



## Original article

# Estimating the potential economic impact of the Wasfaty program on costs of antidiabetic treatment: An initiative for the digital transformation of health

Thamir M. Alshammari <sup>a,b,\*</sup>, Saud I. Alsubait <sup>c</sup>, Khalidah A. Alenzi <sup>d</sup>, Ziyad S. Almalki <sup>e</sup>

<sup>a</sup> College of Pharmacy, Almaarefa University, Riyadh, Saudi Arabia

<sup>b</sup> Medication Safety Research Chair, King Saud University, Riyadh, Saudi Arabia

<sup>c</sup> National Unified Procurement Company, Riyadh, Saudi Arabia

<sup>d</sup> Regional Drug Information & Pharmacovigilance Center, Ministry of Health, Tabuk, Saudi Arabia

<sup>e</sup> College of Pharmacy, Prince Sattam Bin Abdulaziz University, Alkharj, Saudi Arabia

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## ABSTRACT

**Introduction:** The Saudi health care transformation is taking place through the implementation of many initiatives and programs to serve Saudi Vision 2030, which aims to improve health care services by focusing on digitalization and privatization. This study aimed to evaluate the economic impact of implementing the new digital health transformation initiative (Wasfaty service) on the health care budget using diabetes mellitus as an example.

**Methods:** This study presents a cost analysis evaluation following the implementation of the Wasfaty program during the period between 2017 and 2021. The study compared the pre-Wasfaty period and the Wasfaty period in terms of direct medical costs. Data sources were the Ministry of Health for pre-Wasfaty data and the National Unified Procurement Company, which runs the Wasfaty program, for Wasfaty data. The study focuses on diabetic medications for outpatients. This health economic evaluation used the cost per visit, and sensitivity analyses were conducted utilizing the cost per patient according to the prevalence of diabetes mellitus.

**Results:** After implementing the transformation using the Wasfaty service, the estimated annual mean cost savings per visit were USD 109.18 (SAR 409.43), and the cost savings per patient with a prevalence of 11% were USD 13.89 (SAR 52.1). The saving costs were USD 11,750,600 (SAR 44,064,750) for human resources and USD 97,473,469 (SAR 365,525,508) for pharmacies' operation costs without including warehouse expenditures. The savings from the clinical decision support system preventing undesirable medication costs were estimated at USD 9,842,720 (SAR 36,910,201), and savings from the prevention of undesirable adverse events were estimated at USD 137,332,615 (SAR 514,997,308) for a 6% prediction. The total healthcare expenditure savings were USD 258,762,981 to 274,972,971 (SAR 970,361,178 ± 1,031,148,640).

**Conclusions:** Implementing the new digitization and privatization initiatives (i.e., the Wasfaty program) as a result of the transformation in the health care sector had led to a significant reduction in health care expenditures and cost savings with respect to clinical and pharmacy services using diabetes mellitus as an example.

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**Abbreviations:** CDSS, Clinical decision support system; PHC, Primary health care; NCDs, Noncommunicable diseases; MoH, Ministry of Health; NUPCO, The National Unified Procurement Company; USD, The United States dollar.

\* Corresponding author at: College of Pharmacy, Almaarefa University, Riyadh, Saudi Arabia.

E-mail addresses: [tshammari.c@mcst.edu.sa](mailto:tshammari.c@mcst.edu.sa) (T.M. Alshammari), [ph\\_kh@hotmail.com](mailto:ph_kh@hotmail.com) (K.A. Alenzi).

