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Economic Evaluation

Is the Risk Really Shared? A Retrospective Analysis of Healthcare Costs of Patients With Type 2 Diabetes Mellitus on a Capitation Model

Lovina A. Naidoo, MPharm, Neil Butkow, PhD, Paula Barnard-Ashton, PhD, Jacqueline Miot, PhD, Elena Libhaber, PhD

ABSTRACT

Objectives: Private managed healthcare organizations in South Africa (SA) use a capitation model of care for patients within their healthcare delivery systems for the optimal management of type 2 diabetes mellitus (T2DM) to reduce healthcare costs. Few studies have categorized healthcare costs at a patient level to determine the actual healthcare costs incurred by private insurers for T2DM in SA. This study estimated the direct medical costs of patients with T2DM registered with a private health insurer over a 5-year period between 2 funding models: a capitated risk-sharing model (CM) versus a traditional fee-for-service (FFS) model.

Methods: This population-based cohort study used retrospective claims data of patients with T2DM from 2012 to 2016 of a private medical scheme in SA. Annual healthcare costs of T2DM were assessed.

Results: During the 5-year period, most of the identified patients with T2DM were enrolled in CM—534 (64%) of 828 in 2012, which rose to 789 (81%) of 971 in 2016. The median annual healthcare costs of the treatment and management of the patients with T2DM was significantly higher in CM ($2002 [interquartile range (IQR) 2106] in 2012 to $1095 [IQR 1042] in 2016) than FFS ($582 [IQR 772] to $296 [IQR 507]) ($P<.0001$). A total of 46 patients with T2DM incurred hospitalization costs of ≥$24 243 for a T2DM or other event; 33 were enrolled on CM.

Conclusions: The patients with T2DM on CM accrue significantly higher annual healthcare costs than patients on FFS. The greatest portion of the overall T2DM healthcare costs was associated with high-cost hospitalization of T2DM complications.

Keywords: capitated risk-sharing model, healthcare cost, managed healthcare, type 2 diabetes mellitus.

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Introduction

Type 2 diabetes mellitus (T2DM) continues to be a relentless public health problem affecting a vast number of individuals worldwide. The latest South African estimate is that 12.7%[1] of adults (20-79 years old) have T2DM, which has increased from earlier reports of 7% in 2015.[2] Funding for T2DM treatment and management must compete with not only other non-communicable diseases but also communicable diseases such as HIV/AIDS, tuberculosis, and other infectious diseases in sub-Saharan Africa.[3,4]

South Africa (SA) has a dual tiered healthcare system that is privately financed and covers 15% of the population[5] with an underfunded public sector that struggles to provide adequate healthcare for the 85% balance of the population.[6] Private medical schemes in SA are registered nonprofit organizations that guarantee payment for medical services to its members.[7] The government of SA has been explicit in its plans to roll out a more equitable National Health Insurance (NHI) scheme to provide universal health coverage for all South Africans.[8] A preliminary analysis using probabilistic modeling found that the capitation intervention model of T2DM care could be a cost-effective management strategy within the South African public sector for the NHI.[9] An in-depth understanding of how capitation models could affect or assist in the financing of the proposed universal health coverage is yet to be enumerated.

Comorbidities are common among T2DM individuals, compounding healthcare resource utilization and costs.[10] Patients with T2DM most commonly have cardiovascular comorbidities incurring significant financial burden[11] in addition to diabetic retinopathy and nephropathy costs. Medical schemes in SA use capitated risk-sharing models (CMs) of care for patients with T2DM within their healthcare delivery systems with the aim of reducing healthcare costs while improving patient outcomes.[12] In this model of care, insurers establish risk pools for each provider to act in the overall best interest of the patient. Providers that offer diabetes management programs (DMPs) contract with medical insurers and offer a minimum level of servicing for their enrolled patients with diabetes. The DMPs provide out-of-hospital diabetes-related services, which include medical care from various

health specialists, including general practitioners, medical specialists and allied health professionals, pharmaceuticals, and medical consumables. The only in-hospital diabetic emergencies covered are restricted to diabetic ketoacidosis (DKA) and hypoglycemia crises by the DMPs.[13] In theory, overall risk should be shared between the DMP and the health insurer.

Payment to DMPs is made prospectively as a cost-containment strategy. Financial incentives for DMPs in a CM are to attract additional enrollees; nevertheless, this may lead to the selection of healthier enrollees and underprovision of services.[14] Conversely, in a fee-for-service (FFS) payment system, the provider or facility is reimbursed for each service provided, creating a strong incentive for increased (possible over) delivery of service to achieve a higher revenue.[15] Therefore, we aimed to estimate the healthcare costs in a cohort of patients with T2DM in a privately managed healthcare organization over a 5-year period between 2 funding models: a CM versus a traditional FFS model.

Methods

The study intended to estimate the complete medical costs including the capitation fee, T2DM and other treatment, management, and hospitalization costs to be able to compare the costs of the 2 models. The 2 models were compared with respect to total out-of-hospital costs and total in-hospital costs. This was a retrospective cross-sectional study of the administrative claims database of T2DM members of a South African private medical scheme. The scheme had an agreement with a service provider using a capitation and risk-sharing model for a DMP. Data were sourced from the iMed database, a commercially available administrative system that maintains membership data, claims processing, and contribution premiums of members of private medical schemes.

The iMed database included patient-level demographics and details of scheme member registration on CM and FFS. Records of medicines, diabetic supplies, treatment by providers, and hospitalization cases in conjunction with claims data were identified via the 10th revision of the International Classification of Diseases and Related Health Problems (ICD10) diagnosis codes.[16] The T2DM-related ICD10 codes used were E03 (other hypothyroidism) to E89 (postprocedural endocrine and metabolic complications and disorders), G45 (transient cerebral ischemic attacks and related syndromes) to G64 (other disorders of peripheral nervous system), H25 (age-related cataract) to H40 (glaucoma), I10 (essential hypertension) to I95 (hypotension), and N17 (acute kidney failure) to N19 (unspecified kidney failure). The remaining codes were classified as other, that is, not directly related to the T2DM codes.

