

World Health Organization
Egypt

Egypt's Presidential Initiative to Eliminate Waiting Lists

An Assessment of Its Impact on Health, Economy and Financial Protection of Egyptian Households

Egypt's Presidential Initiative to Eliminate Waiting Lists





Egypt's Presidential Initiative to Eliminate Waiting Lists

An Assessment of Its Impact on Health, Economy and Financial Protection of Egyptian Households

Disclaimer:

This is a prepublication report that is intended for restricted audience only. Subject to permissions and clearances by designated authorities, the content of this document is to be peer reviewed for journal publication. The document may not be reproduced, adapted, or distributed without permission.

All reasonable precautions have been taken by WHO to verify the information contained in this publication. However, the material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall WHO be liable for damages arising from its use.

Table of Contents

Foreword by H.E. Minister of Health and Population vii
Foreword by WHO Representative in Egypt viii
AcknowledgementS ix
Executive Summary x
1. Introduction and background 1
2. Methods 2
2.1. Model concept 2
2.1.1. Direct Costs 3
2.1.2. Indirect costs by the patients 4
2.1.3. Indirect costs by the Caregiver 7
2.1.4. Quality-Adjusted Life Years (QALYs) 9
2.2. Model parameters 10
2.2.1. Cost parameters 10
2.2.2. Utility parameters 12
2.2.3. Population parameters 13
2.2.4. Productivity parameters 16
2.3. Discounting and Time frame of the model 18
2.4. Sensitivity analysis 19
2.4.1. Deterministic sensitivity analysis 19
2.4.2. Probabilistic sensitivity analysis 19
3. Results 20
3.1.1. Results reported 20
3.1.2. The presidential initiative collective results (Aggregated results) 20
3.1.3. Open heart surgeries results 21
3.1.4. Heart catheterization results 22
3.1.5. Cochlear implantations results 22
3.1.6. Retina surgeries results 23
3.1.7. Joint replacement surgeries results 24
3.1.8. Benefit-cost ratio 25
4.1.9 Sensitivity analysis results 26
4. Financial Protection and Equity dimensions of the initiative 28
4.1. Methods 28
4.1.1. Calculating catastrophic health expenditure 28
4.1.2. Data sources for household expenditures, health spending, and cost of surgeries 28
4.1.3. Curve fitting 29

4.1.4. Affordability calculations 29
4.2. Results 30
4.2.1. Affordability 30
4.2.2. Catastrophic Health expenditure 30
4.2.3. The presidential initiative in relation to the Egyptian poverty line 32
4.2.4. Poverty line calculations summary 33
5. Discussion 34
6. Conclusion 36
7. Study team* 37
8. References 38
9. Annexes 39
9.1. Annex 1 39
9.2. Annex 2 40
9.3. Annex 3 41
9.4. Annex 4 45
11.5. Annex 5 48
11.5.1. Partial normative food spending method 48
11.5.2. Normative spending on food, housing, and utility method 48
11.5.3. Affordability details 49

List of Figures

Figure 1 Diagram explaining the model arms 2
Figure 2 Partitions of each model arm 2
Figure 3 Graphical representation of the three partitions of the direct cost 4
Figure 4 Graphical representation of the three partitions of the indirect cost by patients 5
Figure 5 Graphical representation of the three partitions of the indirect cost by caregivers 7
Figure 6 Graphical representation of the 3 partitions of QALYs 9
Figure 7 Tornado diagram showing the DSA results 26
Figure 8 CEA scatter plot showing the results of the PSA 27
Figure 9 Cost-effectiveness acceptability curve 27
Figure 10 Affordability of different surgeries 31
Figure 11 Affordability of open-heart surgeries in Egypt (no. of patients) 49
Figure 12 Affordability of cardiac catheterization in Egypt (no. of patients) 50
Figure 13 Afordability of cochlear implantation surgeries in Egypt (no. of patients) 50
Figure 14 Affordability of ophthalmic surgeries in Egypt (no. of patients) 51
Figure 15 Affordability of orthopedic surgeries in Egypt (no. of patients) 51

List of Tables

Table 1 Equations to calculate the difference in direct costs 4
Table 2 Equations to calculate the difference in indirect costs by patients 6
Table 3 Equations to calculate the difference in indirect costs by Caregivers....8
Table 4 Equations to calculate the difference in QALYs 10
Table 5 Costs of early and delayed surgeries....11
Table 6 Medical costs....12
Table 7 Model utilities and utility decrements....13
Table 8 Number of patients who benefited from the initiative and Males' ratio 14
Table 9 The reduction of waiting time in years....14
Table 10 The percentage of avoided missed surgeries....14
Table 11 The percentage of mortality averted....15
Table 12 The average age for surgeries 15
Table 13 Average age at death per surgery 16
Table 14 Days lost by the patients....17
Table 15 Days lost by the Caregiver....18
Table 16 General productivity parameters 18
Table 17 Model results (Discounted and undiscounted) 21
Table 18 Undiscounted results for Open heart surgery....21
Table 19 Discounted results of open-heart surgery 21
Table 20 Undiscounted results of cardiac catheterization....22
Table 21 Discounted results of cardiac catheterization....22
Table 22 Undiscounted results of Cochlear implantation....23
Table 23 Discounted results of Cochlear implantation....23
Table 24 Undiscounted results of Retina surgeries 24
Table 25 Discounted results of Retina surgeries 24
Table 26 Undiscounted results of Joint Replacement surgeries 25
Table 27 Discounted results of Joint Replacement surgeries 25
Table 28 Benefit-Cost Ratio results 25
Table 29 Methods of calculating catastrophic health expenditure....28
Table 30 Percentage who could afford the surgeries according to Budget Share method 30
Table 31 Percentage who could not afford the surgeries according to Budget Share method....30
Table 32 Affordability of selected surgeries according to budget share method 31
Table 33 Poverty line details 32
Table 34 Expenditure compared to the poverty line results....33
Table 35 The tool used for structured interviews 39
Table 36 The health services package for each surgery 40
Table 37 Model inputs included in the DSA 41
Table 38 Model inputs included in the PSA 45
Table 39 Percentage who could afford the surgeries according to partial normative and normative calculation methods 48
Table 40 Percentage who could not afford the surgeries according to partial normative and normative calculation methods 48
Table 41 Affordability of selected surgeries....49

FOREWORD BY H.E. MINISTER OF HEALTH AND POPULATION

As an essential step towards elimination of patients' sufferings, ending waiting lists for patients of various medical interventions, and keeping up with high level quality of medical services, efficiency and effectiveness for all patients equally, President Abdel Fattah El-Sisi launched the presidential initiative to end waiting lists for surgeries in July 2018.

Alleviating the patients' suffering by ending waiting lists for 11 medical surgical interventions and providing medical services through effective cooperation between all health entities including multi sectorial cooperation between governmental and private sectors, in an effort to reduce health burdens and make it possible for every citizen to have the medical services in need of high quality and on time without thinking of the financial barriers.

The initiative has contributed to achieving many benefits since it has been launched specially for the health automation process which includes: following up the implementation of procedures through the electronic system, establishing a unified electronic system that links the decision-making authorities (e.g. Programme for the treatment at the expense of the state, health insurance organization), and issuing decisions based on the capacity of each specialty within each hospital, with the possibility of transferring cases between the sectors implementing the service.

Therefore, I have seen the importance of using the bowl of data, information and statistics, which resulted from this initiative, to clarify the relationship between improving the health status of citizens and the return on investment on the national economic situation.

Our ultimate goal is to bring Egypt to the ranks of countries that have the strongest health systems in the world and in line with international standards.

Minister of Higher Education

Acting Minister of Health and Population

Professor Dr Khaled Abd El Ghafaar

FOREWORD BY WHO REPRESENTATIVE IN EGYPT

Long waiting time for health services has been a persistent challenge that faces health systems in many countries around the world where Egypt is not an exception. The extended waiting time experienced by patients can lead to health deterioration, patient dissatisfaction, mental health stress, inequities and impose costs not only on the patients themselves and their families but also on their direct providers and economy as a whole.

The problem of long waiting time usually arises from an imbalance between the demand for and the supply of health services. And, while there is no one-size-fits-all policy to resolve the problem, successful approaches usually combined demand side interventions such as strengthening referral systems as well as supply side policies such as providing extra funding, in addition to improved monitoring to demonstrate progress.

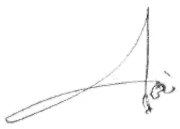
WHO acknowledges Ministry of Health and Population's request to assess the value for money of interventions in order to reduce the delays in medical interventions where the return is improved care with efficient use. The policy under the directives of His Excellency the President of the Republic of Egypt has been the launch of the Presidential initiative to eliminate waiting lists by allocating additional funding, expanding the network of providers to address extended waiting lists that are associated with certain clinical interventions and increasing patients and families satisfaction with rights to care.

This report presents the economic and health benefits of the Presidential initiative to eliminate waiting lists. It also demonstrates the impact the initiative has on the population level of financial protection.

This significant work lies within the WHO mandate to improve institutional capacities for transparent decision-making in priority-setting and resource allocation, and support the analysis of the impact of health on the national economy. The WHO remains committed to maintain and expand its technical efforts in addressing health system challenges in Egypt and we are looking forward to continuing our collaboration with the Ministry of Health and Population and all national partners.

Dr Naeema Al Gasseer

WHO Representative in Egypt and Head of Mission



ACKNOWLEDGEMENTS

This document is a result of collaborative effort between the Ministry of Health and Population, Syreon Middle East, and the World Health Organization Representative Office in Egypt.

The study team would like to acknowledge the sincere efforts made by Syreon Middle East technical experts, available in section 9 of this report. We are grateful for the contribution of the presidential initiative scientific committee and resource persons. In particular, we would like to thank: Eng. Akram Mohmed Samy Ahmed, Eng. Mohamed Mahmoud Mohamed Abd Elhafez, Eng. Mohammed Magdy Fouad Mahmoud, Dr Ahmed Mohamed Mostafa, Dr Eman Ghorab, Dr Nashaat Abd-ElHamid, Dr Ashraf Ahmed, Dr Bassem Zarif, Dr Mohamed Shikhon, Dr Ahmed Fayez, Dr Ahmed Abdel Nabi, Dr Ayman Ebied, Dr Karim Karam Mahmoud, Dr Nada Mohamed Gamal and Mr. Abdallah Gomaa.

The study team would like to greatly acknowledge Dr Naeema Al Gasseer for her sincere efforts to support the completion of this research.

Gratitude is due to the leadership and patronage of H.E. Minister of Health and Population for the overall support throughout the study process.

EXECUTIVE SUMMARY

Waiting time is an indicator to evaluate the efficiency of the health system, patient satisfaction, and horizontal equity in providing health care. Despite Egypt's exceptional efforts to satisfy patients' needs, waiting time reduction is still one of the ongoing challenges to the Egyptian health care system. Waiting time is when patient experience is more prolonged than medically acceptable for treatment. Such waiting incurs costs not only on the patients themselves but also on the economy as a whole.

This research uses an innovative method to assess the economic and health impact of the presidential initiative to eliminate waiting lists. First, the research presents a cost-effectiveness analysis of the initiative based on the estimates of the marginal costs and marginal outcomes before and after the initiative. The costs are used in updated prices in the Egyptian pounds (discounted and undiscounted costs), while the outcomes are represented in Quality-adjusted life years (QALYs). Moreover, the research includes a benefit-cost analysis to estimate the return on investment of the initiative, in addition to an affordability assessment to quantify the benefits of the initiative on the financial protection of the Egyptian population due to direct household health spending.

The analysis focuses on five key interventions from the presidential initiative during the period of January 2019 to February 2020. It shows that the initiative added 48,385 Quality-adjusted life years with an incremental cost of around 2 billion EGP, including the productivity lost (i.e., societal perspective) and around 3 billion EGP from a payer's perspective. This gives an incremental cost-effectiveness ratio of 46,795 EGP, and 56,094 EGP per QALY from a societal and payer perspective, respectively. This value is considered **cost-effective** compared to the cost-effectiveness threshold in Egypt and global norms. The overall benefit-cost ratio indicates a return on investment of 1.14 EGP and 1.51 EGP for every 1 EGP spent on the initiative in the discounted and undiscounted scenarios, respectively.