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## 1. Introduction

The Saudi health care system is a social system mainly run by the Ministry of Health (MoH) (Alshammari et al., 2017). More than 60% of health care services are provided by the MoH, and the remaining services are provided by other government entities and the private sector (Sebai et al., 2001). The Saudi MoH has an

extensive network of primary health care (PHC) providers, clinics, and hospitals of various levels (less than 50 beds, more than 50 beds, tertiary hospitals, and medical cities) (Almalki et al., 2011, Al Asmri et al., 2020). As of 2021, there were 2121 PHC providers and 287 hospitals under the MoH. There were 51 hospitals and 159 hospitals in other governmental and private sectors, respectively (MOH, 2021). These health institutions provide various types of health services, from regular disease care to treatment of more complex diseases such as cancer and rare diseases (Almalki et al., 2011). However, there are some concerns about the efficiency of the health care system, especially the increasing prevalence of non-communicable diseases (NCDs) at a rate that is greater than the international rate. Diabetes mellitus and heart diseases are examples of such diseases, which place a high burden on both humanistic and economic outcomes (Naeem 2015, Ahmed et al., 2017, SaudiVision2030, 2022). Furthermore, health care services consumed a considerable proportion of the Saudi budget; health care was considered the second highest-consuming sector after the education sector (MOF, 2021). Therefore, there was a need for a highly cost-efficient health care system.

In 2016, Saudi Vision 2030 was launched, focusing on economic development and national growth. Saudi Vision 2030 includes 96 strategic objectives. The MoH was one of the earlier sectors that the Saudi Vision 2030 included with the aim of restructuring the health sector to make it more effective, comprehensive, and integrated (SaudiVision2030, 2022).

The health care system will be based on value-based care principles to ensure transparency and financial sustainability. This will be achieved by promoting health and preventing diseases. The strategic objectives aimed to have comprehensive and equitable geographic distribution, improve access to health services, expand the digitalization of health services, and improve the quality of health services (SaudiVision2030, 2022).

The new programs are restructuring the health care system to overcome the latest health and disease concerns and to increase the average life expectancy at birth from 75 years in 2016 to 80 years in 2030. They also aim to reduce the burden of NCDs, including ischemic heart diseases, stroke, chronic kidney diseases, respiratory diseases, diabetes mellitus, cirrhosis, and mental illness. NCDs led to 75% of all deaths in Saudi Arabia in 2019 (Alqunaibet et al., 2021, SaudiVision2030, 2022).

Pharmaceutical expenditures are among the highest burdens on total health expenditure in Saudi Arabia. Pharmaceutical expenditures represent around 20% of total health expenditures and are increasing over time. In 2011, they cost USD 4.894 billion (SAR 18.35 billion), and pharmaceutical expenditures increased to almost USD 7.897 (SAR 30 billion) in 2018 (Alrasheedy 2020). The high expenditures could be due to several factors, including the high prevalence of NCDs, especially diabetes mellitus; the fact that only 30% of pharmaceuticals are manufactured locally; and many others, such as waste and oversupply of medications (Tawfik et al., 2022, Wasfaty, 2022). Diabetes mellitus is considered one of the endemic diseases in Saudi Arabia. There is no specific reference for the prevalence of diabetes, but a recent study found that the prevalence of diabetes is 11.65% (Almubark et al., 2022).

Therefore, as one of the Vision 2030 programs, the Wasfaty (an electronic prescription and dispensing system through community pharmacies) initiative program has been introduced to improve the quality and efficiency of health care services (Wasfaty, 2022). It also aims to be a cost-efficient service, reduce medication errors, provide patient medication counseling, and improve medication availability. Wasfaty is a nationwide program led by 2 institutions, the Saudi MoH and the National Unified Procurement Company (NUPCO). It is an electronic prescribing solution intended to enable physicians at the government's primary health care cen-

ters and hospitals to prescribe electronically and allow patients to pick up their prescriptions at private pharmacies. In addition, it connects PHC services and hospitals to community pharmacies, and patients can obtain their medications from their nearest participating pharmacy. Wheels Wasfaty applies to all health care providers. Wasfaty currently has more than 25 leading health care providers for the government sectors (Almaghaslah et al., 2022, Wasfaty, 2022).

This health economic study aimed to evaluate the introduction of the Wasfaty nationwide program under Vision 2030, using diabetes mellitus as an example.

## 2. Material and methods

A health cost analysis was conducted between 2017 and 2021 to estimate the financial consequences of establishing the Wasfaty service program and assess its impact from a MoH perspective.