Patients

Once the treating doctor has registered their condition with the medical scheme (via a telephonic or written prescription), members who received a diagnosis of T2DM register on the scheme's chronic program for funding of their diabetic medications and medical management (consultations and procedures) for T2DM. Effective from 2000, scheme members who received a diagnosis of T2DM were encouraged to enroll onto the DMP. The T2DM members who opted out of the DMP were managed within the medical scheme on a medicine management program via FFS. In FFS, the patients visited doctors, nurse educators, dietitians, podiatrist, and pharmacy of their own choosing for self-management of their diabetes. The FFSs for the diabetic services rendered to the patients with T2DM were reimbursed by the insurer on receipt of a claim from the respective service provider.

Patients with T2DM on the DMP visited a multidisciplinary team of doctors, diabetes nurse educators, dietitians, podiatrist, and pharmacy at an allocated facility for review of their diabetes management and treatment. The capitation fee covered the costs of the DMP service providers and diabetic oral and parenteral medications. The capitation fee was paid directly by the medical scheme, through the finance department, into the DMP bank account in advance for active members on CM. The DMP organization invoiced the capitation fee for the active members serviced in the previous month and refunded the insurer for patients who had resigned, were deceased, or opted out of the DMP and did not receive diabetic services. The insurer terminated the contract of DMP at the end of 2016 because of an increased number of member's requests to deregister from the CM, who preferred their own doctors to manage their diabetes, and the increase in the healthcare cost of the patients with T2DM on the CM.

Patients (>18 years old) were classified as having T2DM, if they had any of the ICD10 diagnosis codes of E11.0 (T2DM with hyperosmolarity) to E11.9 (T2DM without complications) as stated by the practitioner. These ICD10 codes were obtained from the Council of Medical Schemes Prescribed Minimum Benefit ICD10 coded list 2013.[17] In addition, the patients with T2DM who received a diagnosis of coronary artery disease, dysrhythmia, deep vein thrombosis, stroke, or valvular heart disease were further classified as having a thromboembolic comorbidity in this analysis.

Identified patients with T2DM were further stratified into 2 mutually exclusive funding models based on the program enrolment records, that is, patients with T2DM enrolled onto CM and patients with T2DM registered on FFS. In Figure 1, the movement of patients with T2DM in CM and FFS from 2012 to 2016 is depicted. Each year, patients with T2DM joining the scheme as new members were encouraged to enroll onto CM at the time of member registration. Existing scheme members registered on FFS when they received a diagnosis of T2DM were urged to enroll onto CM. Within this cohort, 105 patients with T2DM (new or existing members on the scheme) voluntarily moved between the 2 funding models between 2012 and 2016. Deceased or resigned patients were accounted for the full year, and their healthcare costs included until the date of their demise or resignation.

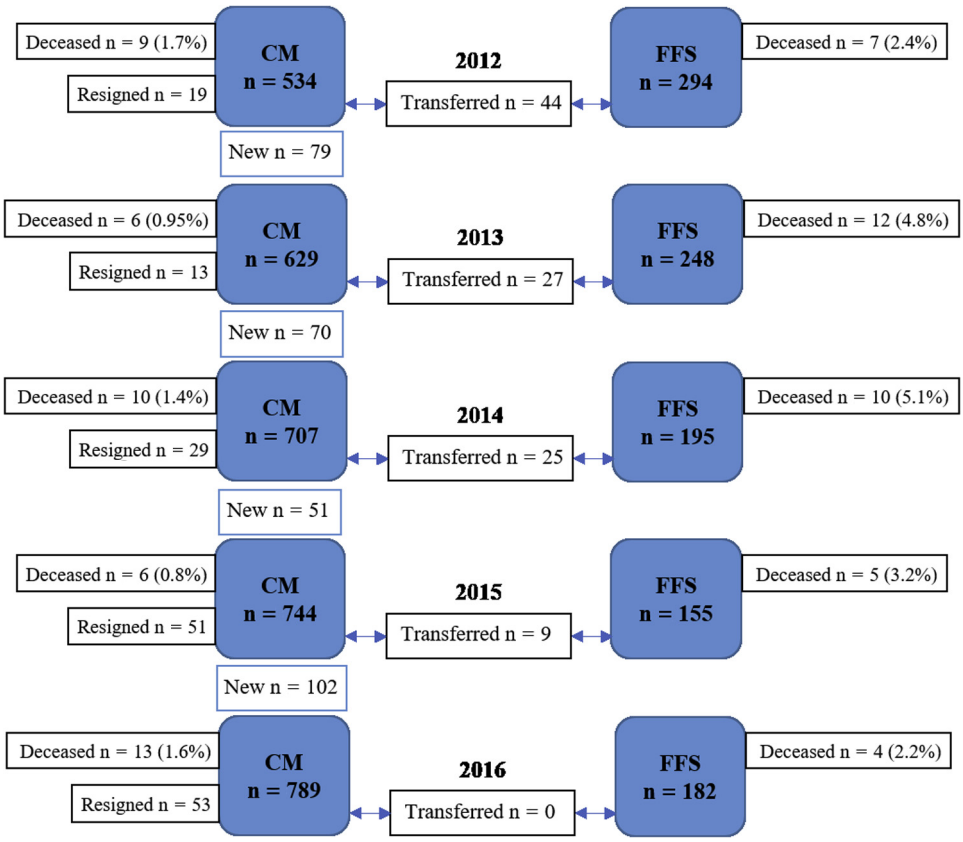
Ethical Considerations

Confidentiality was maintained throughout the analysis; the patients' unique scheme membership number and dependent code were used to align patient-level records. The study was approved by the University of the Witwatersrand, Johannesburg, Faculty of Health Sciences Human Ethics Committee (M140326). Approval was also granted by the Principal Officer of the scheme, for the scheme data to be used in the study and by the Human Resources Manager of the scheme administrator to gather data from the iMed database for the research. Approval was obtained from the chief executive officer of the CM for the transaction records of T2DM members enrolled on the DMP.

