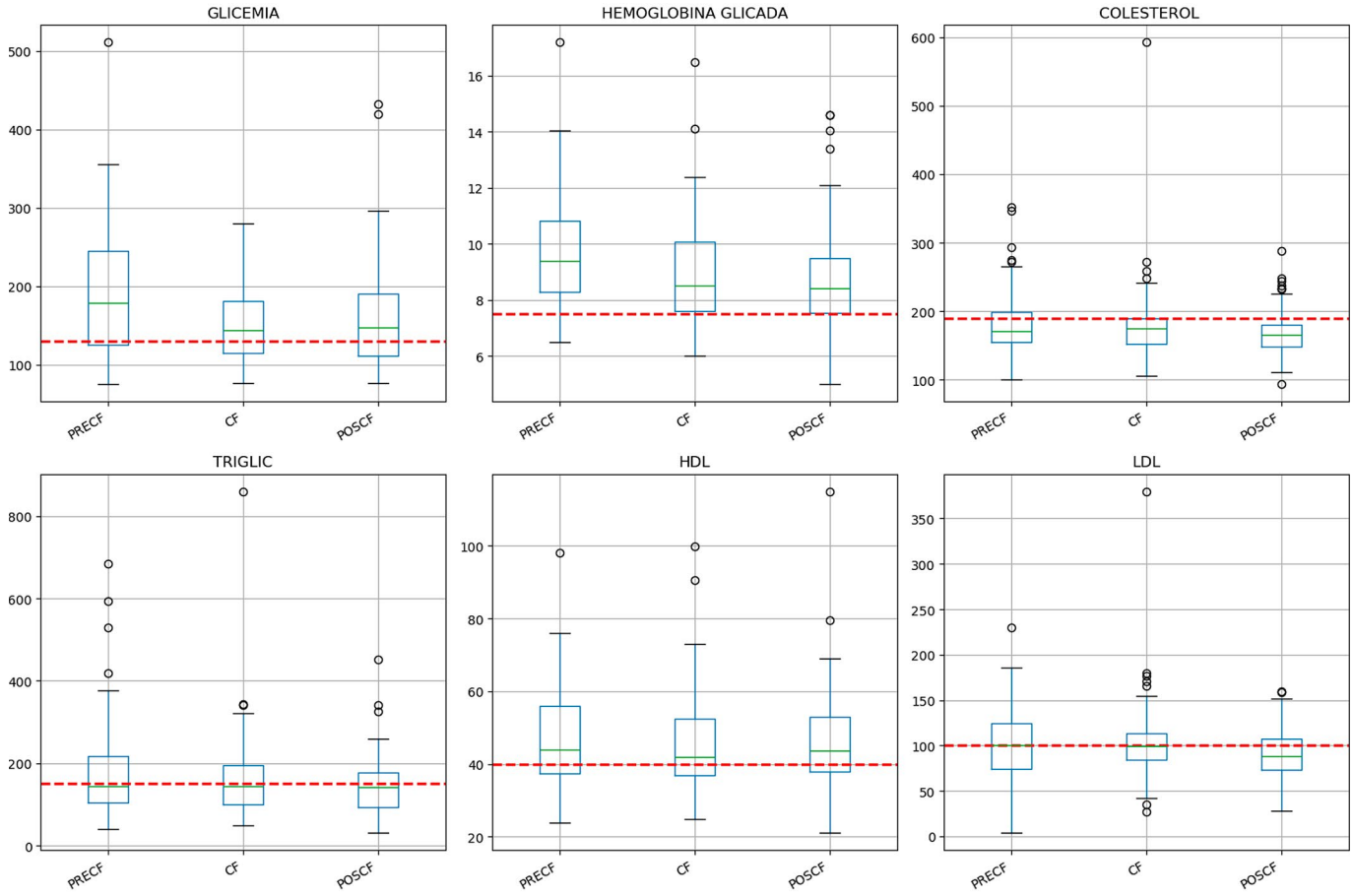
JHPHS Journal of Hospital Pharmacy and Health Services

Table 4. Overall values of lipid and glycemic profiles across the three periods of outcome analysis.