To estimate the financial consequences of establishing the Wasfaty service program and assess its impact from a payer perspective, we first defined the program's goals, target population, services provided, and delivery model. Next, we estimated the costs associated with establishing and running the program, such as operating costs and other overhead expenses. Then, we determined the potential savings associated with the program and calculated the net cost. We assessed the impact on payers, we present the findings and highlight the net cost, potential savings, and impact on the health sector.

The model was divided into the pre-Wasfaty period and the Wasfaty period. Wasfaty initiative was started in 2019 and cover various regions (Wasfaty, 2022). The pre-Wasfaty period was defined as the time before the implementation of the Wasfaty service program, which is during the era when the MoH provided the full medication service through its pharmacy network (i.e., before 2019). For this study, the pre-Wasfaty included the MoH PHC providers. At the same time, the Wasfaty period was defined as the time after the implementation of the Wasfaty program for providing medications through community pharmacies. We did not include 2019 because it was a transition stage to Wasfaty (i.e., moving from the MOH providing the service to Wasfaty).

### 2.1. The Wasfaty service

Wasfaty began serving patients through 1588 community pharmacies in 2019. This number increased by 93% in 2020 and 2021 to reach 2401 and 3062 community pharmacies, respectively. Furthermore, the number of PHC providers served has grown over the **three** years, from 905 in 2019 to 2121 PHC providers in 2021. Wasfaty provides free home delivery for elderly, disabled, and pregnant patients and for any eligible persons as health care providers define it, as well as if medication is unavailable at the first visit.

### 2.2. Study population

Diabetes mellitus, as one of the most prevalent diseases in Saudi Arabia, was used as an example in this health economic evaluation because it is difficult to assess the whole program due to the lack of other disease information, especially from the MoH (ie, pre-Wasfaty program).

### 2.3. Outcome measurements

Diabetes mellitus was used to assess the cost analyses pre-Wasfaty and during Wasfaty. Cost per visit was used as a primary outcome (MOH, 2017, MOH, 2018). As a sensitivity analysis, we

used diabetes mellitus prevalence to assess cost per patient. A recent study estimated the prevalence of diabetes mellitus to be 11.65% in 2021 (Almubark et al., 2022). Beginning in the pre-Wasfaty period, including 2017 and 2018, we used a range of 11–12% as the prevalence of diabetes mellitus to avoid underestimation of diabetes mellitus during the study period, and we calculated the proportion of the patients treated in MoH facilities from the total prevalence, which equaled 43.2% in 2017 and 42.9% in 2018 (MOH, 2017, MOH, 2018).

#### 2.4. Measurement of costs

The direct medical costs were calculated for pharmaceutical-related expenditures during the pre-Wasfaty period and the Wasfaty period.

##### 2.4.1. Cost sources

Data sources were the MoH and the Wasfaty administration for the pre-Wasfaty and Wasfaty periods, respectively. Furthermore, we searched the literature for published works that have information on the cost relevant to this study. These data sources were used to calculate the costs, including the cost of medications, human resources costs, pharmacy operation costs, and other related costs.

##### 2.4.2. Pharmacists, pharmacy technicians, and operation costs

For the pre-Wasfaty period, pharmacists' and pharmacy technicians' salaries were calculated by multiplying the number of pharmacists and pharmacy technicians in 2017 and 2018 based on the MoH's statistical books by the estimated average salaries for each category. In addition, pharmacy operation costs were calculated using a published study of the operation costs of outpatient pharmacies in hospitals (Alsheikh et al., 2022). The included operations costs are the costs of physical space, software, offices, landline telephones, small refrigerators for medications, chairs, medication shelves, and tables for dispensing. The numbers of PHCs in 2017 and 2018 were 1671 and 2325, respectively (MOH, 2017, MOH, 2018).