From the financial protection perspective, most surgeries are considered not affordable since they would expose households to catastrophic health expenditure if paid from households out of pocket. In total, for the five selected interventions, only 4.5% of the population can afford the interventions without suffering financial hardship. Furthermore, surgeries may drag a significant percentage of the patients to poverty or even extreme poverty. For example, ophthalmic and cardiac catheterization surgeries are the least expensive, leading to 65% of the population being dragged into poverty if paid out of pocket, compared to 30% without surgery. On the other hand, cochlear implantation surgeries are the costliest. If paid out of pocket, they lead to dragging nearly all patients to poverty (98%).

The Waiting list elimination presidential initiative is a cost-effective public health intervention from both payer and societal perspectives. Moreover, it provides an effective and equitable financial coverage mechanism for the affected population. Therefore, it is recommended to expand the initiative to more curative and preventive services and integrate its resources within the overall Egyptian health reform plans.

1. INTRODUCTION AND BACKGROUND

Waiting lists in elective surgeries and procedures are a global healthcare problem. In many OECD countries, the mean time of waiting for elective surgery may reach up to three months (Hurst & Siciliani, 2003). The issue of waiting lists is multifaceted and is growing worldwide (Price, 2021). The problem with waiting lists can arise from supply and/or demand-related healthcare services constraints (HOPE, 2001). Therefore, countries that suffer waiting list problems adopt different mitigation policies to alleviate the harmful effects of waiting lists (Hurst & Siciliani, 2003).

The Egyptian health care system has numerous challenges, and one of them is the extended waiting time that many Egyptians are experiencing while accessing their indicated health interventions. For example, in some elective procedures, it was believed that the average waiting list was up to one year, according to healthcare experts and ministerial officials. Such waiting time may affect the patients medically and the economy as a whole in the form of productivity losses and financial repercussions (Badakhshan et al., 2015). To address this challenge, and under the President of the Arab Republic of Egypt's directives, the Ministry of Health and Population (MoHP) launched "the Presidential initiative to eliminate/reduce waiting lists" in July 2018. The initiative expanded a network of providers and secured extra funding to address the waiting time associated with eleven clinical specialties/interventions. The eleven clinical interventions are Open heart surgeries, cardiac catheterization, cochlear implantation, orthopedic (joint replacement) surgeries, neurosurgery, liver transplantation, kidney transplantation, cerebral catheterization, vascular surgeries, oncology (surgeries), and ophthalmic surgeries. This initiative was funded by budget transfers from the state's general budget, the Health Insurance Organization, and the Central Bank of Egypt.

The study objective is to assess the impact of reducing waiting times for those surgeries by evaluating the difference between both scenarios. Therefore, the scope of the study is not interested in the commonalities between the two scenarios (i.e., The study does not include the health benefit of the surgery itself; it instead quantifies the extra benefit gained from conducting earlier surgeries). Furthermore, this study does not assess the mortality reduction caused by the surgery; instead, it evaluates the mortality reduction due to the earlier surgery compared to later surgery. Finally, this study does not consider the total cost of the surgery; it is concerned with the time value of money for paying for the surgery now instead of later.

The study aims to conduct a cost-effectiveness analysis and a cost-benefit analysis to eliminate/reduce waiting times for the presidential initiative. To optimize data collection and analytical efforts, and based on recommendations of the initiative's scientific committee, the study team made a preliminary prioritization to narrow down interventions to be assessed under this study. The selected interventions are Open Heart Surgeries, Cardiac Catheterization, Cochlear implantation, ophthalmic surgeries, and Orthopedic (joint replacement) surgeries. In addition, retina surgery was assessed as representing the whole specialty for ophthalmic surgeries.

In addition to cost-effectiveness and cost-benefit analysis, the study conducts an affordability assessment to quantify the initiative's benefits on the financial protection of the Egyptian population due to direct out-of-pocket health spending.

2. METHODS

2.1. Model concept

To estimate the cost-effectiveness of the presidential initiative to eliminate/reduce waiting times, we calculated the difference in costs and health benefits of reducing the waiting time for each surgery. As mentioned earlier, we only assessed the difference between both cases and not the commonalities. Therefore, the costs and benefits are calculated for three groups:

1) Patients who had the surgery earlier (Reduced waiting time group);
2) Patients who died while waiting for surgery (Avoided missed surgery group);
3) Patients who missed the surgery due to ineligibility related to the delay (Mortality averted group).

All three groups are analyzed for the five chosen interventions: Open heart surgeries, Cardiac catheterization, Cochlear implantation, Ophthalmological surgeries (represented through retina surgeries), and Orthopedic (joint replacement) surgeries.

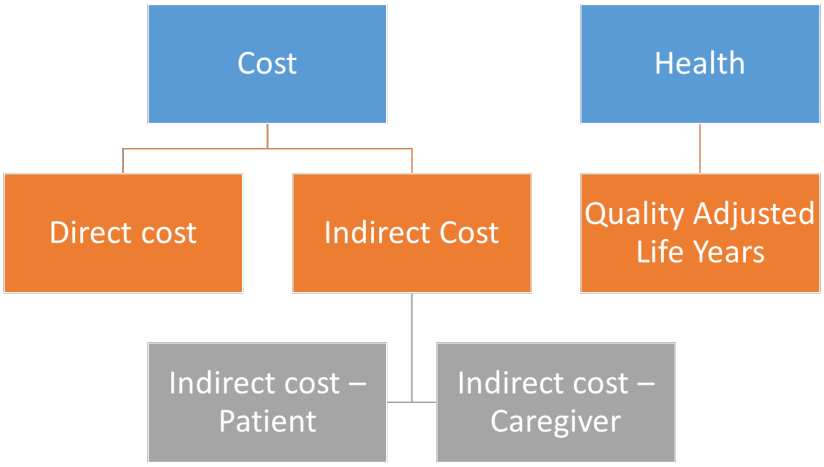


Figure 1 Diagram explaining the model arms

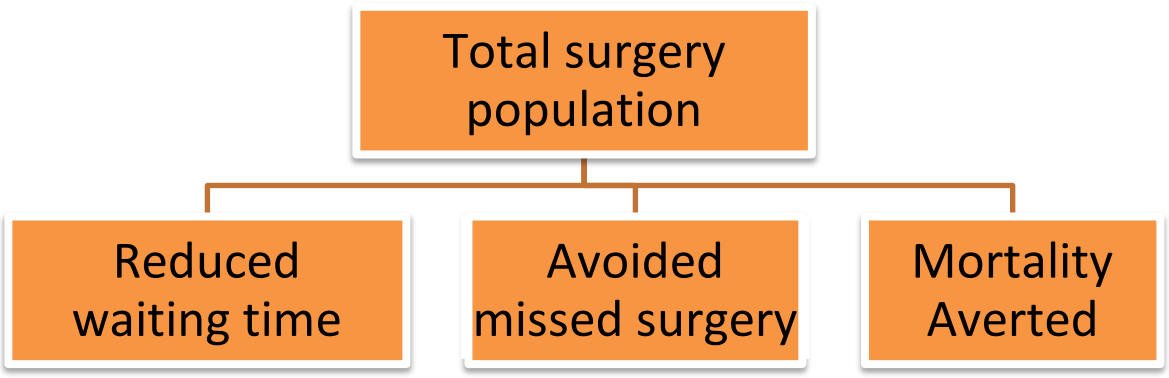


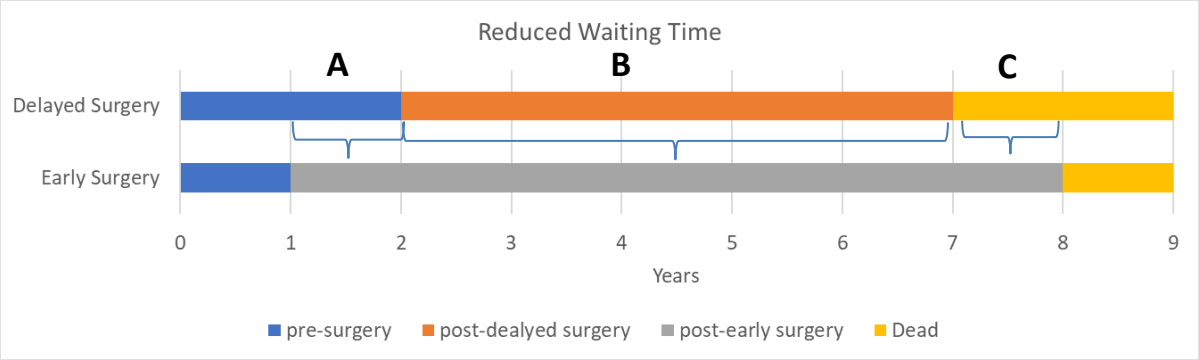
Figure 2 Partitions of each model arm

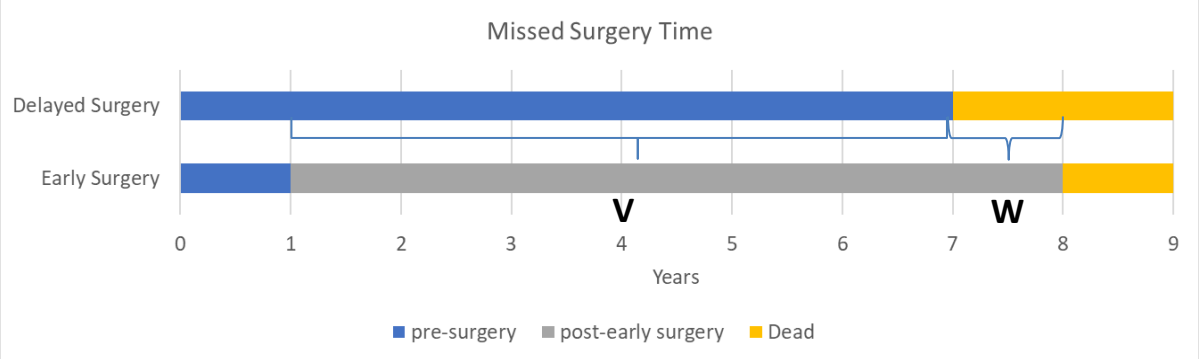
2.1.1. Direct Costs

2.1.1.1. Direct costs break down

- Reduced waiting time
  - The difference in the value of surgery before and after the initiative
  - Possible reduction in medical cost during the reduced waiting time
  - Possible lower long-term medical management cost due to improved prognosis in case of early surgery
  - The extra cost paid on medical management accompanied by more prolonged survival
- Avoided missed surgery
  - The additional cost of surgery
  - Possible reduction in medical cost in the long-term due to better prognosis of those who undergo the surgery
  - The extra cost paid on medical management accompanied by more prolonged survival
- Mortality averted
  - The extra cost of surgery
  - The extra cost paid on medical management accompanied by more prolonged survival

2.1.1.2. Direct costs graphical representation





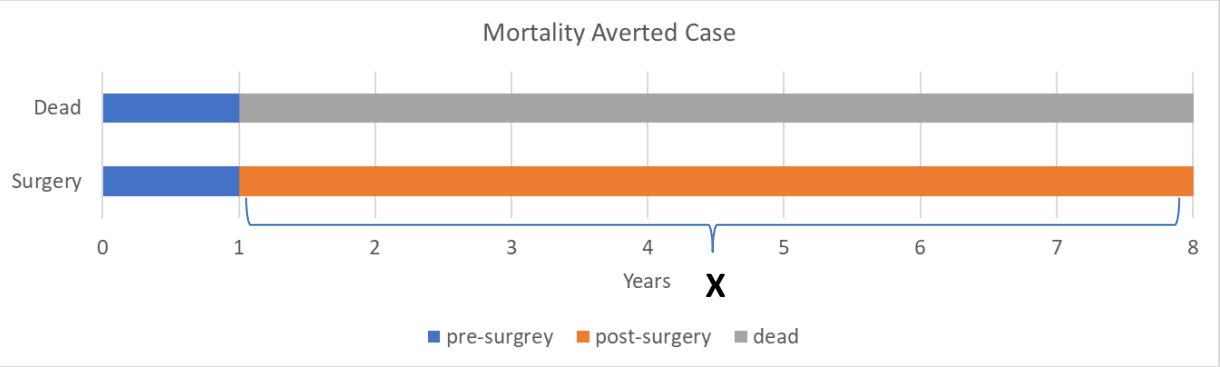


Figure 3 Graphical representation of the three partitions of the direct cost

2.1.1.3. Direct costs mathematical equation

The difference of direct cost = Reduced waiting time percentage + Avoided missed surgery percentage + Averted mortality percentage

Table 1 Equations to calculate the difference in direct costs

Category	Number of patients	Calculations per patient
Reduced waiting time	Number of patients * (1- Percentage of missed surgery- percentage of averted mortality)	((Age at delayed surgery – Age at early surgery) * (Medical costs after early surgery – Medical costs before surgery) + (Age at death after delayed surgery – Age at delayed surgery) *(Medical costs after early surgery – Medical costs after delayed surgery) + (Age at death after early surgery – Age of death after delayed surgery) * Medical costs after early surgery + (cost of early surgery – cost of delayed surgery))
Avoided missed surgery	Number of patients * Percentage of missed surgery	= (age at death before surgery – Age at early surgery) * (Medical costs after early surgery – Medical costs before surgery) + (Age at death after early surgery – Age at death before surgery) * Medical costs after early surgery +cost of early surgery
Averted mortality	Number of patients * percentage of averted mortality)	= (Age at death after early surgery – Age at early surgery) *Medical costs after early surgery + cost of early surgery

2.1.2. Indirect costs by the patients

2.1.2.1. Patients' indirect costs break down

- Reduced Waiting time
  - Reduction in working days lost due to reducing the waiting time
  - Productivity gained due to extended survival
- Avoided missed surgery
  - Reduction in working days lost in the long term due to better prognosis of those who undergo the surgery
  - Productivity gained due to extended survival
- Mortality averted
  - Productivity gained due to extended survival

N.B. Some elements don't apply to all surgeries. Later on, those elements will be factored out.

