



INTRODUCTION

Diabetes is a chronic metabolic condition that represent a significant public health challenge due to its chronic complications, its high prevalence, and the associated healthcare costs.

Poor management of hyperglycemia, combined with other risk factors, leads to both microvascular and macrovascular chronic complications, including hypertension, lower limb arterial disease, myocardial infarction, stroke, and diabetic foot.

In Algeria, the prevalence is estimated at 14.4% among individuals aged 18 to 69 ¹. Among Algerian patients with type II diabetes, macrovascular complications, primarily hypertension, are observed in 7.6% of cases ².

OBJECTIVES :

Primary objective : is to assess the annual expenditures related to the management of well-controlled and complicated diabetes with macroangiopathies. We base this assessment on the costs associated with pharmaceutical product consumption and the frequency of supplementary diagnostic tests, both within the public and private healthcare sectors.

Secondary objective : is to predict the anticipated cost trends over a 5-year period, considering demographic growth. In addition, we aim to calculate the potential cost-savings resulting from lifestyle modifications and the introduction of Metformin among individuals predisposed to diabetes.

METHODS

A multicenter pharmacoeconomic study involving 425 patients with type II diabetes (PwDT2) records, including 414 reviewed retrospectively and 11 prospectively. This study was conducted in various clinical services in Algiers, among public and private sectors.

We addressed therapeutic regimens and supplementary examinations required for managing well-controlled diabetes, glycemic imbalances, hypertension, compensated lower limb arterial disease, and diabetic foot. Data related to complications such as strokes and myocardial infarctions required consultation with specialized services (specifically medical intensive care and cardiology).

Prices required for cost calculations were obtained from various sources : Hospital pharmacy for hospital-use medications and consumables, community pharmacies for outpatient medications, medical analysis laboratories for biological tests, imaging centers for diagnostic scans, and private sectors for various specialized medical procedures. The inclusion of the private sector was necessary due to the complexity of cost estimation within public institutions. The annual cost of patient care was calculated based on Fig.1

The overall cost incurred for patient care could not be estimated due to a lack of data for certain patients. Only the maximum, average, and minimum expenses were considered.

Data collection were extrapolated to a national scale using an economic model, with a simulation of their evolution over 5 years, considering only demographic changes and assuming constant expenses and prevalence rates.

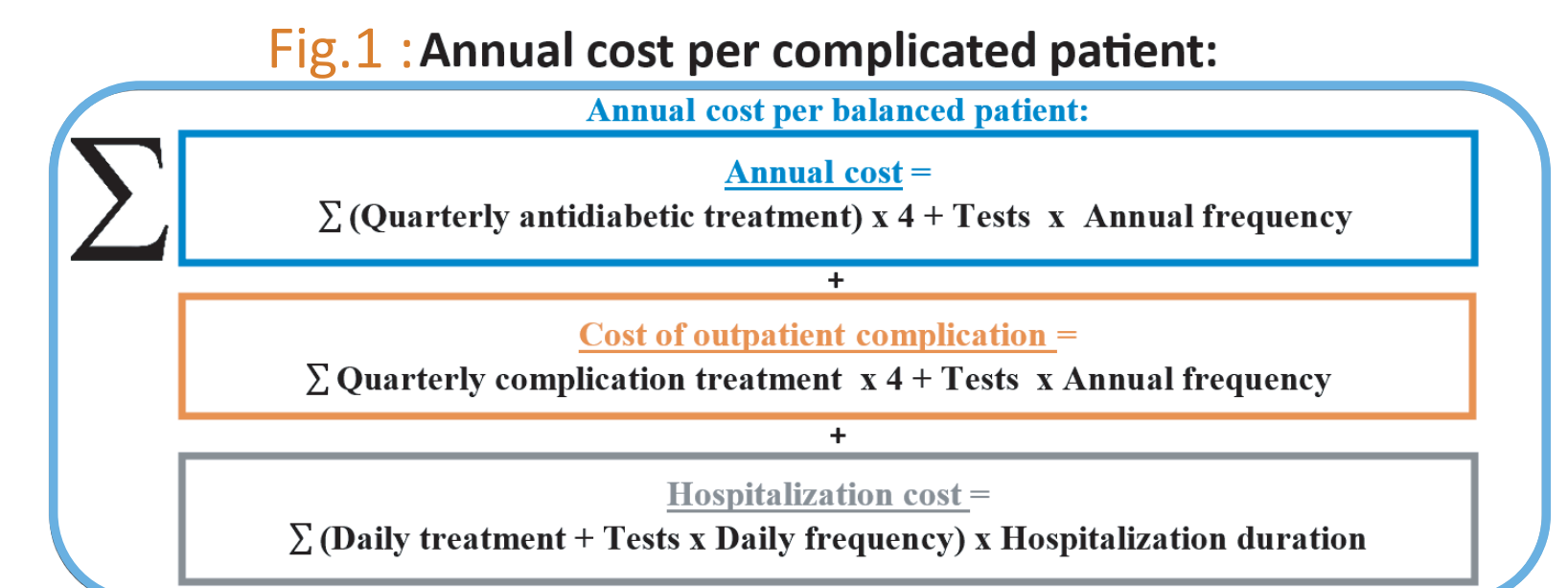
Investigation results and the eligible were combined in the model, considering two scenarios :

First scenario : With lifestyle modifications and the addition of Metformin for prediabetic individuals.