In addition, the salaries after Wasfaty in 2020 and 2021 are related to the community pharmacists and paid by their employers (i.e., the community pharmacies that participated in Wasfaty) and not by Wasfaty. Therefore, this cost is included in the Wasfaty commission to the participating pharmacy as a fixed percentage, which ranged from 6 to 10% during the study period. We estimated that a PHC pharmacy is one-fourth the size of a hospital outpatient pharmacy. Then the operation cost was calculated by multiplying the number of PHC pharmacies by the cost calculated based on a published study (Alsheikh et al., 2022).

##### 2.4.3. Medication costs

For pre-Wasfaty, data on diabetes mellitus medications (i.e., hypoglycemic medications) were captured from the contracts after MoH confirmation for the shipment distribution plan per quarter; this was treated as actual demand. The data included the total quantity per medication per year and the total cost per medication per year with unit cost. Because we focused on outpatient services, the proportion of outpatients was calculated by deducting the percentage of inpatients from the total quantity per medication.

In addition, the net cost includes 4% procurement and 6% logistics. The model deducted the estimated proportion of each medication used for inpatient services because the focus was on outpatient services such as Wasfaty services (NUPCO).

For the Wasfaty period, the data were captured from the actual dispensations per year as medication cost plus the pharmacies' commission for providing the service, including purchasing, storage, logistics, distribution, dispensing, administration, counselling,

labelling, etc. The community pharmacies are also responsible for expiry, overstock, and damage, as well as medication destruction and recall, if needed. Therefore, the budget that the Wasfaty program gave to community pharmacies covers all these expenditures. The community pharmacy commission was a 6% markup from the medication cost (government price) from 2020 until the end of June 2021, and then it was 10% until the end of the study. All commissions were included in the analyses. The government price was defined through publishing a tender, receiving quotations from the suppliers and manufacturers, finalizing the evaluation (technical and commercial), publishing the awardation, and then contracting with the suppliers that submitted the first 3 best quotations. The medications were to be delivered directly to the participating community pharmacies at the same wholesale price, and then the difference between the government price and the wholesale price was to be repaid (reimbursed) after completion of prescription dispensing under the Wasfaty system.

In addition, the estimated lowest cost saving considered the lowest price of the awarded trade as a saving, and the estimated average cost saving considered the average price of the awarded trade as a saving.

##### 2.4.4. Alert costs

As part of the calculated direct cost for total health care expenditures, we highlight the safety measurements implemented in the Wasfaty system, which include but are not limited to the clinical decision support system (CDSS). The CDSS aims to support prescribers in their decisions and ensure the safety of their e-prescriptions with regard to both prescribing and dispensing. The CDSS helps to prevent medication duplications, drug overdoses, drug-drug interaction, drug-herbal interaction, disease interaction, and refilling too soon. The cost due to such incidents that were prevented by the CDSS was estimated using national and international references (Databank, 2022, IBM, 2022, Kluwer, 2022). Panagiotti et al found that around 6% of such incidents were associated with harm. Therefore, we multiplied the number of patients alerted related to diabetes mellitus medications in the CDSS due to 1 of the abovementioned incidents by 6% and by the estimated cost, with a national reference of USD 593.33 (SAR 2225) and an international reference of USD 472 (SAR 1770) (Najafzadeh et al., 2016, Alomi et al., 2018, Panagiotti et al., 2019). All costs were captured in Saudi riyals (SAR) and US dollars (USD) with currency exchange equal to SAR 3.75 for USD 1.

#### 2.5. Statistical analysis

Descriptive statistics were used to calculate all study variables. The mean cost and the mean cost differences were calculated for the two periods (before and during Wasfaty). All variables were managed utilizing Microsoft Excel, and all analyses were conducted using Microsoft Excel, R (version 4.1.3), and RStudio (2022.7.1.554) software.

### 3. Results

In Table 1, the cost of antidiabetic medications is broken down by year, comparing 2017 and 2018 (pre-Wasfaty) to 2020 and 2021 (the Wasfaty period).