2.1.2.2. Patients' indirect costs graphical representation

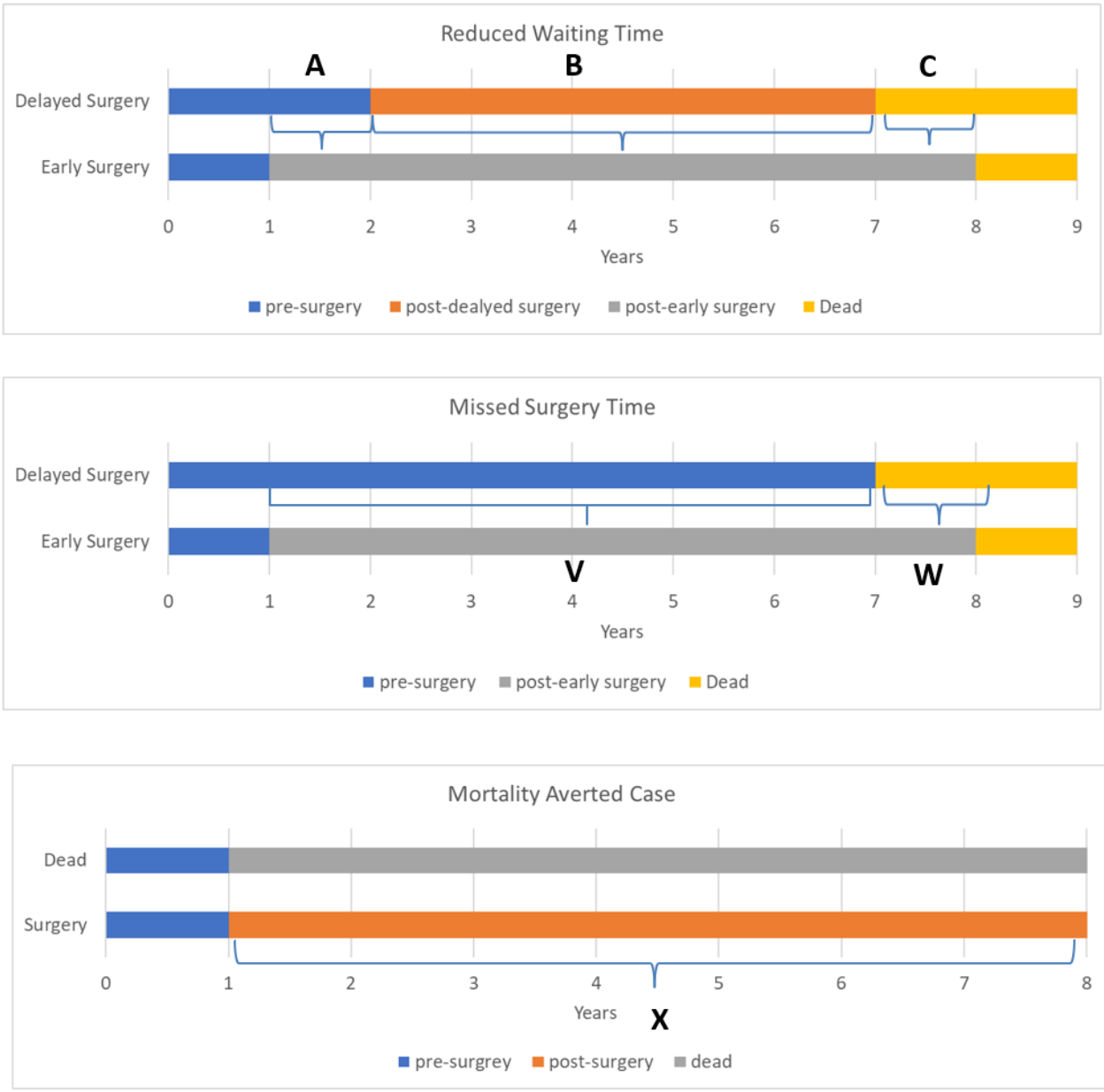


Figure 4 Graphical representation of the three partitions of the indirect cost by patients

2.1.2.3. Patients' indirect costs mathematical equation

The difference in indirect cost by the patient = Reduced waiting time percentage + Avoided missed surgery percentage + Averted mortality percentage

Table 2 Equations to calculate the difference in indirect costs by patients

Category	Number of patients	Calculations per patient
Reduced waiting time	Number of patients * (1 – Percentage of missed surgery- percentage of averted mortality)	=(((days lost after early surgery – days lost before surgery)/Number of working days per year)*(MIN(Age at delayed surgery, Age of retirement) – MIN(Age at early surgery, age of retirement))+ ((days lost after early surgery–days lost after delayed surgery)/number of working days per year)*(MIN(Age at death after delayed surgery, Age of Retirement) – MIN(Age at delayed surgery, Age of Retirement))+ ((days lost after early surgery)/number of working days per year–1)*(MIN(Age at death after early surgery, Age of retirement) – MIN(Age at death after delayed surgery, Age of retirement)))*(Male to female ratio in patients *Labor force participation rate in males +(1–Males to females ratio in patients)* Labor force participation rate in females)*(1–Unemployment rate)*Average salary of patient
Avoided missed surgery	Number of patients * Percentage of missed surgery	=(((days lost after early surgery–days lost before surgery)/number of working days per year) *((MIN(Age at death before surgery, Age of Retirement))–(MIN(Age at early surgery, age of retirement)))+ ((days lost after early surgery)/number of working days per year –1)*(MIN(Age at death after early surgery, Age of retirement)–MIN(Age at death before surgery, age of retirement))*(Male to female ratio in patients *Labor force participation rate in males +(1–Males to females ratio in patients)* Labor force participation rate in females)*(1–Unemployment rate)*Average salary of patient
Averted mortality	Number of patients * percentage of averted mortality)	= (((days lost after early surgery)/number of working days per year – 1)*(MIN(Age at death after early surgery, Age of retirement)–MIN(Age at early surgery, age of retirement))*(Male to female ratio in patients *Labor force participation rate in males +(1–Males to females ratio in patients)* Labor force participation rate in females)*(1–Unemployment rate)*Average salary of patient)

2.1.3. Indirect costs by the Caregiver

2.1.3.1. Caregivers' indirect costs break down

- Reduced Waiting time
  - Reduction in working days lost due to reducing the waiting time
  - Productivity lost due to care for patients due to extended survival
- Avoided missed surgery
  - Reduction in working days lost in the long term due to better prognosis of those who undergo the surgery
  - Productivity lost due to care for patients due to extended survival
- Mortality averted
  - Productivity lost due to care for patients due to extended survival

N.B. Some elements don't apply to all surgeries. Later on, those elements will be factored out

1.1.1.1. Caregivers' indirect costs graphical representation

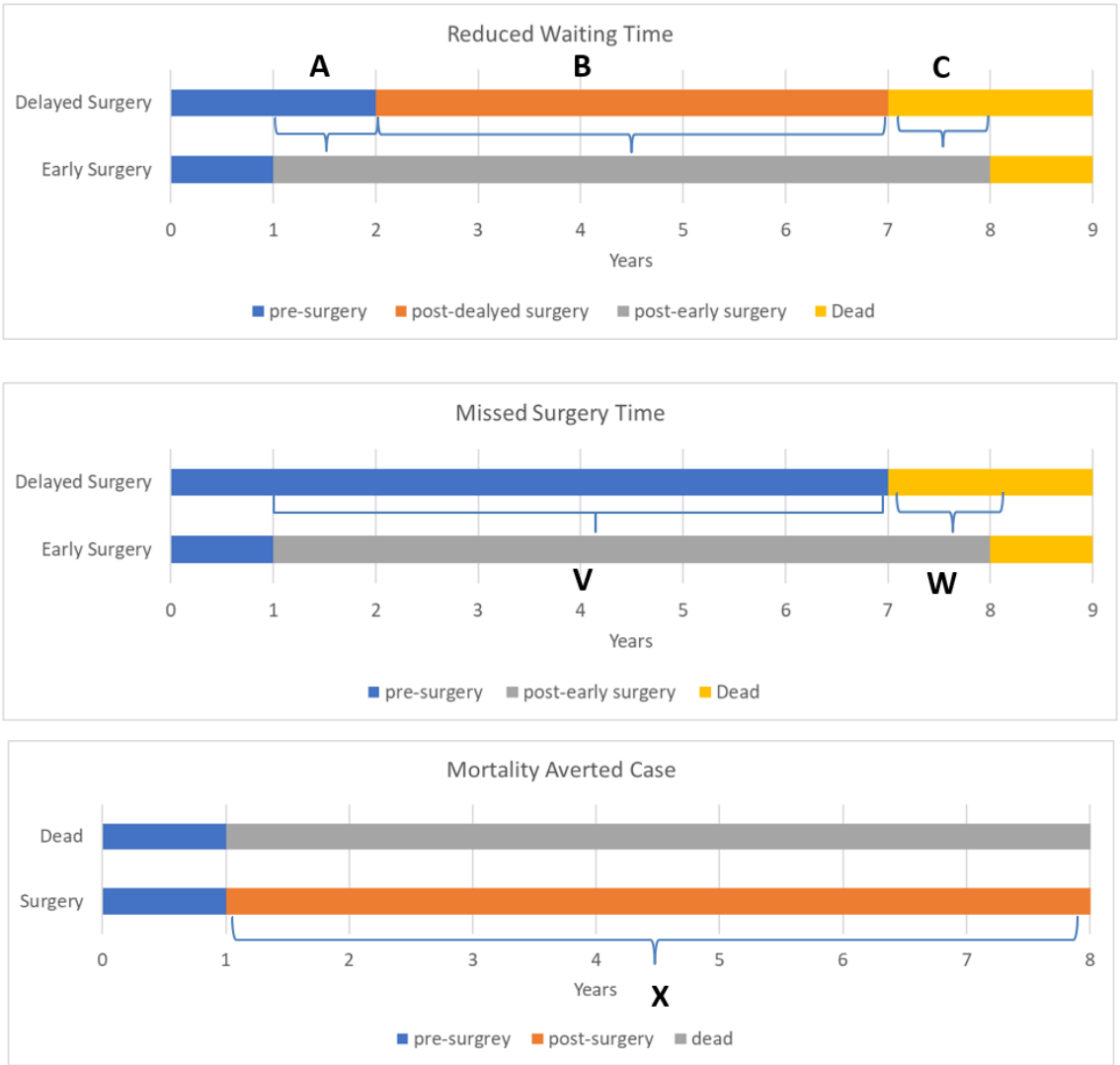


Figure 5 Graphical representation of the three partitions of the indirect cost by caregivers