Second scenario : Without lifestyle modifications and addition of Metformin.

The application of the relative risk reduction (RRR) have been considered from the "D-CLIP" study ³.

The model is based on the demographic growth of the national population⁴, incorporating the respective prevalences of target population, considering the following criteria : adult population, PwDT2, Pw prediabetes, overweight or obese Pw prediabetes, balanced PwD, PwD with macrovascular complications, PwD with hypertension, compensated AOMI, diabetic foot, strokes, and myocardial infarctions.



RESULTS

The study has revealed that out of 425 patients, with an average age of 62 years and a slight male predominance, with a sex ratio of 1.05, only 104 patients have well-managed diabetes (24.5%) , while 321 have complicated diabetes (75.5%) . Among these, 308 have macrovascular complications, and 13 have glycemic imbalances. By applying the prevalence of 14.4% to the national adult population, we estimate that there will be over 3.8 million PwDT2 in 2023, reaching 4 million by 2027, of which 293,051 and 310,752 will have macrovascular complications (7.6%).

Taking into account the prevalence of prediabetes, which affects 8.2% of the Algerian adult population, and assuming that 90% of Pw prediabetes are obese or overweight, which represents more than 1.9 million in 2023, potentially reaching 2 million by 2027, of which 150,188 and 159,260 patients, respectively, will develop macroangiopathies.

According to the D-CLIP study, lifestyle modifications and the addition of Metformin to obese or overweight Pw prediabetes result in a 32% reduction in the relative risk of developing diabetes³, which represent a reduction of 632,372 PwDT2 in 2023 and 670,570 in 2027, including 48,060 and 50,963 PwDT2 with macrovascular complications. This addition of Metformin applies to 72% of Pw prediabetes, with 52% taking Metformin and 69.6% adhering to their treatment, resulting in a population of 514,953 in 2023, reaching 546,058 in 2027.

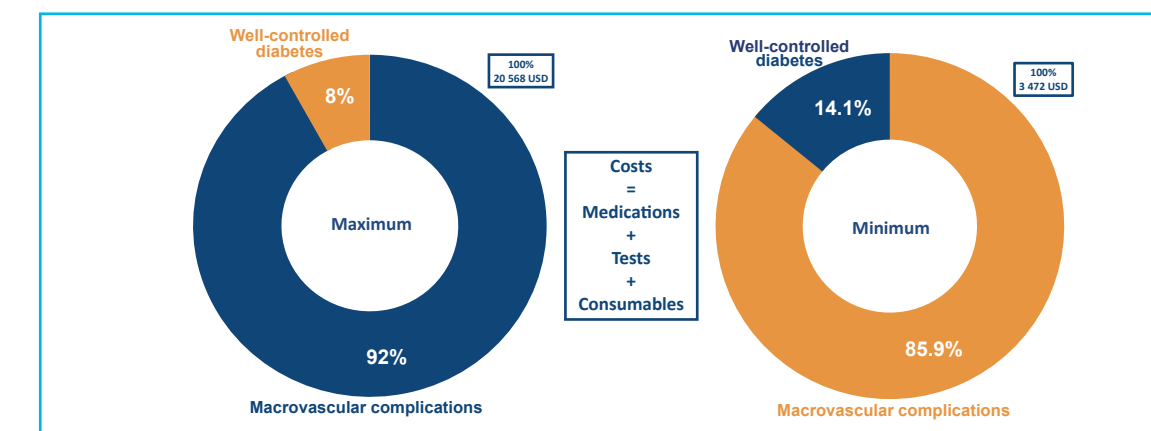


Fig.2 : Costs of macrovascular complications compared to the cost of well-controlled diabetes.