The antidiabetic medication cost per visit was calculated for both before Wasfaty and during Wasfaty. The cost per visit dropped from USD 189.77 (SAR 711.63) and USD 93.43 (SAR 350.35) in 2017 and 2018, respectively, to USD 27.62 (SAR 103.57) and USD 37.21 (SAR 139.55) in 2020 and 2021, respectively. Furthermore, when we compared the cost per visit of the pre-Wasfaty to the Wasfaty period, we found that the estimated

**Table 1**  
Antidiabetic medications cost savings associated with Wasfaty program implementation.

	Pre-Wasfaty			Wasfaty period			Before and after difference mean
	2017	2018	Mean	2020	2021	Mean	
Antidiabetic medications cost*	81,751,269	68,232,720	74,991,995	33,975,244	87,580,613	60,777,929	14,214,065
Antidiabetic medications cost per visit	189.77	93.43	141.60	27.62	37.21	32.42	109.18
Antidiabetic medications Cost per Patient (P11%)	53.80	43.30	48.55	29.42	39.89	34.65	13.89
Antidiabetic medications Cost per Patient (P12%)	49.33	39.73	44.53	29.42	39.89	34.65	9.88

\* The costs are in US dollars.

annual mean cost saving per visit was USD 109.18 (SAR 409.43; Table 1).

In addition to the above-mentioned method of calculating the antidiabetic medications per visit, we also calculated the cost of antidiabetic medications using the prevalence of diabetes mellitus as a sensitivity analysis during the pre-Wasfaty period. Using a prevalence of 11%, the cost of antidiabetic medications per patient was USD 53.797 (SAR 201.74) and USD 43.299 (SAR 162.37) in 2017 and 2018, respectively. When using a prevalence of 12%, the cost of antidiabetic medication per patient was USD 49.33 (SAR 185) in 2017 and USD 39.73 (SAR 149) in 2018. We found that the estimated annual mean cost saving per patient with a prevalence of 11% and 12% was USD 13.89 (SAR 52.1) and USD 9.88 (SAR 37.05), respectively (Table 1).

We examined the expenses associated with two distinct resource categories during the pre-Wasfaty and Wasfaty periods (Table 2). For pharmacy technicians, the annual mean cost was found to be USD 9,274,067 (SAR 34,777,750), whereas the annual cost for pharmacists was assessed to be USD 2,476,533 (SAR 9,287,000). During the Wasfaty period, there is no cost with respect to human resources (ie, pharmacists and pharmacy technicians). The cost of running the PHC pharmacies during the pre-Wasfaty period was also calculated; the average yearly cost of pharmacies resulted in costs of USD 97,473,469 (SAR 365,525,508). Similar to the cost of pharmacists and pharmacy technicians, there is no cost for the pharmacy itself after implementation of the Wasfaty service (Table 2).

In the Wasfaty period, the total estimated cost of medications that might be associated with patient harm but were not dispensed because of the associated alerts that the CDSS captured ranged between USD 6,475,046 (SAR 24,281,422) and USD 11,424,342 (SAR 42,841,283) for 2020 (Table 3) and USD 13,210,394 (SAR 49,538,980) and USD 24,448,524 (SAR 91,681,967) for 2021 (Table 4). Furthermore, the total number of alerts (eg, duplicate therapy and drug overdose) that were associated with prescriptions was 3,103,734 in 2020 and 5,490,297 in 2021. Therefore, by using a national and international estimate of harm cost associated with these alerts with a 6% prediction of occurrence, it was found that the estimated average cost saving was USD 99,195,339 (SAR 371,982,520) and USD 175,469,892 (SAR 658,012,095) in 2020 and 2021, respectively (Table 5 and Table 6).

**Table 2**  
Cost of human resources (pharmacists and pharmacy technicians) and pharmacy operation cost before Wasfaty program implementation.

Resources category	2017			2018			The annual cost, mean
	Number	Average Cost	Cost per year	Number	Average Cost	Cost per year	
Professionals							
Technicians**	4,019	2,267	9,109,733	4,164	2,267	9,438,400	9,274,067
Pharmacists**	468	4,933	2,308,800	536	4,933	2,644,267	2,476,533
Health facilities							
Pharmacy***	1,671	48,785.52	81,520,604	2,325	48,785.52	113,426,334	97,473,469

\*The costs are in US dollars.