Clinical Outcome	n	Mean ± SD	Mean ± SD	Mean ± SD	Mean Difference PC vs. Pre-PC	*p*	Mean Difference PC vs. Post-PC	*p*	Mean Difference Pre-PC vs. Post-PC	*p*
		Pre-PC	PC	Post-PC						
Triglycerides (mg/dL)	50	174.53±120.96	162.51±117.93	148.89±72.70	(-)1.016	0.709	13.624	0.570	25.640	0.133
Total Cholesterol (mg/dL)	51	179.33±46.10	184.36±68.05	171.21±38.36	5.03	1.000	13.15	0.205	8.12	0.556
LDL-c (mg/dL)	48	99.70±37.18	106.66±51.96	95.69±30.53	6.97	0.703	10.976	0.2	4.006	1.000
HDL-c (mg/dL)	49	47.15±14.30	46.18±14.38	47.22±14.58	(-)0.972	1.000	(-)1.043	1.000	(-)0.71	1.000
Fasting Glucose (mg/dL)	47	188.54±87.7	148.53±48.56	164.31±76.54	(-)40.01	0.005*	(-)1.78	0.645	24.22	0.321
Glycated Hemoglobin										
0–90 days Post-PC	23	9.63±2.52	9.02±2.21	8.07±1.20	(-)0.610	0.823	0.952	0.062	1.562	0.026*
91–365 days Post-PC	52	9.78±2.20	9.08±1.89	8.82±2.17	(-)0.703	0.039	0.258	0.321	0.961	0.27

Legend: All values are presented as mean ± standard deviation (SD). Adjustment for multiple comparisons: Bonferroni; PC = Pharmaceutical Care. *The mean difference is significant at the 0.05 level.

Figure 1. Distribution of clinical parameters during the Pre-Pharmaceutical Care, Pharmaceutical Care, and Post-Pharmaceutical Care periods.



Legend: The red dashed line indicates the therapeutic target for pharmacological treatment recommended by the Brazilian Diabetes Society[23] and the Brazilian Society of Cardiology[24]. PRE-PC: Pre-Pharmaceutical Care Period; PC: Pharmaceutical Care Period; POST-PC: Post-Pharmaceutical Care Period. Units of measurement are mg/dL for triglycerides, total cholesterol, fasting glucose, HDL, and LDL. Glycated hemoglobin (HbA1c) values are expressed as a percentage (%).

Discussion

The profile of Primary Care users of SUS identified in this study reflects the national picture of individuals living with uncontrolled T2DM, predominantly aged over 60 years. Additionally, the study highlights the higher prevalence of T2DM among elderly women, particularly in primary care services[6,26].

Pharmaceutical Care demonstrated a significant impact on T2DM management, especially in glycemic and lipid control, reflecting an overall improvement in metabolic control[15,27]. This effect is often associated with intensified guidance on rational medication use, treatment adherence, and health education—central aspects of the pharmacist's role in pharmacotherapeutic follow-up in collaboration with the healthcare team[19].

Furthermore, health should be understood as an essential asset requiring a holistic approach, in which care goes beyond disease treatment and includes prevention, health promotion, and rehabilitation[22]. In this context, the increase in the number of medical, nursing, and nutrition consultations (Table 1) may be related to the pharmacist's role in identifying health needs and/or pharmacotherapy-related issues, prompting referrals and additional interventions by other members of the multidisciplinary team[27].

Interdisciplinary collaboration is fundamental to effective care. According to the Brazilian Diabetes Society[23], integration across different areas enhances rational medication use, promotes self-care, and improves clinical outcomes[28-30]. In this context, awareness of the role of nutrition in T2DM management is particularly relevant. When combined with clinical follow-up and team-based work, nutrition constitutes one of the pillars for achieving adequate metabolic control[21,30].

Comprehensive care, therefore, requires continuous coordination among healthcare professionals, enabling not only the development of shared therapeutic plans but also the implementation of safer and more effective interventions that reduce risks and optimize outcomes[21,22]. Within this scenario, PC emerges as a strategic integration tool, facilitating communication among professionals and enhancing the effectiveness of health interventions with a patient-centered focus[19,28].

In the context of PC, pharmacotherapeutic follow-up allows continuous patient monitoring, enabling individualized therapy adjustments to optimize medication dosages[19], such as NPH insulin and metformin (Table 3), through ongoing assessment of clinical and laboratory parameters, including fasting glucose, glycated hemoglobin, treatment adherence, and adverse effects[19].

Regarding the lipid profile, there is a tendency toward improvement in total cholesterol, triglycerides, and LDL levels in patients followed by pharmacists. This contribution is particularly relevant given that individuals with T2DM have an increased cardiovascular risk, and adequate lipid control reduces events such as myocardial infarction and stroke[31,32]. Thus, the integration of pharmacists within the multidisciplinary team enhances cardiovascular risk management, amplifying the benefits of therapy.

It is important to highlight that pharmacotherapeutic follow-up is not limited to laboratory monitoring but also includes the identification and resolution of medication-related problems, general guidance on lifestyle changes—such as adherence to a healthy diet and regular physical activity as self-care practices—and the development of strategies to improve pharmacotherapy adherence[27,33]. These dimensions expand the reach of interventions and support both glycemic and lipid control, aligning with comprehensive care policies for T2DM[19,32].