Categorization of Healthcare Costs

The healthcare costs were compared between FFS and CM and categorized as in-hospital and out-of-hospital medicines and out-of-hospital services (Fig. 2). In-hospital related costs included all in-hospital treatment, procedures, and emergencies for diabetes. Medicine fees included out-of-hospital diabetic and nondiabetic medicines. Services charged included all out-of-hospital physician visits, auxiliary services, laboratory, and radiology services for diabetes.

Figure 1. Movement of patients with T2DM within the CM and FFS per year.



CM indicates capitated risk-sharing model; FFS, fee-for-service; T2DM, type 2 diabetes mellitus.

Estimated Healthcare Costs

Healthcare costs were estimated based on member scheme plan options- and patient-paid amounts for medicines, services, and hospital claims on FFS and CM and were measured by category type across the 5 years using claims data and included (1) T2DM-related and other in-hospital costs defined as total per-patient-per-year (PPPY) cost related to all inpatient length of stay (LOS), treatment, procedures, surgical and medical appliances, and emergencies; (2) out-of-hospital medicine costs, defined as total PPPY cost related to all diabetic, nondiabetic chronic and acute, and over-the-counter medicines; (3) out-of-hospital services costs, defined as total PPPY cost related to out-of-hospital physician visits, auxiliary services, and laboratory and radiology services for diabetes and other events; and (4) capitation fee costs, defined as per-member-per-month enrolled on the CM, which for patients on oral treatment were $121, $99, $86, $64, and $65 and for patients on insulin or parenteral treatment were $287, $236, $205, $152, and $154 (2012-2016).

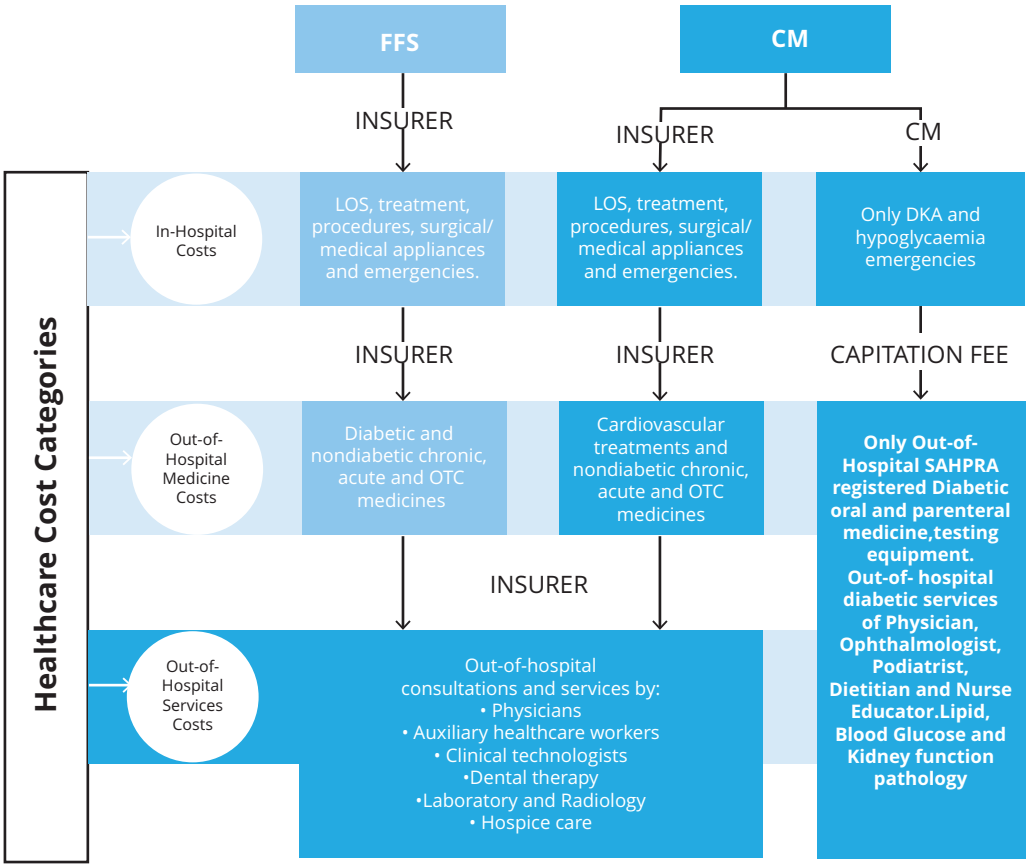
Given that the medicine and services fees covered by the insurer were categorized differently between FFS and CM, these costs were categorized as out-of-hospital expenditure and defined as out-of-hospital PPPY medicine + services + capitation fee per-member-per-month for the CM and PPPY medicine + services (diabetic and nondiabetic) for the FFS. The calculated costs represent total costs incurred by the insurer. Hospital claims for DKA and hypoglycemia admissions of patients with T2DM on the CM were invoiced by the medical scheme directly to the DMP. The DMP provider responsible for the patient's diabetes care would meet the full costs of the hospitalization for these patients.

Data collection on patient out-of-pocket expenses were not performed. There were no patient out-of-pocket costs incurred for patients enrolled on the CM. Nevertheless, patients with diabetes on the FFS who chose nonformulary medicines or, non-network physician and auxiliary services would incur out-of-pocket copayments. This analysis was undertaken from a provider perspective.

The medicine costs were adjusted to 2016 prices according to the ZAR value of the single exit price (SEP) as regulated each year by the South African National Department of Health.[18] The SEP adjusted price increases based on inflation were 2.1% in 2012, 5.8% in 2013, 5.82% in 2014, and 7.5% in 2015.[19] The SEP% increases each year were adjusted for all medicines authorized by the scheme and updated on the medicine management program by Medi-Kredit,[20] an independent technology company contracted to the scheme to process pharmacy claims.