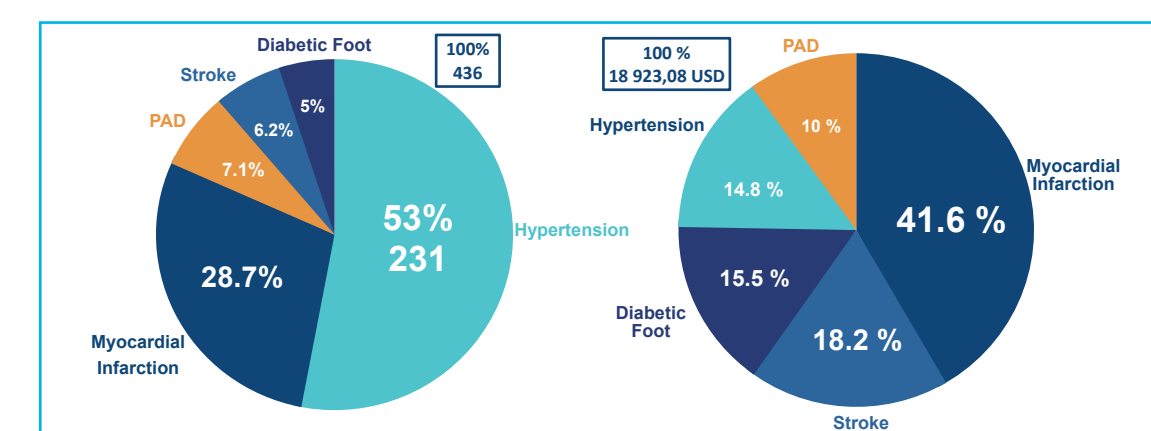


Fig.3 : Proportions of macrovascular complications by their numbers and maximum costs.

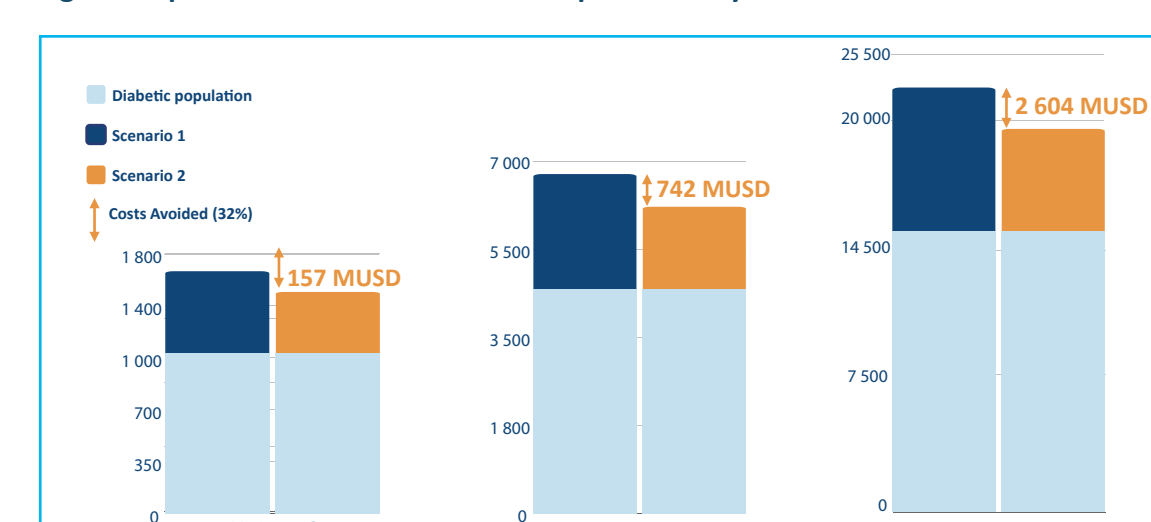


Fig.4 : Summary of cumulative minimum, average, and maximum costs saved by lifestyle modification and the addition of Metformin.

Tab.1 : Costs of macrovascular complications compared to the cost of well-controlled diabetes.

	Myocardial Infarction	Stroke	Diabetic Foot	Hypertension	Glycemic Imbalance	PAD	well-controlled diabetes
MAX (USD)	7 867,77	3 442,88	2 934,34	2 793,11	2 083,27	1 884,96	1 645,34
AVE (USD)	2 542,64	1 800,37	1 739,41	876,31	1 697,09	1 156,68	421,18
MIN (USD)	1 067,38	1 041,75	739,92	186,81	974,41	380,85	56,12

Tab.2 : Accumulated costs of well-controlled diabetes and macrovascular complications in the type II diabetic population.

	Type 2 Diabetic Population	
	2023	Accumulated Costs 2023-2027
well-controlled diabetes	29,57% ⁽⁴⁾	1 876 MUSD
Hypertension	53,00% ⁽⁴⁾	433 MUSD
Myocardial Infarction	29,00% ⁽⁴⁾	661 MUSD
Stroke	6,00% ⁽⁴⁾	62 MUSD
PAD	7,00% ⁽⁴⁾	39 MUSD
Diabetic Foot	5,00% ⁽⁴⁾	43 MUSD
Maximum Accumulated Cost		3 115 MUSD
Average Accumulated Cost		912 MUSD
Minimum Accumulated Cost		220 MUSD

Tab.3 : Accumulated additional costs and savings associated with each scenario.