This study has some limitations that should be considered when interpreting the results. First, this is not a controlled clinical trial, as ethical constraints related to withholding the intervention from a control group prevented this design. This characteristic limits the ability to establish causal relationships between the interventions performed and the outcomes observed. In addition, intermediate variables, such as laboratory parameters (glycemic control and lipid profile), were analyzed, which do not constitute deterministic morbidity or mortality outcomes. Although these markers are widely used in clinical research and recognized as relevant indicators, they do not necessarily directly reflect the occurrence of final clinical outcomes, such as micro/macrovascular complications or mortality.

Nevertheless, this study provides data on the care of patients with T2DM over approximately four years in primary care, considering the Pre-PC and Post-PC periods, and reinforces the strategic role of pharmacists within the healthcare team. Pharmacists contribute to optimizing pharmacotherapy and coordinating care in primary care settings alongside multidisciplinary teams[19], supporting the maintenance of positive long-term clinical outcomes. Therefore, the findings of this study may provide evidence to support the implementation and expansion of Pharmaceutical Care in other Brazilian municipalities, contributing to improved management of patients with T2DM and enhancing the quality of primary healthcare nationwide.

Conclusion

Pharmaceutical Care represents a relevant strategy for managing T2DM in Primary Care within SUS. In addition to contributing to glycemic and lipid profile control, its implementation demonstrated potential to strengthen care coordination by promoting integrated collaboration among different healthcare professionals. These findings highlight the importance of multidisciplinary collaboration and continuous patient guidance, which are essential both for preventing T2DM complications and for ensuring sustained adherence to the therapeutic plan.

Funding Sources

This research did not receive specific funding for its conduct.

Contributions

MOP participated in the project conception, data collection and analysis, and manuscript writing. MSAC contributed to data analysis and manuscript drafting. LRLP participated in project conception, data analysis, and critical manuscript review. All authors approved the final version for publication and are responsible for the information contained in the article, ensuring accuracy and integrity of all parts.

Conflicts of Interest

The authors declare no conflicts of interest related to this article.