Similarly, the costs of services were adjusted each year according to the ZAR value of the National Health Reference Price List (2012-2016) published by the South African National Department of Health[21] and implemented on the iMed systems. The average consumer price index SA[22] increases of 5.73% (2012), 5.78% (2013), 6.14% (2014), 4.51% (2015), and 6.59% (2016) were calculated into the cost of services. The hospital costs were paid at 100% of the negotiated rate by the scheme with the hospital groups for general wards and specialized units and updated each year onto the iMed healthcare payment systems. The average

Figure 2. Categorization of healthcare costs of patients with T2DM in CM versus FFS.



CM indicates capitated risk-sharing model; DKA, diabetic ketoacidosis; FFS, fee-for-service; LOS, length of stay; OTC, over the counter; SAHPRA, South African Health Products Regulatory Authority.

negotiated hospital rates of 7.1% (2012), 7.1% (2013), 6.9% (2014), 7.3% (2015), and 6.3% (2016) with the scheme[23] were used to inflate the hospital tariffs. Healthcare cost were converted for the period 2012 to 2016 to the US dollar (USD) value after adjusting for inflation in ZAR. The fluctuation in inflation rates report the true costs that the scheme paid for over the 5-year period where costs were escalated. Costs represented in USD were calculated according to the average exchange rate of 1 USD to the ZAR in December of that respective year[24]: 1 USD = 8.6 ZAR (2012), 1 USD = 10.4 ZAR (2013), 1 USD = 11.5 ZAR (2014), 1 USD = 15.0 ZAR (2015), and 1 USD = 13.9 ZAR (2016). The high-cost hospitalization amounts included in this study were determined at the 99.9th percentile of all hospitalization costs over the 5 years, which resulted in a value of ≥$24 243 per admission.

Statistical and Data Analysis

Data extracted from the database were exported to Microsoft Excel 2016, and statistical analysis was performed with Statistica 13.3 (StatSoft Inc, Tulsa, OK) and Statistical Analysis System 9.4. The total costs, the T2DM costs, and other costs for services, medicines, and hospitalizations were presented as median (interquartile range) costs per patient in USD per annum. The variables age, costs, and LOS of the 2 models were compared with a Mann-Whitney *U* test because the variables were not a normal distribution. For analysis purposes, patients in each year were treated independently, despite some remaining in each model through the 5 years (Fig. 1). Categorical variables such as sex, number of deceased patients, and number of claims for medicines, services, and hospitalizations of CM and FFS were summarized as frequencies and percentages and compared using chi-square or Fisher's exact tests. A significance level was set at 0.05.

Results

During the 5-year period (2012-2016), among the registered beneficiaries in the scheme database, a higher proportion of the identified patients with T2DM (64%-83%), represented in Table 1, were enrolled in CM at each year as opposed to FFS. The demographics for CM favored a younger male profile than the profile of FFS over the 5-year period, with a significant younger population in CM ($P<.0001$) each year (Table 1). Patients with T2DM were older in FFS and had more thromboembolic comorbidities each year. The all-cause mortality rate of the patients with T2DM in CM (0.81%-1.4%) was lower than in FFS (3.2%-5.1%) between years 2013 to 2015. In the years 2012 and 2016, the mortality rates were similar in both models.

T2DM-Related and Other Medicine and Services Costs

The comparisons of the direct healthcare expenditure attributable to T2DM-related and other combined medicine and services PPPY between the 2 funding models across the 5-year period are presented in Table 2. The unit healthcare costs are represented as medians with the interquartile range difference between the

Table 1. Characteristics of patients with T2DM CM versus FFS.

Characteristics	CM, n (%)	FFS, n (%)	*P* value
2012	n = 534 (64%)	n = 294 (36%)	
Age (y)	55 ± 14	61 ± 15	<.0001
Male	322 (60)	156 (53)	.044
Thromboembolic comorbidity	89 (17)	67 (23)	.031
Deceased	9 (1.7)	7 (2.4)	.49
2013	n = 629 (72%)	n = 248 (28%)	
Age (y)	55 ± 14.2	62 ± 14.3	<.0001
Male	371 (59)	131 (53)	.11
Thromboembolic comorbidity	95 (15)	63 (25)	.0004
Deceased	6 (0.95)	12 (4.8)	<.001
2014	n = 707 (78%)	n = 195 (22%)	
Age (y)	55 ± 14.4	62 ± 14.6	<.0001
Male	417 (59)	101 (52)	.09
Thromboembolic comorbidity	107 (16)	51 (24)	.005
Deceased	10 (1.4)	10 (5.1)	.002
2015	n = 744 (83%)	n = 155 (17%)	
Age (y)	56 ± 14.4	68 ± 12.5	<.0001
Male	424 (57)	82 (53)	.37
Thromboembolic comorbidity	123 (17)	40 (26)	.031
Deceased	6 (0.81)	5 (3.2)	.013
2016	n = 789 (81%)	n = 182 (19%)	
Age (y)	56 ± 14.3	62 ± 14.2	<.0001
Male	442 (56)	100 (55)	.80
Thromboembolic comorbidity	132 (17)	42 (23)	.044
Deceased	13 (1.6)	4 (2.2)	.54

CM indicates capitated risk-sharing model; FFS, fee-for-service; T2DM, type 2 diabetes mellitus.

75th and the 25th percentile. T2DM-related medicine and services costs (includes the capitation fee) were significantly higher in CM than FFS $P<.0001$ across all years (Table 2). Other medicine and services costs incurred by the patient with T2DM were similar in both models. The total T2DM-related costs accrued over the 5-year period in CM was $6 277 453 compared with $816 321 incurred in FFS.

The cost of medicine and services claims for the members who crossed over between models were only included if they remained on a particular model for a consecutive period of longer than 6 months. The cost of members excluded over the 5-year period on CM amounted to $8757 (0.14%) and on FFS was $5216 (0.64%). These figures were not significant contributors to the overall costs.