2.1.3.2. Caregivers' indirect costs mathematical equation

The difference in indirect cost by the Caregiver = Reduced waiting time percentage + Avoided missed surgery percentage + Averted mortality percentage

Table 3 Equations to calculate the difference in indirect costs by Caregivers

Category	Number of patients	Calculations per patient
Reduced waiting time	Number of patients * (1- Percentage of missed surgery- percentage of averted mortality)	=(((days lost by Caregiver after early surgery – days lost by Caregiver before surgery)/number of working days per year)* (Age at delayed surgery – Age at early surgery) + ((days lost by Caregiver after early surgery – days lost by Caregiver after delayed surgery)/ Number of working days per year)* (Age at death after delayed surgery – Age at delayed surgery) + (1–(days lost by Caregiver after early surgery)/number of working days per year)* (Age at death after early surgery - Age at death after delayed surgery))*)*(Male to female ratio in patients *Labor force participation rate in males +(1–Male to female ratio in caregivers)*Labor force participation rate in females)*(1–Unemployment rate)*Average salary for Caregiver
Avoided missed surgery	Number of patients * Percentage of missed surgery	=((((days lost by Caregiver after early surgery – days lost by Caregiver before surgery)/)/ Number of working days per year)* (Age at death before surgery –Age at early surgery))+(1–((days lost by Caregiver after early surgery)/ Number of working days per year))* (Age at death after early surgery – Age at death before surgery))*)*(Male to female ratio in patients *Labor force participation rate in males +(1–Male to female ratio in caregivers)*Labor force participation rate in females)*(1–Unemployment rate)*Average salary for Caregiver
Averted mortality	Number of patients * percentage of averted mortality)	= ((1–(days lost by Caregiver after early surgery)/ Number of working days per year) *(Age at death after early surgery – Age at early surgery) *(Male to female ratio in patients *Labor force participation rate in males +(1–Male to female ratio in caregivers) *Labor force participation rate in females) *(1–Unemployment rate)*Average salary for Caregiver

2.1.4. Quality-Adjusted Life Years (QALYs)

2.1.4.1. QALYs break down

- Reduced Waiting time
  - Improvement in Quality of Life (QoL) during the reduced waiting time
  - Improvement on the long term QoL due to improved prognosis in case of early surgery
  - Extended life expectancy
- Avoided missed surgery
  - long term Improvement QoL due to better prognosis of those who undergo surgery
  - Extended life expectancy
- Mortality averted
  - Extended life expectancy

1.1.1.2. QALYs graphical representation

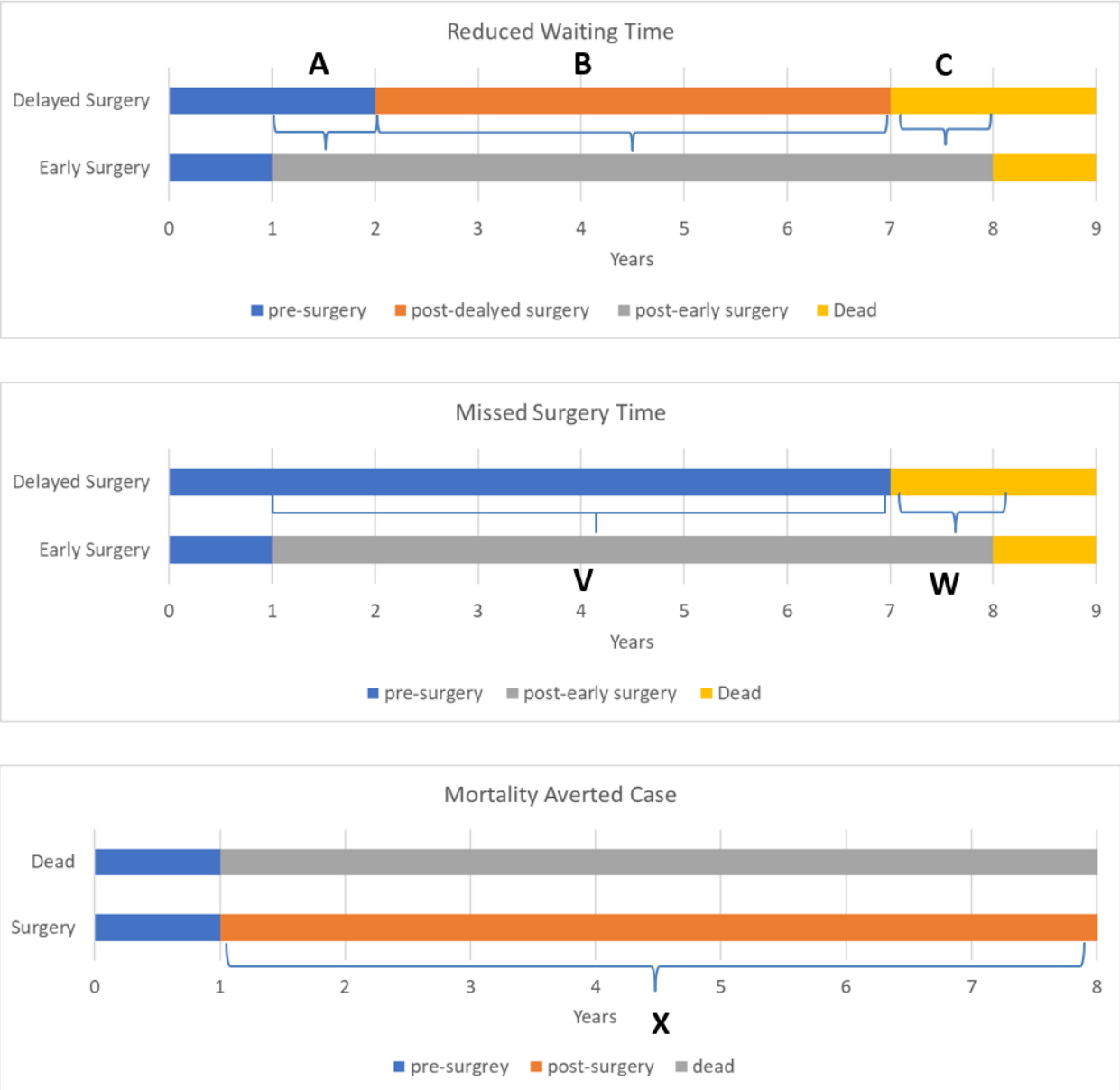


Figure 6 Graphical representation of the 3 partitions of QALYs

2.1.4.2. QALYs mathematical equation

The difference in QALYs = Reduced waiting time percentage + Avoided missed surgery percentage + Averted mortality percentage

Table 4 Equations to calculate the difference in QALYs

Category	Number of patients	Calculations per patient
Reduced waiting time	Number of patients * (1- Percentage of missed surgery- percentage of averted mortality)	= (QALYs after early surgery– QALYs before surgery) *(Age at delayed surgery –Age at early surgery)+ QALYs after early surgery – QALYs after delayed surgery *(Age at death after delayed surgery –Age at delayed surgery)+ QALYs after early surgery * (Age at death after early surgery – Age at death after delayed surgery)+ Utility decrement* (Age at delayed surgery – Age at early surgery)
Avoided missed surgery	Number of patients * Percentage of missed surgery	= (QALYs after early surgery–QALYs before surgery) *(Age at death before surgery – Age at early surgery)+(QALYs after early surgery)*(Age at death after early surgery – Age at death before surgery)
Averted mortality	Number of patients * percentage of averted mortality)	= QALYs after early surgery *(Age at death after early surgery – Age at early surgery)

2.2. Model parameters

2.2.1. Cost parameters

2.2.1.1. Cost of surgeries

The cost of surgeries covers the whole case-based payment including the surgeon's fee, equipment, and prosthesis (if applicable), immediate pre-operative and post-operative investigations, immediate and post-operative hospital stay. The cost of surgeries before and after the initiative were different. Both prices were obtained from the Ministry of Health and Population in 2021 Egyptian pounds. Details are available in Annex 1.

Table 5 Costs of early and delayed surgeries

Cost of surgery (before the initiative)	Value	Source
Open heart surgeries	22,750	MoHP 2021
Cardiac catheterization	15,550	MoHP 2021
Cochlear implantation	90,000	MoHP 2021
Ophthalmic surgeries (Retina)	4,500	MoHP 2021
Orthopedic (joint replacement) surgeries	26,171	MoHP 2021
Cost of Surgery (after the initiative)	**Value**	**Source**
Open heart surgeries	40,625	MoHP 2021
Cardiac catheterization	17,900	MoHP 2021
Cochlear implantation	130,000	MoHP 2021
Ophthalmic surgeries (Retina)	13,500	MoHP 2021
Orthopedic (joint replacement) surgeries	47,107	MoHP 2021

2.2.1.2. Medical costs

Medical costs are key cost parameters for the model. Capturing the differences in medical treatment expenses is pivotal to assessing the cost-effectiveness of the initiative. The costs of medical treatment were calculated using a structured tool and expert panel of each specialty. For each procedure, 1-2 experts were interviewed independently to fill the structured tool in addition to other open-ended questions to obtain accurate resources and medications utilization. Then, MoHP provided the price list for the needed services. Those price lists were updated according to 2021 prices and used to calculate the annual maintenance before and after the procedure and the one-time costs before and after the procedure. For the medications, updated market prices were used. One-time costs are defined as the expenses that were not covered in the surgery cost. The structured tools and the results are in Annex 2.

In the original model design, the annual maintenance medical treatment costs after early surgery were proposed to be different from the medical maintenance costs before early surgery. However, we assumed that both costs were the same in this model version due to a lack of data.

Table 6 Medical costs

Annual Maintenance Health Care Costs (pre-surgery)	Value	Source
Open heart surgeries	1301	Expert Panel
Cardiac catheterization	1024	Expert Panel
Cochlear implantation	0	Expert Panel
Ophthalmic surgeries (Retina)	0	Expert Panel
Orthopedic (joint replacement) surgeries	0	Expert Panel
Annual Maintenance Health Care Costs (post delayed surgery)	**Value**	**Source**
Open heart surgeries	4707	Expert Panel
Cardiac catheterization	5883	Expert Panel
Cochlear implantation	0	Expert Panel
Ophthalmic surgeries (Retina)	0	Expert Panel
Orthopedic (joint replacement) surgeries	0	Expert Panel
Annual Maintenance Health Care Costs (post early surgery)	**Value**	**Source**
Open heart surgeries	4707	Assumption
Cardiac catheterization	5883	Assumption
Cochlear implantation	0	Assumption
Ophthalmic surgeries (Retina)	0	Assumption
Orthopedic (joint replacement) surgeries	0	Assumption
One time cost before surgery	**Value**	**Source**
Open heart surgeries	1,599	Expert Panel
Cardiac catheterization	1,901	Expert Panel
Cochlear implantation	2,865	Expert Panel
Ophthalmic surgeries (Retina)	1,734	Expert Panel
Orthopaedic (joint replacement) surgeries	2,658	Expert Panel
One time cost after early surgery	**Value**	**Source**
Open heart surgeries	3,858	Expert Panel
Cardiac catheterization	2,073	Expert Panel
Cochlear implantation	5,115	Expert Panel
Ophthalmic surgeries (Retina)	5,649	Expert Panel
Orthopaedic (joint replacement) surgeries	5,866	Expert Panel

2.2.2. Utility parameters

The health outcomes for this study are measured through Quality-adjusted life years (QALYs), calculated by multiplying the health utility for each health status by the time the patients spent in this period: the time spent before particular surgery * the health utility of this before surgery states. The utilities of the before procedures state (Pre-surgery utilities) and the utility of the after-surgery states were obtained from the literature. The original model proposed that the post-delayed surgery utilities may differ from the post early surgery utilities. However, there was no evidence of such difference, so we assumed that both utilities were equal. Moreover, no literature discussed the utility decrement due to the psychological stress caused by the long waiting.