\*\* The estimated average salary is 2267 for technicians and 4933 for pharmacists.

\*\*\* The average pharmacy costs include place, computers, offices, landline telephone, small refrigerator for medications, chairs, controlled medications cabinet, medications shelves, table for dispensing (Pinch).

**Table 3**  
The estimated saved medication cost using the low and average price of medications for each prevention alert in 2020.

Alert Type (2020)	Est. Lowest Cost Saving <sup>**</sup>	Est. Average Cost Saving <sup>***</sup>
Drug Age & Drug Gender	25,770	36,263
Drug Allergy	732	732
Drug Diagnosis Contraindication	375,951	714,031
Drug Diagnosis Indication	1,951,681	3,118,480
Drug Overdose	68,573	120,973
Drug-Drug Interaction	5	19
Duplicate Therapy	4,052,335	7,433,843
Grand Total	6,475,046	11,424,342

\*The costs are in US dollars.

\*\* Est. lowest cost saving: We consider the lowest price of the awarded trade as saving.

\*\*\* Est. average cost saving: We consider the average price of the awarded trade as saving.

**Table 4**  
The estimated saved medication cost using the low and average price of medications for each prevention alert in 2021.

Alert Type (2021)	Est. Lowest Cost Saving <sup>**</sup>	Est. Average Cost Saving <sup>***</sup>
Drug Age & Drug Gender	43,282	53,701
Drug Allergy	459	528
Drug Diagnosis Contraindication	586,441	1,011,824
Drug Diagnosis Indication	3,839,770	6,245,469
Drug Overdose	137,650	184,984
Drug-Drug Interaction	32,638	82,931
Duplicate Therapy	8,570,155	16,869,088
Grand Total	13,210,395	24,448,525

\*\* Est. lowest cost saving: We consider the lowest price of the awarded trade as saving.

\*\*\* Est. average cost saving: We consider the average price of the awarded trade as saving.

#### 4. Discussion

Saudi Arabia is undergoing significant transformation following the Saudi Arabia Vision 2030 initiative, which began in 2016. The ultimate goals of Vision 2030 are to have an ambitious nation, a

**Table 5**

The estimated saving cost of prevention alerts using national and international rates by multiplying the number of alerts by the average harm cost for a 6% prediction of occurrence in 2020.

Alert Type	# of Alerts	Est. Average Cost Benefit (national)	Est. Average Cost Benefit (international)
Drug Age & Drug Gender	2,990	4,524,760	3,599,472
Drug Allergy	84	161,387	128,384
Drug Diagnosis Contraindication	67,622	118,998,340	94,663,848
Drug Diagnosis Indication	178,450	270,468,033	215,158,840
Drug Overdose	13,349	19,278,587	15,336,224
Drug-to-Drug Interaction	2	1,780	1,416
Duplicate Therapy	565,165	856,888,440	681,659,568
Grand Total	827,662	1,270,321,327	1,010,547,752
The associated harms are estimated at 6%	49,660	110,492,930	87,897,747

\* The costs are in US dollars.

**Table 6**

The estimated saving cost of prevented alerts using national and international rates by multiplying the number of alerts by the average harm cost for a 6% prediction of occurrence in 2021.

Alert Type (2021)	# Of Alerts	Est. Average Cost Benefit (national) SAR	Est. Average Cost Benefit (international) SAR
Drug Age & Drug Gender	3,547	5,125,807	4,077,608
Drug Allergy	127	242,080	192,576
Drug Diagnosis Contraindication	93,916	162,604,187	129,352,544
Drug Diagnosis Indication	337,244	510,618,513	406,199,896
Drug Overdose	15,528	21,989,527	17,492,792
Drug-to-Drug Interaction	2,069	3,075,840	2,446,848
Duplicate Therapy	1,011,647	1,578,109,433	1,255,394,920
Grand Total	1,464,079	2,281,765,387	1,815,157,184
The associated harm was estimated at 6%	87,845	195,454,573	155,485,211