T2DM-Related and Other Hospitalization Costs

The annual median T2DM-related hospital costs across the 5-year period represented in Table 3 showed no difference in the hospitalization costs between the 2 funding models, despite having T2DM members enrolled in a CM—a model contracted out as a cost-containment strategy aimed at achieving a reduction in-hospital costs. Additionally, the number of patients with T2DM

Table 2. Costs of T2DM-related and other combined medicine plus services PPPY in CM versus FFS.

T2DM-related medicine + services + capitation fee costs				Other medicine + services costs		
Year	CM	FFS	*P* value	CM	FFS	*P* value
	Median, $ (IQR)	Median, $ (IQR)		Median, $ (IQR)	Median, $ (IQR)	
2012	n = 534	n = 294		n = 534	n = 294	
	2002 (2106)	582 (772)	<.0001	1114 (1677)	1474 (2273)	.008
2013	n = 629	n = 248		n = 629	n = 248	
	1586 (1615)	487 (668)	<.0001	920 (1343)	1148 (1631)	.043
2014	n = 707	n = 195		n = 707	n = 195	
	1417 (1431)	333 (580)	<.0001	664 (1263)	778 (1603)	.14
2015	n = 744	n = 155		n = 744	n = 155	
	1065 (1064)	293 (458)	<.0001	660 (1012)	820 (1216)	.0061
2016	n = 789	n = 182		n = 789	n = 182	
	1095 (1042)	296 (507)	<.0001	690 (1100)	738 (1376)	.071

CM indicates capitated risk-sharing model; FFS, fee-for-service; IQR, interquartile range; PPPY, per-patient-per-year; T2DM, type 2 diabetes mellitus.

Table 3. Hospital admission costs PPPY in CM versus FFS.

Median hospital admission costs PPPY						
T2DM-related hospital admissions				Other hospital admissions		
Year	CM, n (%) Median, $ (IQR)	FFS, n (%) Median, $ (IQR)	*P* value	CM, n (%) Median, $ (IQR)	FFS, n (%) Median, $ (IQR)	*P* value
2012	n = 110/534 (21)	n = 45/294 (15)	.06	n = 193/534 (36)	n = 111/294 (38)	.65
	1634 (5456)	3032 (6167)	.30	2909 (7326)	3176 (6010)	.89
2013	n = 108/629 (17)	n = 36/248 (15)	.34	n = 201/629 (32)	n = 77/248 (31)	.79
	1905 (5368)	2290 (3600)	.81	2587 (5409)	2706 (9403)	.08
2014	n = 110/707 (16)	n = 32/195 (16)	.77	n = 219/707 (31)	n = 65/195 (33)	.53
	1816 (3828)	3182 (6078)	.53	2145 (3889)	2792 (7933)	.32
2015	n = 130/744 (17)	n = 28/155 (18)	.86	n = 238/744 (32)	n = 52/155 (34)	.71
	1111 (3459)	1139 (3594)	.64	1712 (3591)	2518 (6724)	.09
2016	n = 161/789 (20)	n = 26/182 (14)	.06	n = 311/789 (39)	n = 62/182 (34)	.18
	1544 (3341)	2627 (4457)	.06	2355 (4376)	1680 (4800)	.56

CM indicates capitated risk-sharing model; FFS, fee-for-service; IQR, interquartile range; PPPY, per-patient-per-year; T2DM, type 2 diabetes mellitus.

hospitalized each year for T2DM-related and other admissions was similar between the 2 models.

Table 4 depicts the very high-cost hospitalization cases of patients with T2DM (≥$24 423) within this cohort between 2012 and 2016. The LOS and proportion of costs covered by the scheme, CM, and the patient for each adverse outcome are shown in Table 4. Of the 46 patients with T2DM hospitalized for a very high-cost event, 33 were enrolled in CM. A total of 2 patients had repeated admissions for ketoacidosis and stroke and were fatal. Over the 5-year period, the DMP paid $26 912 (0.75%) for the DKA and hypoglycemia emergencies hospital costs of the total diabetes-related hospital admissions cost of $3 611 157.

Discussion

This study contributes to the understanding of the estimated direct medical costs of patients with T2DM within 2 funding models. Our findings showed that the financial burden of T2DM patient care on the insurer was substantial when the treatment and management costs related to the management of T2DM were compared between CM and FFS. Patients with T2DM enrolled on CM accrued a large proportion of the total costs annually, owing to the capitation fee. These costs were compounded by the very high in-hospital costs attributed to the complications of T2DM and other events, which were not covered by the DMP.

In this cohort, despite a predominantly female population of the overall scheme membership, the proportion of patients with T2DM within the funding models were mostly male (Table 1). It is well known that the incidence of T2DM is slightly higher in the male population.[25]

The demographics in the study showed a significantly younger population in CM across the 5-year period, possibly indicating a deliberate selection of younger patients thereby achieving better outcomes as complications increase with age. Older adults are more likely to develop other complications of T2DM, such as vision loss and kidney damage, besides the major cardiovascular and cerebrovascular events.[26] Theoretically, in this setting, one would expect a decrease in overall healthcare expenditure of the patients with T2DM and reduction in diabetic complications over the longer term, because of good compliance management on the DMP.

The findings of our previous study[10] showed that the patients with T2DM within this managed care organization had high rates of comorbidities and consumed significant healthcare resources. In 2013, the average overall direct healthcare expenditure for a T2DM patient in France was €6506 ($8652),[27] more expensive than our study possibly attributed to the larger cohort and higher prices of the newer antidiabetic drugs reimbursed during that year. In a Chinese multicenter prospective cohort study of 871 patients with T2DM in 2019, the mean annual total direct medical costs that included overall treatments, complications, and comorbidities were $1990 and the average costs per inpatient per admission were $2127.[28] These costs depicted were similar to our T2DM-related healthcare costs. The other costs in treating general conditions not directly related to T2DM were higher in our cohort, an additional comorbid illness burden to the patient and the scheme, which also reported in the US economic costs of diabetes for 2017.[29]

The analysis of CM in this study exposed several concerns, such as the following: it recruited an increased number of younger patients with T2DM and did not take the fiscal risk of the overall resource consuming treatment, management, and hospitalizations of the patients with T2DM, including the individual high-cost outliers that resulted in extended LOS and intense level of care in-hospital.