Table 7 Model utilities and utility decrements

Pre-surgery utilities	Value	Source
Open heart surgeries	0.74	(Cohen et al., 2011)
Cardiac catheterization	0.75	(Cohen et al., 2011)
Cochlear implantation	0.67	(Crowson et al., 2018)
Ophthalmic surgeries (Retina)	0.54	(Yannuzzi et al., 2018)
Orthopedic (joint replacement) surgeries	0.407	(Baker et al., 2012)
Post early surgery utilities	**Value**	**Source**
Open heart surgeries	0.77	(Cohen et al., 2011)
Cardiac catheterization	0.85	(Cohen et al., 2011)
Cochlear implantation	0.94	(Crowson et al., 2018) (adjusted)
Ophthalmic surgeries (Retina)	0.71	(Yannuzzi et al., 2018)
Orthopedic (joint replacement) surgeries	0.71	(Baker et al., 2012)
Post delayed surgery utilities	**Value**	**Source**
Open heart surgeries	0.77	(Cohen et al., 2011)
Cardiac catheterization	0.85	(Cohen et al., 2011)
Cochlear implantation	0.88	(Crowson et al., 2018) (adjusted)
Ophthalmic surgeries (Retina)	0.71	(Yannuzzi et al., 2018)
Orthopedic (joint replacement) surgeries	0.71	(Baker et al., 2012)
Utility decrement due to pre-operative stress	**Value**	**Source**
Open heart Surgeries	0.04	Assumption
Cardiac catheterization	0.02	Assumption
Cochlear implantation	0	Assumption
Ophthalmic surgeries (Retina)	0.01	Assumption
Orthopedic (joint replacement) surgeries	0.02	Assumption

2.2.3. Population parameters

2.2.3.1. Number of patients

The number of patients is obtained from the MoHP database, and they represent the actual number of patients who underwent the procedures through the initiative from January 2019 to February 2020. Complementary to the numbers of patients was the male to female ratios of each procedure which was also obtained from the MoHP.

Table 8 Number of patients who benefited from the initiative and Males' ratio

Number of patients	Value	Source
Open heart surgeries	17,003	MoHP 2021
Cardiac catheterization	118,802	MoHP 2021
Cochlear implantation	2,113	MoHP 2021
Ophthalmic surgeries (Retina)	133,804	MoHP 2021
Orthopedic (joint replacement) surgeries	16,595	MoHP 2021
Males' ratio	**Value**	**Source**
Open heart surgeries	0.56	MoHP 2021
Cardiac catheterization	0.53	MoHP 2021
Cochlear implantation	0.51	MoHP 2021
Ophthalmic surgeries (Retina)	0.50	MoHP 2021
Orthopedic (joint replacement) surgeries	0.42	MoHP 2021

2.2.3.2. Waiting time

Waiting time is a crucial parameter as it is defined as the difference between waiting time before and after the initiative in years. This parameter was also obtained from the MoHP.

Table 9 the reduction of waiting time in years

Reduction in waiting time (years)	Value	Source
Open heart surgeries	0.750684932	MoHP 2021
Cardiac catheterization	0.452054795	MoHP 2021
Cochlear implantation	0.653424658	MoHP 2021
Ophthalmic surgeries (Retina)	0.329452055	MoHP 2021
Orthopedic (joint replacement) surgeries	0.764383562	MoHP 2021

2.2.3.3. Percentage of avoided missed surgeries

The percentage of avoided missed surgeries is another critical parameter as it represents the percentage of patients who underwent the procedures through the initiative which would have missed the opportunity to do their necessary procedure due to waiting time. Hence, the initiative enabled them to do the procedures and moved them from missed surgery category to being part of the patients served by the initiative. These numbers were calculated from the MoHP databases.

Table 10 the percentage of avoided missed surgeries

Percentage of avoided missed surgeries	Value	Source
Open heart surgeries	0.104%	MoHP 2021
Cardiac catheterization	0.035%	MoHP 2021
Cochlear implantation	0.003%	MoHP 2021
Ophthalmic surgeries (Retina)	0.041%	MoHP 2021
Orthopedic (joint replacement) surgeries	0.073%	MoHP 2021

2.2.3.4. Percentage of Mortality averted

The percentage of mortality averted represents the percentage of patients who underwent the procedures through the initiative but who would have died waiting for their required procedure. Hence, the initiative enabled them to do the procedures, saved their lives, and moved them from the dead category to being part of the patients served by the initiative. These numbers were calculated from the MoHP databases.

Table 11 the percentage of mortality averted

Mortality averted percentage	Value	Source
Open heart surgeries	4%	MoHP 2021
Cardiac catheterization	1%	MoHP 2021
Cochlear implantation	0%	MoHP 2021
Ophthalmic surgeries (Retina)	0%	MoHP 2021
Orthopedic (joint replacement) surgeries	1%	MoHP 2021

2.2.3.5. The average age at surgery

The average age of patients at each procedure before and after the initiative is crucial in calculating the difference in costs and outcomes before and after the initiative, hence the timeframe of the model and its consequences. The average age of patients at early surgery (the initiative) was obtained from the MoHP databases. In contrast, the average age at the delayed surgery (Before the initiative) was calculated, adding the average age at early surgery plus the waiting time in years.

Table 12 the average age for surgeries

Average age at early surgery (years)	Value	Source
Open heart surgeries	42.1	MoHP 2021
Cardiac catheterization	55.5	MoHP 2021
Cochlear implantation	9.8	MoHP 2021
Ophthalmic surgeries (Retina)	56.5	MoHP 2021
Orthopedic (joint replacement) surgeries	49.4	MoHP 2021
Average age at delayed surgery (years)	**Value**	**Source**
Open heart surgeries	42.85	Calculated
Cardiac catheterization	55.95	Calculated
Cochlear implantation	10.45	Calculated
Ophthalmic surgeries (Retina)	56.83	Calculated
Orthopedic (joint replacement) surgeries	50.16	Calculated

2.2.3.6. The average age at death

The average age at death is a parameter that is together with the average age at the surgery is used to calculate the lifetime of the patients before the surgery, after delayed surgery (before the initiative), and after early surgery (after the initiative). The experts' panel assumed that cochlear implantation, Ophthalmic surgeries, and joint replacement do not affect the average age at death. In contrast, open

heart and cardiac catheterization affect the average age of surgery if the procedures are done timely without unnecessary waiting. Therefore, the average age at death before, after early surgery, and after delayed surgery for cochlear implantation, Ophthalmic surgeries, and joint replacement is the same as the average age of death in the general population (life expectancy for the Egyptian population).

Table 13 Average age at death per surgery

Average age of death pre-surgery	Value	Source
Open heart surgeries	44	Expert opinion
Cardiac catheterization	58	Expert opinion
Cochlear implantation	72	(Life expectancy at birth, total (years) - Egypt, Arab Rep. | Data, 2019)
Ophthalmic surgeries (Retina)	72	(Life expectancy at birth, total (years) - Egypt, Arab Rep. | Data, 2019)
Orthopedic (joint replacement) surgeries	72	(Life expectancy at birth, total (years) - Egypt, Arab Rep. | Data, 2019)
Average age of death post early surgery	**Value**	**Source**
Open heart surgeries	72	Expert opinion
Cardiac catheterization	72	Expert opinion
Cochlear implantation	72	(Life expectancy at birth, total (years) - Egypt, Arab Rep. | Data, 2019)
Ophthalmic surgeries (Retina)	72	(Life expectancy at birth, total (years) - Egypt, Arab Rep. | Data, 2019)
Orthopedic (joint replacement) surgeries	72	(Life expectancy at birth, total (years) - Egypt, Arab Rep. | Data, 2019)
Average age of death post delayed surgery	**Value**	**Source**
Open heart surgeries	72	Expert opinion
Cardiac catheterization	72	Expert opinion
Cochlear implantation	72	(Life expectancy at birth, total (years) - Egypt, Arab Rep. | Data, 2019)
Ophthalmic surgeries (Retina)	72	(Life expectancy at birth, total (years) - Egypt, Arab Rep. | Data, 2019)
Orthopedic (joint replacement) surgeries	72	(Life expectancy at birth, total (years) - Egypt, Arab Rep. | Data, 2019)

2.2.4. Productivity parameters

2.2.4.1. Patients' productivity parameters

The productivity lost by patients is one of the main cost drivers for societal perspectives. The number of days lost before and after procedures was obtained from the literature for all the procedures except for cochlear implantations. Although cochlear implantation is a life-changing procedure for the child and their family, little or no literature addressed the effect of cochlear implantation on the child's productivity in terms of productivity-time lost. Consequently, the productivity lost by the cochlear implantation was calculated based on the productivity lost due to hearing disabilities. According to (Disability and Employment | United Nations Enable, 2021), unemployment among the disabled is around 80%. Consequently, it was multiplied by the number of working days (216 days) to get the number of working

days lost. Based on those figures, we made assumptions for after early and delayed surgery days lost in addition to the caregivers' days lost.
The model was designed initially to differentiate between productivity lost after delayed and early surgery, but we used the exact figures due to a lack of literature.

Table 14 Days lost by the patients

No. of days lost per year by a patient before surgery	**Value**	**Source**
Open heart surgeries	79.0	(Kotseva et al., 2019)
Cardiac catheterization	37.0	(Kotseva et al., 2019)
Cochlear implantation	172.6	Calculated
Ophthalmic surgeries (Retina)	11.2	(Retinal International, 2019)
Orthopedic (joint replacement) surgeries	17.2	(Stigmar et al., 2017)
No. of days lost per year by patient post early surgery	**Value**	**Source**
Open heart surgeries	23.7	(Kotseva et al., 2019)
Cardiac catheterization	23.0	(Kotseva et al., 2019)
Cochlear implantation	16.4	Assumption
Ophthalmic surgeries (Retina)	7.0	Deloitte 2019
Orthopedic (joint replacement) surgeries	12.9	(Stigmar et al., 2017)
No. of days lost per year by patients post delayed surgery	**Value**	**Source**
Open heart surgeries	31.7	(Kotseva et al., 2019)
Cardiac catheterization	23.0	(Kotseva et al., 2019)
Cochlear implantation	65.6	Jung 2012
Ophthalmic surgeries (Retina)	7.0	Deloitte 2019
Orthopedic (joint replacement) surgeries	12.9	(Stigmar et al., 2017)
Employment parameters	***Value***	***Source***
Average salary of patients per year	44,369	Rankings by Country of Average Monthly Net Salary (After Tax) (Salaries and Financing), 2021

2.2.4.2. Caregiver productivity parameters

The productivity lost by caregivers is one of the main cost drivers for societal perspectives. However, little literature addressed this issue, and only data was found for open heart and catheterization. Therefore, assumptions based on expert opinion were used for the rest of the procedures.

Table 15 Days lost by the Caregiver

No. of days lost per year by caregivers before surgery	Value	Source
Open heart surgeries	11.0	(Kotseva et al., 2019)
Cardiac catheterization	11.0	(Kotseva et al., 2019)
Cochlear implantation	86	Assumption
Ophthalmic surgeries (Retina)	5.6	Assumption
Orthopedic (joint replacement) surgeries	0.0	Assumption
No. of days lost per year by caregivers post early surgery	**Value**	**Source**
Open heart surgeries	16.0	(Kotseva et al., 2019)
Cardiac catheterization	0.0	Assumption
Cochlear implantation	8.2	Assumption
Ophthalmic surgeries (Retina)	0.0	Assumption
Orthopedic (joint replacement) surgeries	0.0	Assumption
No. of days lost per year by caregivers post delayed surgery	**Value**	**Source**
Open heart surgeries	16.0	Kotseva 2019
Cardiac catheterization	0.0	Assumption
Cochlear implantation	32.8	Assumption
Ophthalmic surgeries (Retina)	0.0	Assumption
Orthopedic (joint replacement) surgeries	0.0	Assumption
Employment parameters	***Value***	***Source***
Average Salary of Caregivers per year	44,369	Rankings by Country of Average Monthly Net Salary (After Tax) (Salaries And Financing), 2021
Males to female's ratio as Caregivers	50%	Assumption

2.2.4.3. General productivity parameters

Table 16 General productivity parameters

Employment parameters	Value	Source
Retirement age	65	CAPMAS 2019
Labor Force Participation Rate (total)	41.5%	ILO estimates 2020
Unemployment rate(total)	7.9%	ILO estimates 2020
Labor Force Participation Rate (males)	67.4%	ILO estimates 2020
Labor Force Participation Rate(females)	14%	ILO estimates 2020
Average number of working days per year	216	Assumption
Average number of days per year	365	CAPMAS 2019

2.3. Discounting and Time frame of the model

The model results were discounted using 3.5% for both costs and QALYs, according to (Elsisi et al., 2013). Discounting is a user-defined input that can be modified by the user in the Microsoft Excel model. In addition, the model captured the patient's lifetime starting from the perioperative period.