JHPHS
Journal of Hospital Pharmacy and Health Services

References

1. Organização Pan-Americana da Saúde A atenção à saúde coordenada pela APS: construindo as redes de atenção no SUS: contribuições para o debate. Brasília: Organização Pan-Americana da Saúde;2011.
2. Gomes MMF, Esteves MP, Barbosa DBA, et al. Estudo Técnico no 23/2013; Projeções populacionais para o Brasil (2000-2060) e estimativas da população para grandes regiões (2000-2030): síntese de resultados de publicação do IBGE. Brasília: MDS;2013.
3. Malta DC, Merhy EE. The path of the line of care from the perspective of nontransmissible chronic diseases. Interface - Comunic, Saude, Educ. 2010;14(34):593-605. doi:10.1590/S1414-32832010005000010.
4. Cavalcante WT, Filgueiras MF, Olanda DES, *et al*. Gestão do cuidado em pessoas com doenças crônicas. Braz J Dev. 2023;9(5):16345-16354. doi:10.34117/bjdv9n5-123.
5. Hossain MJ, Al-Mamun M, Islam MR. Diabetes mellitus, the fastest growing global public health concern: Early detection should be focused. Health Sci Rep. 2024;7(3):e2004. doi: 10.1002/hsr2.2004.
6. Muzy J, Campos MR, Emmerick I, *et al*. Prevalência de diabetes mellitus e suas complicações e caracterização das lacunas na atenção à saúde a partir da triangulação de pesquisas. *Cad Saude Publica*. 2021;37(5):e00076120. doi:10.1590/0102-311X00076120.
7. GBD 2021 Diabetes Collaborators. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet*. 2023;402(10397):203-234. doi:10.1016/S0140-6736(23)01301-6.
8. Bahia LR, Araujo DV, Schaan BD, *et al*. The costs of type 2 diabetes mellitus outpatient care in the Brazilian public health system. *Value Health*. 2011;14(5 Suppl 1):S137-S140. doi:10.1016/j.jval.2011.05.009.
9. Młynarska E, Czarnik W, Dzieża N, *et al*. Type 2 Diabetes Mellitus: New Pathogenetic Mechanisms, Treatment and the Most Important Complications. *Int J Mol Sci*. 2025;26(3):1094. doi:10.3390/ijms26031094.
10. Aguiar PM, da Silva CHP, Chiann C, *et al*. Pharmacist-physician collaborative care model for patients with uncontrolled type 2 diabetes in Brazil: results from a randomized controlled trial. *J Eval Clin Pract*. 2018;24(1):22-30. doi:10.1111/jep.12606.
11. Alhabib S, Aldraimly M, Alfarhan A. An evolving role of clinical pharmacists in managing diabetes: Evidence from the literature. *Saudi Pharm J*. 2016;24(4):441-446. doi:10.1016/j.jsps.2014.07.008.
12. Pereira LRL, Freitas ODA. A evolução da Atenção Farmacêutica e a perspectiva para o Brasil. Rev Bras Cienc Farm. 2008;44(4):601-12, 2008. doi:10.1590/S1516-93322008000400006.
13. Zubioli A, Silva MARCP, Tasca RS, *et al.* Pharmaceutical consultation as a tool to improve health outcomes for patients with type 2 diabetes. *Braz J Pharm Sci*. 2013; 49(1):85-94. doi:10.1590/S1984-82502013000100010.
14. Pereira LB, Guidoni CM, Borges APS, *et al.* Evaluation of the effectiveness of pharmacotherapy follow-up in long-term control of diabetes mellitus type 2. Clin Biomed Res. 2018; 38(3):237-244. doi:10.22491/2357-9730.81089.
15. Bakhsh HT. Impact of Pharmacist Interventions on Health Outcomes of Patients with Type 2 Diabetes Mellitus in the Middle East: A Systematic Review. Integr Pharm Res Pract. 2025;14:85-98. doi: 10.2147/IPRP.S515197.
16. Barberato LC, Scherer MDA, Lacourt RMC. O farmacêutico na atenção primária no Brasil: uma inserção em construção. Cien Saúde Colet. 2019; 24(10):3717-3726. doi:10.1590/1413-812320182410.30772017.
17. Zucchi P, Ferraz M. Economia e gestão em saúde - Avaliação econômica em saúde. Barueri: Manole;2010.
18. Strand LM, Cipolle RJ, Morley PC, *et al*. The impact of pharmaceutical care practice on the practitioner and the patient in the ambulatory practice setting: twenty-five years of experience. *Curr Pharm Des*. 2004;10(31):3987-4001. doi:10.2174/1381612043382576.
19. Brasil. Ministério da Saúde. Secretaria de Atenção Primária à Saúde. Departamento de Promoção da Saúde. Cuidado Farmacêutico na Atenção Básica: aplicação do método clínico. Brasília: Ministério da Saúde;2020.
20. Ministério da Saúde. Gestão do Cuidado Farmacêutico na Atenção Básica. Brasília: Ministério da Saúde;2019.
21. Ministério da Saúde. Serviços farmacêuticos na atenção básica à saúde. Brasília: Ministério da Saúde;2014.
22. Malta D, Silva M, Albuquerque G, *et al*. Política Nacional de Promoção da Saúde, descrição da implementação do eixo atividade física e práticas corporais, 2006 a 2014. Revista Brasileira de Atividade Física & Saúde. 2014; 19(3):286. doi: 10.12820/rbafs.v.19n3p286.
23. Sociedade Brasileira de Diabetes. Diretrizes da Sociedade Brasileira de Diabetes 2023/.2024. São Paulo: SBD;2023.
24. Faludi AA, Izar MCO, Saraiva JFK, *et al.* Atualização da Diretriz Brasileira de Dislipidemias e Prevenção da Aterosclerose – 2017. *Arq Bras Cardiol*. 2017;109(2 Supl 1):1-76. doi:10.5935/abc.20170121
25. Fávero PF, Belfiore P. Manual de Análise de Dados – Estatística e Machine Learning com Excel, SPSS, Stata, R e Python. Rio de Janeiro: LTC; 2024.
26. Ministério da Saúde. Vigitel Brasil 2023: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico: estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2023. Brasília: Ministério da Saúde;2023.

27. Coutureau C, Slimano F, Mongaret C, *et al*. Impact of Pharmacists-Led Interventions in Primary Care for Adults with Type 2 Diabetes on HbA1c Levels: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health*. 2022;19(6):3156. doi:10.3390/ijerph19063156.

28. Conselho Nacional de Secretarias Municipais de Saúde. Instrumento de referência dos serviços farmacêuticos na Atenção Básica. Brasília: CONASEMS;2023.

29. Malerbi F, Andrade R, Morales P, *et al.* Manejo da retinopatia diabética. São Paulo: Sociedade Brasileira de Diabetes; 2023. doi: 10.29327/557753.2022-17.

30. Seyffarth AS, Lima LP, Leite MC. Abordagem nutricional em *diabetes mellitus*. Brasília: Ministério da Saúde;2000.

31. Borges APS. Avaliação do impacto clínico e da viabilidade econômica da implantação de um modelo de atenção farmacêutica em uma UBDS de Ribeirão Preto-SP. Faculdade de Ciências Farmacêuticas de Ribeirão Preto: Ribeirão Preto;2008. doi:10.11606/D.60.2008.tde-03122008-171950.

32. Arnett DK, Blumenthal RS, Albert MA, *et al.* 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*. 2019;140(11):e563-e595. doi:10.1161/CIR.0000000000000677.

33. Cipolle RJ, Strand LM, Morley PC. Pharmaceutical Care Practice: the patient-centered approach to medication management. New York: McGraw-Hill; 2012.