\*The costs are in US dollars.

thriving economy, and a vibrant society (Chowdhury et al., 2021, SaudiVision2030, 2022). One of the main pillars of Vision 2030 is the health sector transformation program, which aims to restructure the health sector to be more effective, comprehensive, and integrated. The health care transformation uses value-based care, a new worldwide principle for ensuring transparency and financial suitability. This health sector transformation aimed to expand the use of e-health services and digital solutions to improve patients' access to high-quality health care. This will help to promote public health and prevent disease, especially chronic diseases, which are burdensome from both a humanistic and a financial standpoint.

One of these health transformations is the establishment of the Wasfaty program by the Saudi MoH, which is outsourced to and run by NUPCO. The Wasfaty program has aimed to digitalize and monitor the entire prescription cycle, from prescribing to dispensing, by applying a reimbursement mechanism utilizing the private sector to enhance medication accessibility and improve medication availability with a high level of quality and patient safety (Almaghaslah et al., 2022). The Wasfaty program began slowly in 2019 and moved to extensive implementation in 2020 and 2021. Our study aimed to assess the economic impact of introducing this new initiative. We used antidiabetic medications because diabetes mellitus is one of the most common economic burdens in Saudi Arabia and worldwide (Lin et al., 2020).

We used various methods to calculate the cost of antidiabetic medications during the pre-Wasfaty period to have the most accurate cost estimates. Using both methods, our study showed that the Wasfaty program substantially saves costs in comparison to the pre-Wasfaty period. The mean difference between the two periods was USD 109.18 (SAR 530.99), with costs per visit before Wasfaty and after applying Wasfaty being USD 141.6 (SAR 409.43) and USD 32.42 (SAR 121.56), respectively. We used a range of diabetes mellitus prevalence (ie, 11 and 12%) to avoid underestimation of the prevalence of diabetes mellitus. The Wasfaty program was cost-saving using both numbers for the prevalence of diabetes mellitus.

We believe that the Wasfaty initiative has resulted in cost savings due to the availability of the CDSS that is built into the Wasfaty services. The CDSS is supported with drug and clinical information (databases) that help the physician and pharmacist during the prescribing and dispensing of medications. The system can show any medical and safety alerts such as drug-drug, drug-therapy, drug-diagnosis, drug-food, drug-allergy, drug-gender, and drug-age interactions; drug quantity over time (duration); maximum daily dose; maximum single dose; authorization of the prescription of medication based on an approved formulary list; authorization of the prescription of a medication based on the type of facility; and detection of look-alike and sound-alike medications, high-alert medications, and hazardous medications. Each of the aforementioned alerts is a source of cost burden (Kuperman et al., 2007).

Furthermore, the ability of the CDSS to initiate business rules such as controlling the refill time and quantity to avoid overuse of medications or harm and avoiding waste of medications in cases where patients change medications. These are also sources of cost through either loss or saving of money, especially in the case of medications that expire. Before the Wasfaty program, there was no system for considering or controlling these concerns; consequently, they created a cost burden on the budget.

Our study shows that after applying the Wasfaty program, the CDSS caught several safety concerns associated with prescribed medications (eg, duplicate therapy, contraindication, and drug-drug interactions). During the Wasfaty period, these medications would have cost a minimum of USD 6,475,046 (SAR 24,281,422) in 2020 and USD 10,395 (SAR13,249,538,980) in 2021 if these harms had not been caught. This is in addition to USD 99,195,339 (SAR 371,982,520) and USD 175,469,892 (SAR 658,012,095) in 2020 and 2021, respectively, which were saved because of the Wasfaty program's ability to prevent sources of harm that were associated with medications due to safety concerns. These estimations are conservative because we considered

that only 6% of these alerts would lead to harm that would place a cost burden on the health care system.