2.4. Sensitivity analysis

2.4.1. Deterministic sensitivity analysis

By systematically changing the base-case estimates by ±10 %, e.g., cost variables, a series of one-way deterministic sensitivity analyses (DSA) was programmed and run through the model to find the most sensitive parameters. Variables included in the base case DSA are listed in Annex 3. The results of this analysis are presented on a tornado diagram.

2.4.2. Probabilistic sensitivity analysis

Probabilistic sensitivity analysis (PSA) was also performed to account for the simultaneous effect of uncertainty relating to model parameter values. A PSA run contained 5,000 model iterations. Uncertainty surrounding all-important model parameters was described by probability distributions and propagated through the model using Monte Carlo sampling techniques to produce distributions of expected costs and QALYs for each arm. A PSA was undertaken that ran 5,000 model iterations, comparing the case scenario before and after the initiative. Variables included in the base case PSA are listed in Annex 4

3. RESULTS

3.1.1. Results reported

The results are reported separately for each procedure and both discounted and undiscounted for the initiative. The costs are reported in Egyptian pounds (EGP), and the outcomes are reported in Quality-adjusted life years (QALYs). The threshold used is one GDP per capita for public reimbursement, around EGP 56,000 (Fasseeh et al., 2021.)

For each category, the results include the following items:

- Total cost: includes the direct and indirect difference in costs before and after the initiative
    - Direct cost: the difference between the direct medical costs before and after the initiative
    - Indirect cost total includes both indirect patients' and caregivers' costs
        - Indirect cost patient: the difference between patient productivity lost by the patient before, after delayed surgery, and after the initiative.
        - Indirect cost caregiver: the difference between productivity lost by the Caregiver before, and after delayed surgery due to waiting time and after the initiative.
- QALYs gained/lost: the difference in the health outcomes gained/lost before, after delayed procedures, and after the initiative
- Cost-effectiveness analysis:
    - Societal perspective
        - ICER = (Δ Direct cost + Δ Indirect cost by patient + Δ Indirect cost by caregiver) / Δ QALYs
    - Payer perspective
        - ICER = Δ Direct cost / Δ QALYs
- Benefit-cost analysis
    - The Benefit-cost ratio was calculated from societal perspective for the base case of this model.
    - Benefit-cost ratio: (ΔQALYs * GDP per capita) / (Δ Direct cost + Δ Indirect cost by patient + Δ Indirect cost by caregiver) – in case of negative indirect costs, they are added as benefits to the numerator.

3.1.2. The presidential initiative collective results (Aggregated results)

The presidential initiative (the five procedures categories combined) added 48,385 Quality-adjusted life years with an incremental cost of EGP 2,264,156,090, including the productivity lost, which gives an incremental cost-effectiveness ratio of 46,795 EGP per QALY. This value is considered cost-effective compared to the cost-effectiveness threshold in Egypt (the discounted results).

Table 17 Model results (Discounted and undiscounted)

Cost-effectiveness model results	Outcomes in QALYs	Cost in EGP (societal)	Cost in EGP (Payer)
Incremental (Discounted)	48,385	2,264,156,090	2,714,095,516
Incremental cost-effectiveness ratio (ICER) in EGP (Discounted)		46,795	56,094
Incremental (Undiscounted)	63,508	1,914,015,444	2,776,582,672
Incremental cost-effectiveness ratio (ICER) in EGP (Undiscounted)		30,138	43,720

3.1.3. Open heart surgeries results

The results showed that the Open-heart surgeries add 0.649 QALYs per person with additional costs of EGP 24,929, resulting in an ICER of around EGP 38,000 per QALYs from the Payer perspective and EGP 26,000 per QALYs from the societal perspective, which makes both perspectives cost-effective according to one GDP threshold.

Table 18 Undiscounted results for Open heart surgery

Percentage of patients	Group	QALYs	Direct cost	Indirect cost patient	Indirect cost caregiver
95.9%	Delayed Surgery	0.053	20,432	(18,241)	319
0.1%	Missed Surgery	21.543	178,766	(344,002)	474,729
4.0%	Mortality Averted	23.023	181,368	(366,814)	507,848
100.0%	Average per patient	0.994	27,034	(32,523)	21,114
17,003	Per Population	16896	459,662,012	(552,990,473)	358,996,366
	ICER – Payer perspective		**27,205**		
	ICER – Societal perspective				**15,724**

Table 19 Discounted results of open-heart surgery

Percentage of patients	Group	QALYs	Direct cost	Indirect cost patient	Indirect cost caregiver
95.9%	Delayed Surgery	0.053	20,432	(12,715)	319
0.1%	Missed Surgery	13.175	127,503	(213,461)	290,154
4.0%	Mortality Averted	14.630	130,060	(233,093)	322,714
100.0%	Average per patient	0.649	24,929	(21,739)	13,516
17,003	Per Population	11040	423,860,374	(369,626,760)	229,818,686
	ICER – Payer perspective		**38,393**		
	ICER – Societal perspective				**25,729**

3.1.4. Heart catheterization results

The results showed that the heart catheterization adds 0.198 QALYs per person with additional costs of EGP 5000, resulting in an ICER of around EGP 33,000 per QALYs from the Payer perspective and EGP 34,00 per QALYs from the societal perspective, which makes both perspectives cost-effective according to one GDP threshold.

Table 20 Undiscounted results of cardiac catheterization

Percentage of patients	Group	QALYs	Direct cost	Indirect cost patient	Indirect cost caregiver
95.9%	Delayed Surgery	0.054	4,546	(528)	(423)
0.1%	Missed Surgery	12.525	112,921	(122,909)	264,137
4.0%	Mortality Averted	14.025	114,970	(152,726)	302,699
100.0%	Average per patient	0.198	5,689	(2,093)	2,701
17,003	Per Population	23561	675,819,045	(248,613,600)	320,882,844
	ICER – Payer perspective		**28,684**		
	ICER – Societal perspective				**31,752**

Table 21 Discounted results of cardiac catheterization

Percentage of patients	Group	QALYs	Direct cost	Indirect cost patient	Indirect cost caregiver
95.9%	Delayed Surgery	0.054	4,546	(509)	(404)
0.1%	Missed Surgery	9.415	91,252	(89,128)	188,231
4.0%	Mortality Averted	10.889	93,266	(114,289)	224,433
100.0%	Average per patient	0.166	5,464	(1,678)	1,911
17,003	Per Population	19706	649,133,526	(199,299,271)	226,984,658
	ICER – Payer perspective		**32,941**		
	ICER – Societal perspective				**34,346**

3.1.5. Cochlear implantations results

The results showed that the cochlear implantation surgeries add 1.703 QALYs per person with an additional EGP 40,000, resulting in an ICER of around EGP 23,000 per QALYs from the payer perspective, making it cost-effective according to one GDP threshold. While from the societal perspective, it's cost-saving.

Table 22 Undiscounted results of Cochlear implantation

Percentage of patients	Group	QALYs	Direct cost	Indirect cost patient	Indirect cost caregiver
95.9%	Delayed Surgery	3.869	40,000	(218,217)	(123,005)
0.1%	Missed Surgery	16.794	130,000	(675,827)	(380,613)
4.0%	Mortality Averted	58.468	130,000	(862,511)	1,015,337
100.0%	Average per patient	3.870	40,003	(218,231)	(123,013)
17,003	Per Population	8176	84,525,705	(461,121,394)	(259,926,633)
	ICER – Payer perspective		**10,338**		
	ICER – Societal perspective				**Dominant option**

Table 23 Discounted results of Cochlear implantation

Percentage of patients	Group	QALYs	Direct cost	Indirect cost patient	Indirect cost caregiver
95.9%	Delayed Surgery	1.703	40,000	(94,886)	(53,186)
0.1%	Missed Surgery	7.045	130,000	(283,497)	(159,660)
4.0%	Mortality Averted	24.526	130,000	(361,807)	425,915
100.0%	Average per patient	1.703	40,003	(94,892)	(53,189)
17,003	Per Population	3598	84,525,705	(200,507,083)	(112,389,054)
	ICER – Payer perspective		**23,491**		
	ICER – Societal perspective				**Dominant option**

3.1.6. Retina surgeries results

The results showed that the retina surgeries add 0.060 QALYs per person with additional costs of EGP 9000, resulting in an ICER of around EGP 145,000 per QALY from the payer's perspective and EGP 150,000 per QALY from the societal perspective, which makes both perspectives NOT cost-effective according to one cost-effectiveness threshold.

Table 24 Undiscounted results of Retina surgeries

Percentage of patients	Group	QALYs	Direct cost	Indirect cost patient	Indirect cost caregiver
95.9%	Delayed Surgery	0.059	9,000	(107)	(143)
0.1%	Missed Surgery	2.635	13,500	(2,762)	(6,716)
4.0%	Mortality Averted	11.005	13,500	(137,286)	258,739
100.0%	Average per patient	0.060	9,002	(108)	(145)
17,003	Per Population	8076	1,204,482,868	(14,470,517)	(19,460,410)
	ICER – Payer perspective		**149,142**		
	ICER – Societal perspective				**144,941**

Table 25 Discounted results of Retina surgeries

Percentage of patients	Group	QALYs	Direct cost	Indirect cost patient	Indirect cost caregiver
95.9%	Delayed Surgery	0.059	9,000	(107)	(143)
0.1%	Missed Surgery	2.078	13,500	(2,178)	(5,296)
4.0%	Mortality Averted	8.679	13,500	(108,271)	204,056
100.0%	Average per patient	0.060	9,002	(108)	(145)
17,003	Per Population	8046	1,204,482,868	(14,438,492)	(19,382,544)
	ICER – Payer perspective		**149,709**		
	ICER – Societal perspective				**145,505**

3.1.7. Joint replacement surgeries results

The results showed that the joint replacement surgeries add 0.361 QALYs per person with additional costs of EGP 21,217, resulting in discounted ICER of around EGP 58,800 per QALYs from the payer's perspective and EGP 60,000 per QALYs from the societal perspective, which makes both perspectives borderline cost-effective according to the cost-effectiveness threshold.

Table 26 Undiscounted results of Joint Replacement surgeries

Percentage of patients	Group	QALYs	Direct cost	Indirect cost patient	Indirect cost caregiver
95.9%	Delayed Surgery	0.247	20,936	(228)	0
0.1%	Missed Surgery	6.848	47,107	(4,660)	0
4.0%	Mortality Averted	16.046	47,107	(219,350)	327,462
100.0%	Average per patient	0.410	21,217	(2,423)	3,275
17,003	Per Population	6799	352,093,042	(40,205,765)	54,342,353
	ICER – Payer perspective		**51,786**		
	ICER – Societal perspective				**53,865**

Table 27 Discounted results of Joint Replacement surgeries

Percentage of patients	Group	QALYs	Direct cost	Indirect cost patient	Indirect cost caregiver
95.9%	Delayed Surgery	0.247	20,936	(228)	0
0.1%	Missed Surgery	4.843	47,107	(3,295)	0
4.0%	Mortality Averted	11.348	47,107	(155,131)	231,591
100.0%	Average per patient	0.361	21,217	(1,780)	2,316
17,003	Per Population	5995	352,093,042	(29,532,028)	38,432,463
	ICER – Payer perspective		**58,729**		
	ICER – Societal perspective				**60,214**

3.1.8. Benefit-cost ratio

The Benefit-cost ratio shows that for each one EGP spent on the selected procedures of the initiative, we get 1.14 and 1.51 EGP in return on average in the discounted and undiscounted scenarios, respectively. The Highest return is noticed with the Cochlear implant. For each one EGP spent on cochlear implants, we get around 6 EGP in return.