Patients with T2DM enrolled on CM did not have lower total healthcare utilization costs than patients enrolled on FFS. The capitation fee could then be thought of as an additional cost to the scheme with little to no financial benefit. This model does not align with the expected outcomes of a CM that would apportion risk to the DMP. The insurer was responsible for both the capitated fee and all the hospitalizations associated with CM, except for a $26 912 that was for the account of CM over the 5-year period constituting (0.75%) of the total hospitalizations. More patients with T2DM on CM ended up with high-cost adverse hospital outcomes (Table 4). Notably, in this study, the patients with T2DM in FFS were older and had more thromboembolic comorbidities each year and lesser cost than the patients with T2DM in CM.

Table 4. Highest cost proportions ≥$24 423 of T2DM and other hospitalizations CM versus FFS.

Adverse T2DM outcomes	Year	Model	LOS	Cost, $	Cost proportion, $		
					Scheme	CM	Patient
Acute renal failure	2012	CM	52	126 553	126 553	0	0
Acute renal failure	2015	CM	74	112 135	112 000	0	135
Fatal valve replacement	2012	CM	4	87 003	87 003	0	0
Ketoacidosis	2015	CM	32	66 845	65 687	1158	0
Valve replacement	2012	FFS	3	57 272	57 272	-	0
Fatal stroke	2015	FFS	35	52 855	52 855	-	0
CABG	2016	CM	9	50 743	50 743	0	0
Fatal ketoacidosis	2016	CM	39	50 504	50 504	0	0
CABG	2014	CM	15	46 059	46 059	0	0
CABG	2012	CM	8	45 196	45 196	0	0
CABG	2014	CM	10	43 941	43 941	0	0
Angioplasty	2015	CM	27	42 281	42 277	0	4
Angioplasty	2016	FFS	32	41 061	41 061	-	0
Unstable angina	2013	FFS	16	37 902	37 902	-	0
Atrial fibrillation	2012	CM	4	32 093	32 093	0	0
Stroke	2016	CM	46	31 522	31 522	0	0
ICD	2016	FFS	5	30 737	30 737	-	0
CABG	2014	CM	12	29 475	29 475	0	0
Fatal cardiac failure	2012	CM	8	28 400	28 400	0	0
CABG	2016	CM	9	28 157	28 157	0	0
Unstable angina	2012	CM	34	27 867	27 721	0	146
Acute renal failure	2013	CM	29	27 257	27 257	0	0
TAVI	2016	FFS	2	27 078	27 078	-	0
Chronic renal failure	2012	CM	10	26 538	26 538	0	0
Atrial fibrillation	2013	CM	2	25 262	25 262	0	0
Fatal atrial fibrillation	2014	CM	7	25 058	25 058	0	0
Other hospitalizations							
Fatal esophagitis	2016	CM	40	161 444	161 410	0	34
Fatal laparotomy	2015	CM	27	103 530	103 530	0	0
Laparotomy	2015	FFS	45	84 955	84 955	-	0
TSH	2016	CM	62	77 168	77 168	0	0
Hip fracture	2014	FFS	49	72 062	72 062	-	0
Laminectomy	2012	FFS	18	61 797	61 793	-	4
Fatal TSH	2012	CM	18	59 670	59 670	0	0
Oncology wound debridement	2012	CM	21	55 847	55 817	0	30
Hip replacement	2012	CM	17	39 557	39 557	0	0
Laminectomy	2013	FFS	12	37 787	37 405	-	382
Hip replacement complications	2012	CM	10	35 492	35 492	0	0
Cerebral meninges	2012	CM	16	33 973	33 973	0	0
Craniotomy	2014	CM	9	32 842	32 842	0	0
Fracture reduction	2016	CM	21	29 973	29 973	0	0
Spinal Fusion	2014	FFS	12	28 661	28 659	-	2
Multiple fractures	2014	CM	36	27 555	27 538	0	17
Spinal fusion	2013	FFS	7	27 074	27 074	-	0
Spinal fusion	2012	CM	7	26 118	26 106	0	12
Pneumonia	2012	CM	20	25 471	25 448	0	23
Laparotomy	2013	FFS	9	24 897	24 393	-	504

CABG indicates coronary artery bypass graft; CM, capitated risk-sharing model; FFS, fee-for-service; ICD, implantable cardioverter defibrillator; LOS, length of stay; T2DM, type 2 diabetes mellitus; TAVI, transcatheter aortic valve implantation; TSH, traumatic subdural haemorrhage.

Capitation fees with administrative costs were additional costs burdened on the insurer. Studies show that administrative costs account for a substantial part of healthcare expenditure, as seen in the United States where 62% of the healthcare expenditure was related to billing and insurance related expenditures.[30] Another study that examined the impact of the type of health

plan of Medicaid enrollees with T2DM found 14% more hospitalizations of patients on the capitated plan than those in FFS plans.[31]

The 46 severely ill patients hospitalized for T2DM-related high-cost events in our study accrued a total of $2 244 509 million; the greatest portion was reimbursed by the scheme and the balance of $1158 paid by the DMP. Acute renal failure and ketoacidosis were major cost drivers in addition to cardiovascular complications in this study. Similarly, the greatest mean hospitalization cost reported in a Taiwan study in 2012[32] was attributed to cardiovascular complications, for example, $10 411 for fatal ischemic heart disease. DKA that ended up with longer hospital stays and high costs was also reported in an inpatient audit conducted in the United Kingdom in 2012.[33,34] High-cost patients with T2DM accrued $52 000 more in total annual healthcare costs than the not high-cost patients with T2DM in the United States between 2005 and 2010.[35] In our study, the T2DM-related hospital unit median costs incurred in CM ranged from $1111 to $1905 during the 5-year period.