Through privatization, the responsibility for managing the inventory replenishment, expiry, and overstock has been outsourced to the community pharmacies (1 stock used for Wasfaty, insurance, and cash patients). In addition, there are operating costs, which include human resources (pharmacist and technician staffing); the cost of the supply chain and logistics; patient education; the cost of pharmacy, store, and warehouse space per meter; the cost of building, decoration, furniture, equipment, electricity, maintenance, and repairs; etc. Therefore, all of the costs are taken care of by the community pharmacy as a lump sum during the agreement process with NUPCO. However, before Wasfaty, these were all extra costs for the MoH. This study found that the annual average human resources (ie, pharmacists and pharmacy technicians) costs and pharmacy operation costs amounted to USD 11,750,600 (SAR 44,064,750) and USD 97,473,469 (SAR 365,525,509), respectively.

There are other benefits of using the Wasfaty program, such as using only **one** e-prescription system, which will help to reduce prescription errors and is ultimately a patient safety tool. Furthermore, patients do not have to commit to a specific pharmacy; they can fill a prescription at any participating pharmacy. Furthermore, using digitalization on both sides of prescribing, using the e-prescription system, and dispensing through the participating pharmacies will help to facilitate and support the completion of the digital health cycle, especially with virtual clinics and virtual hospitals, as well as unified national patient medical records. The data obtained using the Wasfaty program will make it easier to have accurate information that directly reflects positively on the burden of medications and the health care budget accordingly. The program could also indirectly be a source for estimating an accurate prevalence of chronic diseases; this would help the transformation of health sectors to promote public health, which is one of the health transformation's goals.

We believe that one of the major benefits of applying the Wasfaty initiative is the provision of high-quality patient care, because everyone who provides care through the Wasfaty initiative are pharmacists (hold a minimum of a bachelor degree), whereas before the Wasfaty initiative, most of those who worked in PHC were pharmacy technicians.

The results of our study showed that the cost savings from the Wasfaty program did not come from a single cost source; these savings are from both direct and indirect costs during the study period, and the most significant cost saving came from the indirect costs. Therefore, it is important to look at the whole system with respect to the cost saving and not only the drug cost alone, which is also considered a cost saving. These cost savings are expected to continue if the Wasfaty program is expanded to all health care providers in Saudi Arabia.

However, we believe there is room for improvement in the Wasfaty initiative that might enhance both the economic and clinical impact on patients and the health care system, such as providing home delivery service to patients with a guarantee of providing patient counseling by qualified pharmacists. This will enhance patient satisfaction and lead to improving patients' adherence to their medications, especially patients with chronic diseases. In addition, campaigns can be conducted to educate health care professionals about all services available in the Wasfaty initiative.

The study has several limitations. First, some medications are directly purchased by the MoH through no-tender platforms (eg, a marketplace), which were not included in the study because the data were not available. However, the direct purchase of medications accounts for very minimal costs compared to the regular process of procurement (tender). We analyzed the impact of antidiabetic medications as an example to assess the impact of

the Wasfaty program; however, we believe other diseases and conditions will have the same trend because they fall under the same system and procedures. Our study is the first study to assess the economic impact of the Wasfaty program using one of the most common diseases in Saudi Arabia. Second, we calculated both direct and indirect costs, giving more accurate data on the Wasfaty program's impact.

## 5. Conclusion

Our study implicated that the Wasfaty initiative is an example of implementing digitalization and privatization of the health care sector under Vision 2030. Our study showed that this initiative leads to a reduction in health expenditure and savings using diabetes mellitus as an example. This initiative has not only positively affected economic outcomes but has also humanely protected the public from unwanted harm.

## 6. Authors' contributions

TMA and SIA conceived the study. TMA, SIA, and KAA searched the literature. TMA, SIA, KAA, and ZSA were involved in study design. TMA, SIA, KAA, and ZSA analyzed and interpreted the data. All authors contributed to writing and reviewing the manuscript.

## Ethical approval

According to the MOH Guidelines on Ethical Conduct and Publication of Health Research in Saudi Arabia, ethical approval was not required for our study because we utilized readily accessible secondary data.

## Data availability

All data gathered and analyzed during the current study are available from the corresponding author.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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