Table 28 Benefit-Cost Ratio results

Surgery	Benefit/cost ratio (Discounted)	Benefit/cost ratio (Undiscounted)
Open heart	1.51	1.83
Cardiac catheterization	1.49	1.57
Cochlear implantation	6.09	13.95
Retina	0.40	0.40
Joints	0.94	1.04
Total	1.14	1.51

4.1.9 Sensitivity analysis results

4.1.10.1 Deterministic sensitivity analysis (DSA)

The deterministic sensitivity analysis is presented in the following Tornado diagram, highlighting the most sensitive variables on the ICER value when base case estimates were changed by +/- 10 percent or according to a 95% confidence interval. It shows that the model is most sensitive to QALYs of the delayed Cardiac catheterization, Cochlear surgeries, and Retirement age. The base case shown at the DSA & PSA is the societal perspective

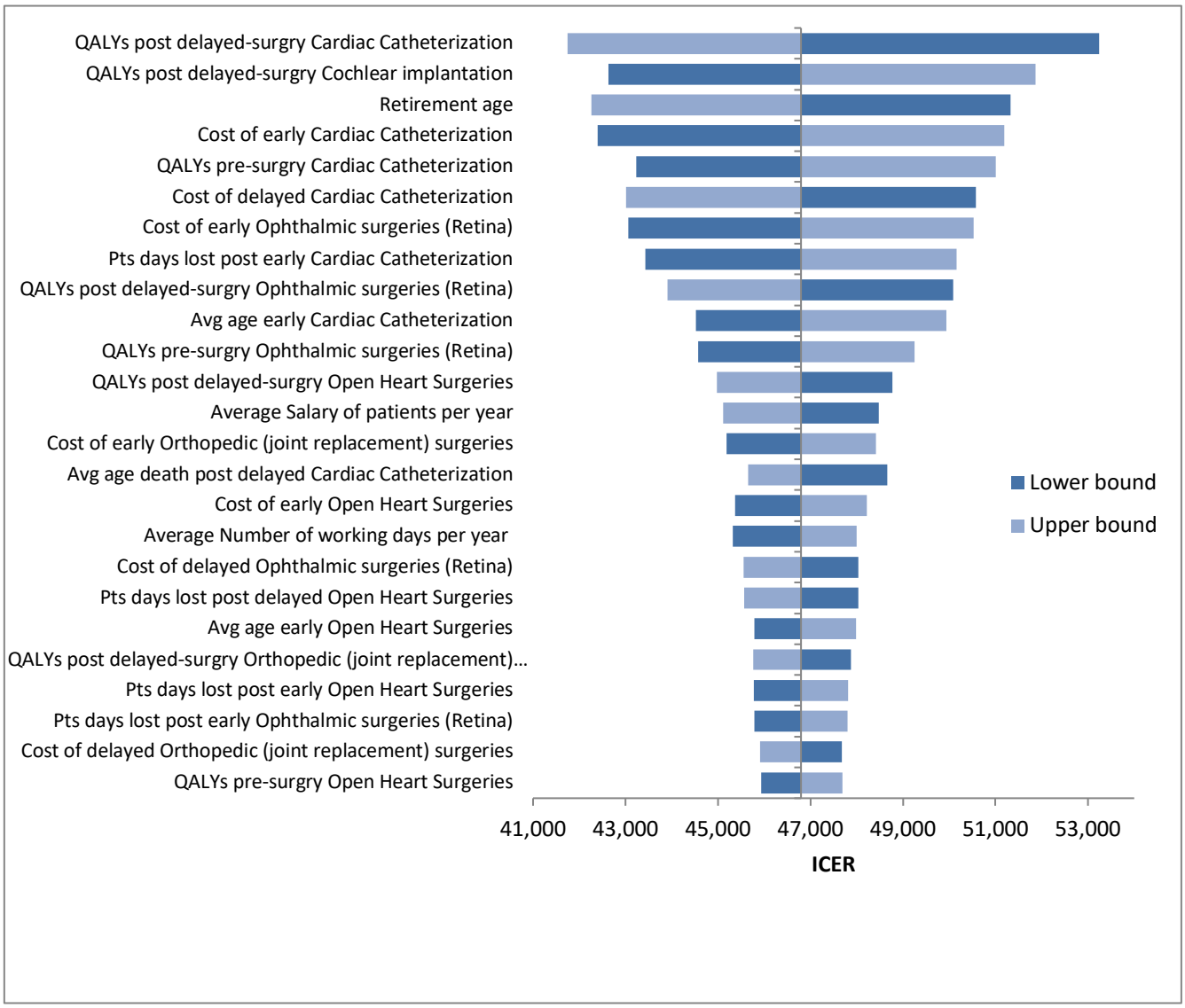


Figure 7 Tornado diagram showing the DSA results

4.1.10.2 Probabilistic sensitivity analysis (PSA)

The PSA results are presented on a scatter plot and cost-effectiveness acceptability curve (Figures 8 & 9). Adopting 1 GDP per QALY willingness-to-pay threshold, the WTP for Egypt is EGP 56,000 based on GDP per capita 2020 (GDP per capita (current US$) - Egypt, Arab Rep. | World Bank Data).

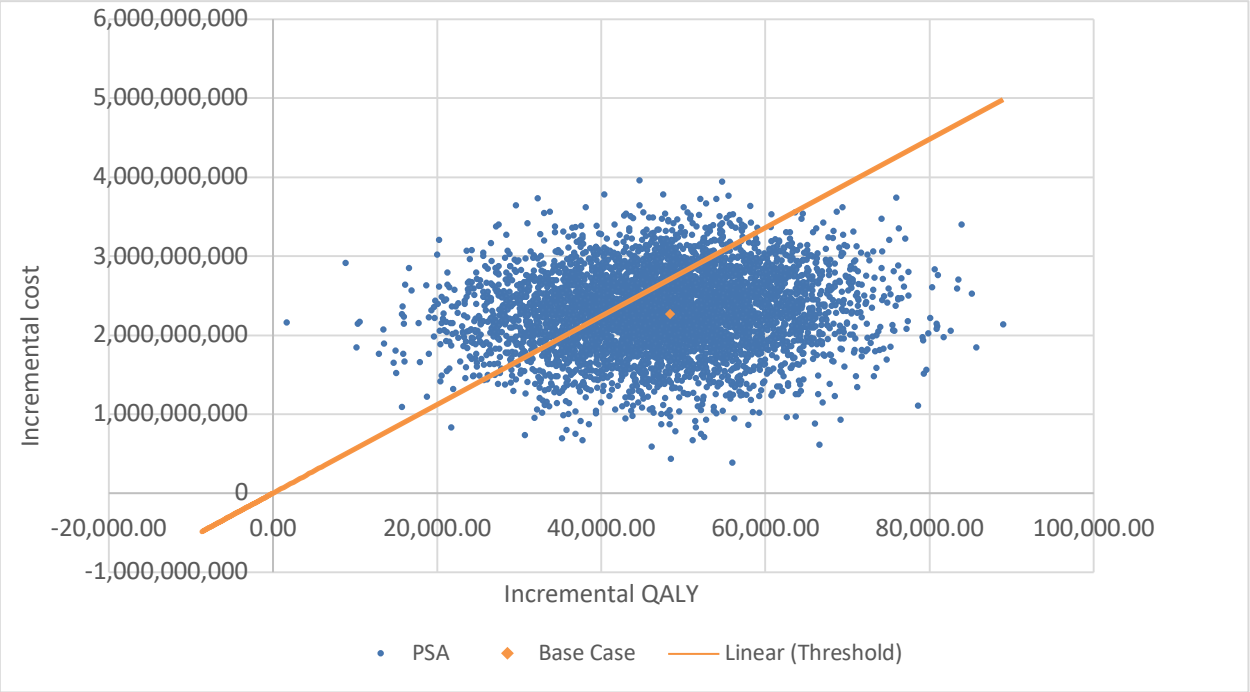


Figure 8 CEA scatter plot showing the results of the PSA

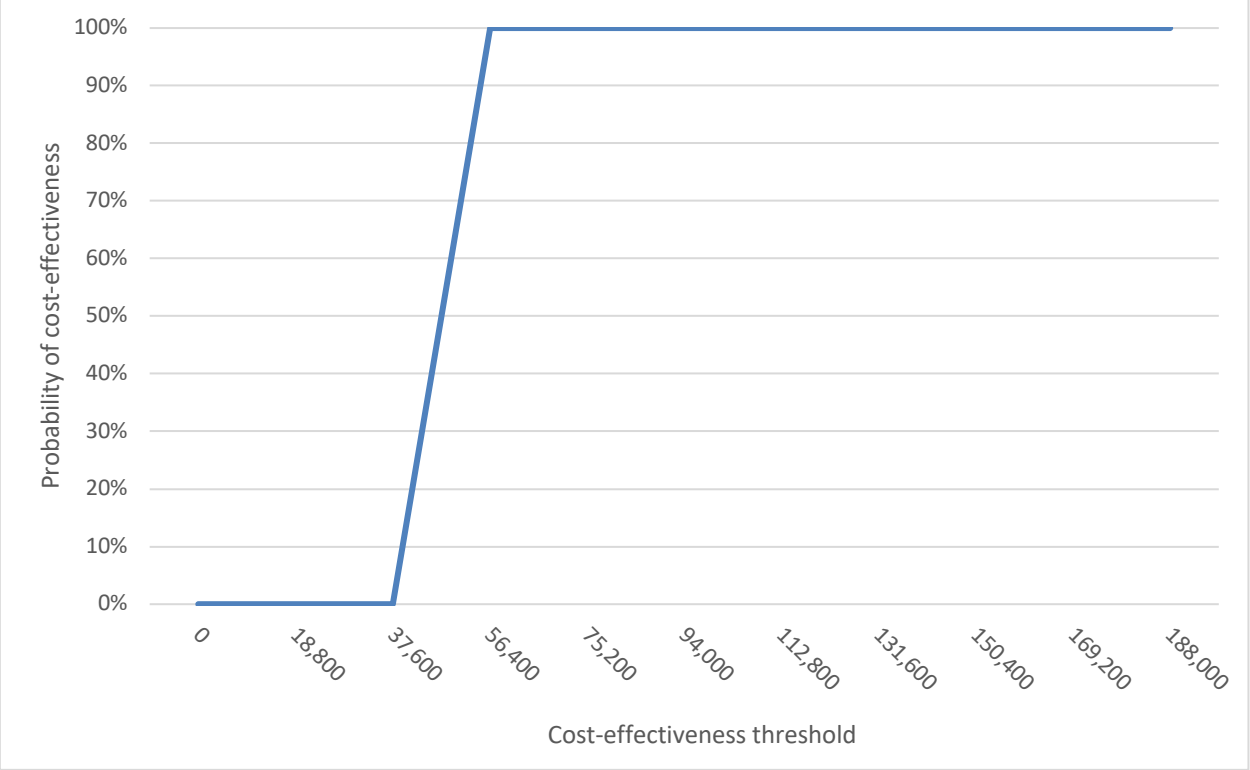


Figure 9 Cost-effectiveness acceptability curve

4. FINANCIAL PROTECTION AND EQUITY DIMENSIONS OF THE INITIATIVE

Health systems ought to provide equitable access to needed, quality health services without anyone suffering financial hardship for paying for these services. The assurance that people will not suffer financial hardship recognizes that health systems should improve health, but this improvement should not be done in ways that put households at financial risk (Saksena P, 2004). The concept of financial risk protection can be quantified using two commonly applied measures, Catastrophic health expenditure and Impoverishment due to health spending.

4.1. Methods

4.1.1. Calculating catastrophic health expenditure

Catastrophic health expenditure is healthcare spending that exceeds a predefined percentage or threshold of a household's income, consumption, or ability to pay. Meanwhile, the ability to pay can be interpreted using different methods. Such methods commonly used to measure catastrophic health spending are distinguished by defining a household's ability to pay for health care.

All methods select out-of-pocket payments as the numerator for calculating the incidence of catastrophic health spending, while the denominator differs. The following table shows the different approaches for calculating catastrophic health expenditure.

Table 29 Methods of calculating catastrophic health expenditure

Method	Denominator
Budget share method	Household total expenditure, if available otherwise, total income
Actual food spending	Household total expenditure minus actual food spending
Partial normative food spending	Household spending minus a standard amount represents subsistence food spending. Except for households that are already below the subsistence level; in that case, use total household expenditure minus actual food spending
Normative spending on food, housing, and utilities	Household total expenditure minus a standard amount representing subsistence spending on food, rent, and utilities (water, electricity, gas, and other fuels);

We used the budget share method for our base case as it complies with the agreed methodology for reporting catastrophic health expenditure target 3.8.2 within the SDG 2030 framework, although there is some criticism that it may oversimplify the calculations (Cylus et al., 2018). The normative and partial normative methods are available in annex 5.