At present, in SA the proposed NHI system[36] will have to adapt the payment systems currently used in both the private and public sectors. Based on the results of this study, a benefit package could be established for diabetes as part of NHI, and CM improved with tighter management and a risk sharing for improved outcomes. A discrete choice analysis should be conducted to understanding what motivates providers, and the incentives could then be aligned with these.

Capitation is a widespread form of reimbursement system for medical care in countries such the United States (Medicare), United Kingdom's National Health Service, Israel's NHI law, and Sweden's healthcare system,[37-39] as well as Ghana's NHI scheme.[40] Similarly, FFS is equally popular in Organization for Economic Cooperation countries such as Belgium, Germany, Japan, Switzerland, and the United States, where most physicians are private and patients have the freedom to choose their physician.[41] From the perspective of the NHI and the resource constraints in SA, the present analysis demonstrates the influence of provider payment systems and limitations of a restricted CM in the management of T2DM.

Limitations

Several limitations must be considered in this study. First, a longitudinal study of the T2DM patient in this cohort was not feasible, because patients voluntarily transferred between the funding models. Our data could not differentiate the types of service or medicine items charged separately or precisely. Hence, the medicine and services costs were combined for both models. Micro costing was not feasible.

The insurer pays all the hospitalization costs incurred by the patients with T2DM on the scheme, directly to the hospital or clinic, with the agreed-upon negotiated tariffs among the hospital groups. This analysis did not risk adjust the healthcare costs or outcomes to account for the fact that there were older and sicker patients with T2DM in FFS. This study was restricted to direct medical costs from the insurer and CM's perspective; the indirect costs such as lost productivity and absenteeism were not addressed. The data set did not include patient-incurred costs, because the costs in this study were from the provider's perspective only. Further research would be necessary to assess costs incurred by the patient, because the different models may shift the costs to the patients, and this may adjust the perception of which model is more suitable for the patient.

Conclusions

The scheme incurred significant healthcare costs and resource utilization despite the patients with T2DM being on managed care models. FFS patients accrued significantly lower costs over the 5-year period of the study, despite CM being touted as a cost-containment strategy with expected better health outcomes. This study highlights that neither model is ideal and opens the possibility for a value-based care model structured according to a shared-savings and shared-risk model to lower diabetes-related adverse outcomes and improve cost management.

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Author Affiliations: Department of Pharmacy and Pharmacology (Naidoo, Butkow), School of Therapeutic Sciences (Barnard-Ashton), and School of Clinical Medicine (Miot, Libhaber), University of the Witwatersrand, Johannesburg, South Africa.

Correspondence: Lovina A. Naidoo, MPharm, Department of Pharmacy and Pharmacology, University of the Witwatersrand, 7 York Rd 2193, Johannesburg, South Africa. Email: 853697@students.wits.ac.za

Author Contributions: *Concept and design:* Naidoo, Butkow, Libhaber
Acquisition of data: Naidoo
Analysis and interpretation of data: Naidoo, Butkow, Barnard-Ashton, Miot, Libhaber
Drafting of manuscript: Naidoo, Butkow, Barnard-Ashton, Miot
Critical revision of the paper for important intellectual content: Butkow, Barnard-Ashton, Miot, Libhaber
Statistical analysis: Libhaber
Administrative, technical, or logistic support: Naidoo
Supervision: Butkow, Barnard-Ashton, Miot, Libhaber

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REFERENCES

1. International Diabetes Federation. *IDF Diabetes Atlas, 9th edn*. Brussels, Belgium: International Diabetes Federation; 2019.
2. IDF diabetes atlas 7th edition 2015. International Diabetes Federation. www.idf.org/diabetesatlas. Accessed May 19, 2021.
3. Hall V, Thomsen RW, Henriksen O, Lohse N. Diabetes in Sub Saharan Africa 1999-2011: epidemiology and public health implications. a systematic review. *BMC Public Health*. 2011;11(1):564.
4. Gill G, Mbanya JC, Ramaiya KL, Tesfaye S. A sub-Saharan African perspective of diabetes. *Diabetologia*. 2009;52(1):8–16.
5. Council of Medical Schemes annual report 2019/2020. Council of Medical Schemes. www.medicalschemes.co.za/annualreport2020/. Accessed May 19, 2021.
6. National Department of Health annual report 2018/2019. Department: Health, Republic of South Africa. https://www.gov.za/sites/default/files/gcis_document/201911/health-annual-report.pdf. Accessed May 19, 2021.
7. Medical schemes act no. 131 of 1998. Statutes of the Republic of South Africa–Medicine, Dentistry and Pharmacy. https://www.gov.za/sites/default/files/gcis_document/201409/a131-98.pdf. Accessed May 19, 2021.
8. National Health Act, 2003, National Health Insurance Policy: towards universal health coverage. Department: Health, Republic of South Africa. https://