	Scenario 1		Scenario 2		Expenses	=	Costs Avoided
	2023	Accumulated Costs 2023-2027	2023	Accumulated Costs 2023-2027			
Maximum Accumulated Cost	1 596 MUSD	8 228 MUSD	510 MUSD	2 638 MUSD	27 MUSD		483 MUSD
Average Accumulated Cost	467 MUSD	2 408 MUSD	149 MUSD	771 MUSD	29 MUSD		122 MUSD
Minimum Accumulated Cost	112 MUSD	582 MUSD	36 MUSD	186 MUSD			8 MUSD

DISCUSSION AND INTERPRETATION

The total number of complications is 472, considering that a same patient may present multiple complications. Since this study primarily focuses on macrovascular complications, cases with glycemic imbalance (a total of 36) were excluded, resulting in a final count of 436 complications.

Hypertension is the most prevalent complication, affecting 53% of the population, but it contributes to only 14.8% of the maximum overall cost. Stroke and diabetic foot complications occupy the last two positions in terms of prevalence, at 6.2% and 5% respectively. However, their costs are tripled. Myocardial infarction is the costliest (more than 7 800 USD), while peripheral arterial disease is the least expensive (more than 1 800 USD). These conditions are found in 28.7% and 7.1% of cases, respectively.

The cumulative cost of these five complications reaches a maximum of 1.2 BUSD in 2023, with a total of 6.4 BUSD over 5 years. The minimum is 156 MUSD in 2023, reaching 165 MUSD in 2027, with a total cumulative of 806 MUSD over 5 years.

In the context of simulating the evolution of Pw prediabetes, two scenarios are possible :

Scenario 1: In the absence of lifestyle modification and the addition of Metformin in 2020, the entire Pw prediabetes, including those who are overweight or obese, becomes PwDT2 in 2023. These additional total costs represent, in the maximum scenario : 1 596 MUSD per year with 8 228 MUSD accumulating over 5 years. In minimum scenario : 112 MUSD per year, with 582 MUSD accumulating over 5 years.

Scenario 2: RRR of 32%³ through lifestyle modification over 3 years in the same population and the addition of Metformin starting from the 4th month generates gains of 510 MUSD at maximum and 36 MUSD at minimum in 2023, totaling 2.6 BUSD and 186 MUSD respectively over 5 years. However, the addition of Metformin leads to additional expenses of 27 MUSD in 2023 and a total of 29 MUSD over 5 years. Therefore, the costs avoided in 2023 amount to 483 MUSD at maximum and 8 MUSD at minimum, with a cumulative total of 2.6 BUSD at maximum and 157 MUSD at minimum over 5 years.

CONCLUSION

The estimation of annual expenses associated with diabetes management, including its macrovascular complications, in select hospital services in Algiers, as well as the extrapolation to a national scale, has revealed a substantial economic burden. The trajectory of these costs over a 5-year period and the potential savings reachable through lifestyle modifications and the introduction of Metformin, totaling more than 150 million dollars over 5 years, underscores the critical need to invest in effective management strategies and preventative measures that encourage healthy behaviors. This aims at enhancing individual health, reducing the prevalence of diabetes, and consequently decreasing the costs associated with its management, ultimately contributing to the sustainability of the algerian healthcare system.

REFERENCES :

1. Stepwise ALGERIA SURVEY 2016-2017: BETTER UNDERSTANDING THE HEALTH PROFILE OF ALGERIANS FOR NON-COMMUNICABLE DISEASE RISK FACTORS [Internet]. WHO | Regional Office for Africa. [cited June 16, 2023].
2. Ministry of Health. Reports from the Barometer Study 2018. Internal documents.
3. Weber MB, Ranjani H, Staimet LR, Anjana RM, Ali MK, Narayan KMV, et al. The Stepwise Approach to Diabetes Prevention: Results From the D-CLIP Randomized Controlled Trial. Diabetes Care. August 8, 2016;39(10):1760-7.

4. National Office of Statistics: ONS, Algerian Demography 2019.
5. Ministry of Health. Reports from the Barometer Study 2020. Internal documents.
6. Field investigations.

Abbreviations :

- PwDT2 : Patient with diabetes type 2.
PwD : Patient with diabetes.
RRR : Relative risk reduction.
MUSD : Million US dollars.
BUSD : Billion US dollars.

Acknowledgements :

The authors thank Lakhef Oussama for the poster's graphic design.