www.gov.za/sites/default/files/gcis_document/201707/40955gon627.pdf. Accessed May 19, 2021.
9. Volmink HC, Bertram MY, Jina R, Wade AN, Hofman KJ. Applying a private sector capitation model to the management of type 2 diabetes in the South African public sector: a cost-effectiveness analysis. *BMC Health Serv Res*. 2014;14(1):444.
10. Butkow NBN, Naidoo L, Barnard-Ashton P, Libhaber E. Hospitalization of type 2 diabetes mellitus patients with and without major depressive disorder in a private managed healthcare organisation. *J Endocrinol Metab Diabetes South Afr*. 2019;24(3):70–76.
11. Einarson TR, Acs A, Ludwig C, Panton UH. Economic burden of cardiovascular disease in type 2 diabetes: a systematic review. *Value Health*. 2018;21(7):881–890.
12. Annual report 2018/19. Council of Medical Schemes. https://www.medicalschemes.com/files/Annual%20Reports/CMSAR2018_19.pdf. Accessed August 30, 2020.
13. Distiller LA, Brown MA, Joffe BI, Kramer BD. Striving for the impossible dream: a community-based multi-practice collaborative model of diabetes management. *Diabet Med*. 2010;27(2):197–202.
14. Gosden T, Pedersen L, Torgerson D. How should we pay doctors? A systematic review of salary payments and their effect on doctor behaviour. *QJM*. 1999;92(1):47–55.
15. National treasury. Department: National Treasury, Republic of South Africa. www.treasury.gov.za. Accessed August 30, 2020.
16. ICD-10 version:2019, International Statistical Classification of Diseases and Related Health Problems 10th Revision. World Health Organization. https://icd.who.int/browse10/2019/en#/. Accessed August 30, 2020.
17. Prescribe Minimum Benefits. https://www.medicalschemes.co.za/resources/pmb/. Accessed May 19, 2021.
18. Single Exit Price. www.mpr.gov.za/publisheddocuments.aspx. Accessed August 30, 2020.
19. Medicines and related substances act, (act no. 101 of 1965) (annual adjustment of the single exit price of medicines and scheduled substances for the year 2013). Department of Health. https://www.gov.za/sites/default/files/gcis_document/201409/36087rg9896gon35a.pdf. Accessed May 20, 2021.
20. MediKredit Integrated Healthcare Solutions (Pty) Ltd. www.medikredit.co.za. Accessed April 25, 2021.
21. National reference price list for services by medical practitioners, effective from 1 January 2006. Council for Medical Schemes. https://www.medicalschemes.com/files/NHRPL%20Schedules/Medical%20Practitioners%202006_v06.pdf. Accessed August 30, 2020.
22. Inflation South Africa 2016. Inflation.eu, Worldwide Inflation Data. https://www.inflation.eu/en/inflation-rates/south-africa/historic-inflation/cpi-inflation-south-africa-2016.aspx. Accessed April 5, 2021.
23. Acceptance letters of negotiated tariffs by the Medical scheme and Netcare, Mediclinic, LIFE Clinix, National Hospital Network, Joint Medical Holdings hospital groups. In.
24. Monthly average: configure converter (USD - US dollar, ZAR - South African rand). X-Rates. https://www.x-rates.com/average/?from=USD&to=ZAR&amount=1&year. Accessed October 9, 2020.
25. Cho NH, Shaw JE, Karuranga S, et al. IDF Diabetes Atlas: global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes Res Clin Pract*. 2018;138:271–281.
26. Huang ES, Laiteerapong N, Liu JY, John PM, Moffet HH, Karter AJ. Rates of complications and mortality in older patients with diabetes mellitus: the diabetes and aging study. *JAMA Intern Med*. 2014;174(2):251–258.
27. Charbonnel B, Simon D, Dallongeville J, et al. Direct medical costs of type 2 diabetes in France: an insurance claims database analysis. *Pharmacoecon Open*. 2018;2(2):209–219.
28. Li X, Xu Z, Ji L, et al. Direct medical costs for patients with type 2 diabetes in 16 tertiary hospitals in urban China: a multicenter prospective cohort study. *J Diabetes Investig*. 2019;10(2):539–551.
29. American Diabetes Association. Economic costs of diabetes in the U.S. in 2017. *Diabetes Care*. 2018;41(5):917–928.
30. Dieleman JL, Squires E, Bui AL, et al. Factors associated with increases in US health care spending, 1996-2013. *JAMA*. 2017;318(17):1668–1678.
31. Pawaskar M, Burch S, Seiber E, Nahata M, Iaconi A, Balkrishnan R. Medicaid payment mechanisms: impact on medication adherence and health care service utilization in type 2 diabetes enrollees. *Popul Health Manag*. 2010;13(4):209–218.
32. Cheng SW, Wang CY, Ko Y. Costs and length of stay of hospitalizations due to diabetes-related complications. *J Diabetes Res*. 2019;2019, 2363292.
33. National diabetes inpatient Audit (NaDIA) – 2012. NHS Digital. https://digital.nhs.uk/data-and-information/publications/statistical/national-diabetes-inpatient-audit/national-diabetes-inpatient-audit-nadia-2012. Accessed August 30, 2020.
34. Kerr M. Inpatient care for people with diabetes: the economic case for change. NHS Diabetes. https://www.diabetes.org.uk/resources-s3/2017-10/Inpatient%20Care%20for%20People%20with%20Diabetes%20%20The%20Economic%20Nov%202011_1.pdf. Accessed August 30, 2020.
35. Meyers JL, Parasuraman S, Bell KF, Graham JP, Candrilli SD. The high-cost, type 2 diabetes mellitus patient: an analysis of managed care administrative data. *Arch Public Health*. 2014;72(1):6.
36. White paper: National Health Insurance for South Africa. Health-E News. https://health-e.org.za/2015/12/14/white-paper-national-health-insurance-for-south-africa/. Accessed May 19, 2021.
37. Rice N, Smith P. Approaches to capitation and risk adjustment in health care: an international survey. The University of York, The Centre for Health Economics. https://www.york.ac.uk/che/pdf/op38.pdf. Accessed May 28, 2020.
38. Shmueli A, Chinitz D. Risk-adjusted capitation: the Israeli experience. *Eur J Public Health*. 2001;11(2):182–184.
39. Anell A, Dackehag M, Dietrichson J. Does risk-adjusted payment influence primary care providers' decision on where to set up practices? *BMC Health Serv Res*. 2018;18(1):179.
40. Amo HF, Ansah-Adu K, Simpson SN. The provider payment system of the National Health Insurance Scheme in Ghana. *Stud Sociol Sci*. 2013;4(1):9–15.
41. Park M, Braun T, Carrin G, Evans DB. Provider payments and cost-containment lessons from OECD countries. Department of Health Systems Financing Health Financing Policy, World Health Organization. https://www.who.int/health_financing/documents/pb_e_07_2-providerpay_oecd.pdf. Accessed August 30, 2020.