In the budget Share method, out-of-pocket healthcare payments that exceed 10% or 25% of the total expenditure are considered catastrophic health expenditures. Therefore, for our base case, we used the 25% threshold.

4.1.2. Data sources for household expenditures, health spending, and cost of surgeries

CAPMAS (The Egyptian Central Agency for Public Mobilization and Statistics) produces biennial reports which include estimates of the households' expenditure in Egypt. The last published detailed reports were in the 2017/2018 report and a summary report for 2019/2020. Hence, we extrapolated the numbers for 2020 using the 2018 report numbers and the 1.2-factor increase observed in the two reports.

The report divides the population into expenditure groups based on household expenditures.
For each expenditure group, the following data were abstracted:

- Total health expenditure (medical products, appliances and equipment, outpatient services, and hospital services)
- Average total household expenditure
- Food and non-alcoholic beverages expenditure
- Housing, water, electricity, gas, and other fuels expenditure

The cost of surgeries were calculated based on the updated official costs obtained from the MoHP for the procedures after implementing the initiative. The rationale for that is that in the study settings, and according to previous expenditure and utilization surveys, most people seek governmental services when it comes to expensive operations.

4.1.3. Curve fitting

The CAPMAS data provided only data on specific percentages of the population. However, such data were used to fit curves that allow estimating any data point provided by CAPMAS. Curve fitting applications were used to estimate the best fitting curves and interpolate missing data. This allowed calculating the drug affordability of specifically defined population percentages (e.g., 50% of the population or 25% of the population, etc.)

4.1.4. Affordability calculations

The cost of the surgery was added to the health expenditure by patients in each expenditure group. Therefore, results will show which expenditure groups are liable for catastrophic health expenditure.
For example, if the health expenditure is 100,000 EGP, then after we add cost of surgery (e.g., 10,000 EGP), total health expenditure = 110,000 EGP. This value will be divided by the total household expenditure (e.g., 350,000 EGP). Assess if the value is above or below the 25% threshold (110,000/350,000 =31.4%); this value is above the threshold, so the proposed price will cause catastrophic health expenditure for this expenditure group.
Affordability was calculated for the five surgeries using Budget share methods. The result identifies which expenditure groups will face catastrophic health expenditure for each calculation due to the surgery and which groups will not.

4.2. Results

4.2.1. Affordability

Affordability is defined as a percentage of the population who could afford surgery without catastrophic health expenditure.

Table 30 Percentage who could afford the surgeries according to Budget Share method

Surgery details		Affordability	
surgery	Number of patients	Percentage	Number of patients
Open Heart Surgeries	17003	1.00%	170
Cardiac Catheterization	118802	5.00%	5,940
Cochlear implantation	2113	0.50%	11
Ophthalmic surgeries (Retina)	133804	5.00%	6,690
Orthopedic (joint replacement) surgeries	16595	1.00%	166

4.2.2. Catastrophic Health expenditure

Catastrophic health expenditure is defined here as a percentage of the population who face catastrophic health expenditure when bearing the surgery costs.

Table 31 Percentage who could not afford the surgeries according to Budget Share method

Surgery details		Catastrophic health expenditure	
surgery	Number of patients	Percentage	Number of patients
Open Heart Surgeries	17003	99.00%	16,833
Cardiac Catheterization	118802	95.00%	112,862
Cochlear implantation	2113	99.50%	2,102
Ophthalmic surgeries (Retina)	133804	95.00%	127,114
Orthopedic (joint replacement) surgeries	16595	99.00%	16,429

4.2.2.1. Affordability details

Table 32 Affordability of selected surgeries according to budget share method

Surgery details			Budget Share method	
surgery	Number of patients	Surgery cost	% Who can afford	% Who face catastrophic health expenditure
Orthopedic (joint replacement) surgeries	16,595	EGP 55,631	1.00%	99.00%
Cardiac Catheterization	118,802	EGP 21,874	5.00%	95.00%
Cochlear implantation	2,113	EGP 137,980	0.50%	99.50%
Ophthalmic surgeries (Retina)	133,804	EGP 20,884	5.00%	95.00%
Orthopedic (joint replacement) surgeries	16,595	EGP 55,631	1.00%	99.00%

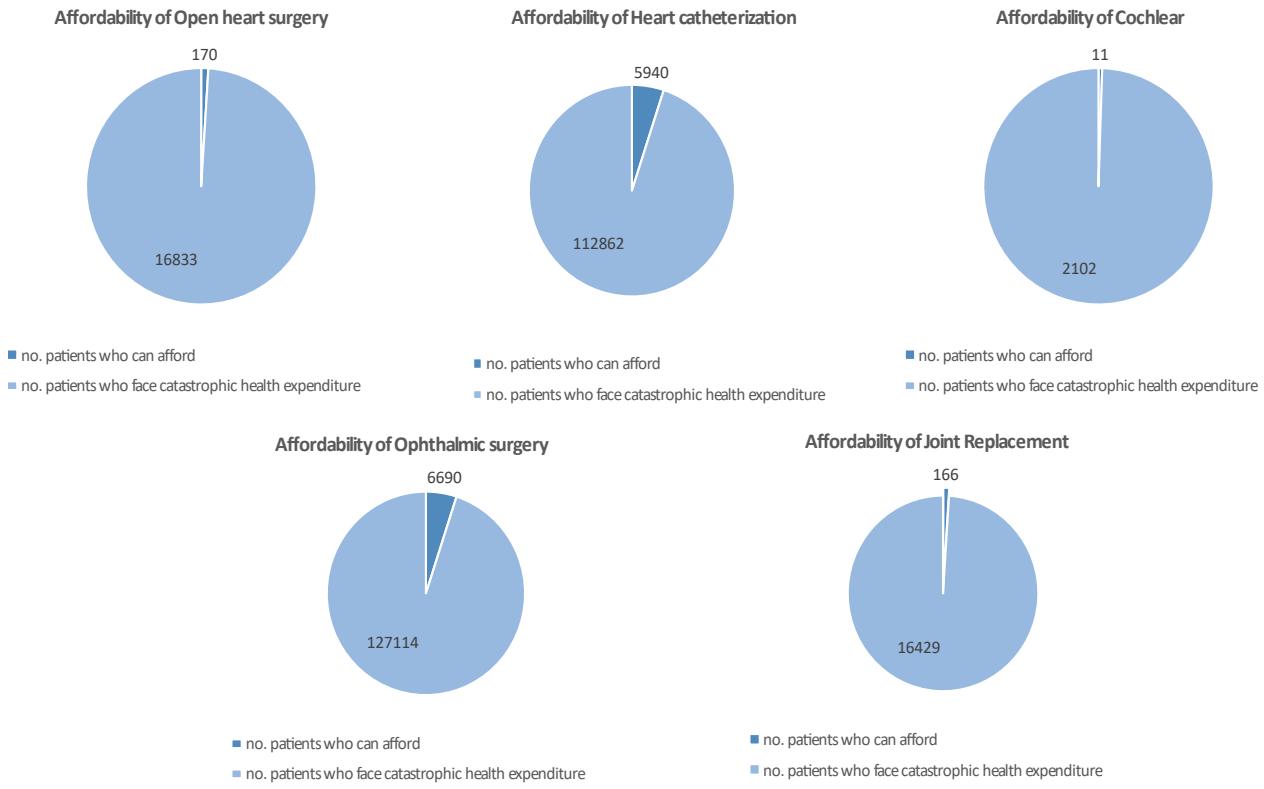


Figure 10 Affordability of different surgeries

4.2.3. The presidential initiative in relation to the Egyptian poverty line

4.2.3.1. The poverty line in Egypt

Impoverishing health expenditures occur when out-of-pocket payments push households below or below the poverty line.

In Egypt, Households with annual expenses below EGP 41,116 are considered below the poverty line (HIECS 2020). Households who have expenses less than EGP 41,116 after deducting the surgery cost annually fall below the poverty line due to the surgery. Households who have expenses more than EGP 41,116 after deducting the surgery cost annually are not dragged below the poverty line due to the surgery.

Table 33 Poverty line details

Calculation unit	Poverty line value	Extreme poverty line value
Per person annually	EGP 10,279	EGP 6,604
Per household annually	EGP 41,116	EGP 26,416
Average household size	4	4

4.2.3.2. Methodology of poverty line calculations

We extracted data for expenditure groups annually from CAPMAS reports from the 2017/2018 income and expenditure report. Unfortunately, the data for 2019/2020 was not complete, except for the average total annual expenditure, which was also reported from 2017/2018.

The average total annual expenditure in 2017/2018 was EGP 51,400, and the average total annual expenditure in 2019/2020 was EGP 61,907. By dividing the 2019/2020 value by the 2017/2018 value, we estimated a growth factor that could be multiplied by all income groups to have a relevant estimate of the updated value in 2019/2020 for each expenditure group. The calculated growth factor was 1.204

4.2.3.3. Poverty line results

Table 34 Expenditure compared to the poverty line results

Procedure		Without surgery	With surgery
Open Heart	Percentage of the population below the poverty line	30%	85%
	Percentage of the population below the **extreme** poverty line	5%	75%
Cardiac catheterization	Percentage of the population below the poverty line	30%	65%
	Percentage of the population below the **extreme** poverty line	5%	45%
Cochlear implants	Percentage of the population below the poverty line	30%	98%
	Percentage of the population below **extreme** poverty line	5%	98%
Ophthalmic surgeries (Retina)	Percentage of the population below poverty line	30%	65%
	Percentage of the population below the **extreme** poverty line	5%	45%
Orthopedic surgeries (Joint replacement)	Percentage of the population below the poverty line	30%	90%
	Percentage of the population below the **extreme** poverty line	5%	85%

4.2.4. Poverty line calculations summary

There are already 29.7% of the population below the poverty line and 5% below the extreme poverty line based on household expenditure values, according to CAPMAS. Surgeries drag a significant percentage of the patients to poverty or even extreme poverty. Ophthalmic and cardiac catheterization surgeries are the least expensive, leading to 65% of the population being dragged to poverty compared to 30% without surgery. On the other hand, cochlear implantation surgery is the costliest and it could lead to dragging nearly all patients to poverty (98%).

5. DISCUSSION

A long waiting list of healthcare services has always been an issue for many health systems regardless of income group (Sutherland et al., 2016). The presidential initiative has already helped diminish the number of people waiting to perform eleven high-priority interventions. The research question in this report was primarily about estimating the initiative's economic impact – its cost-effectiveness, cost-benefit, and impact on the household level of financial protection.

Although the research question is straightforward, the methodology used was quite innovative. First, the research team created a model that captures the initiative's economic added value without micro-costing the healthcare services and detailed health aspects of the interventions. Instead, the researchers depended on incremental costs (direct and indirect) and outcomes in the form of QALYs. As a result, the economic evaluation for the initiative was found to be cost-effective from both the payer and the societal perspectives.

The researchers used one GDP per capita as the willingness to pay threshold (Fasseeh et al., 2021). Accordingly, the five procedures that were evaluated combined were cost-effective. Individually, most of the procedures were either cost-effective or cost-saving except for retinal operations. Open heart surgery and catheterization were close in their ICERs, and both were cost-effective from a payer perspective, with EGP 38,393 and 32,941, respectively, and EGP 25,729 and 34,400 respectively from a societal perspective. The cochlear implant was cost-effective from a payer perspective with ICER equals EGP 23,491 while cost saving from a societal perspective with ICER of (61,000). The joint replacement therapy had an ICER of EGP 59,000 for the payer perspective and ICER of EGP 60,000 for the societal perspective, which is considered close to the cost-effectiveness threshold. Meanwhile, the reduction in waiting time for the retinal operations was not cost-effective from both payer and societal perspectives, with ICER of EGP 150,000 and 145,000, respectively, given the one GDP per capita threshold.

From the Affordability perspective, most surgeries are not affordable to at least 95% of the population, using any calculation method. Moreover, Cochlear implantation surgeries are the most expensive, and only 0.5% of the population can afford them and not face catastrophic health expenditure. In total, for the five surgery types, only 4.5% of the population can afford the surgeries; the other 95.5% will either face catastrophic health expenditure or abstain from using the service. Therefore, Conducting the surgeries under the initiative will improve access and allow all these patients to be treated without facing catastrophic health expenditures.

Despite these results, the researchers believed that the societal impact of different procedures was not captured or represented accurately due to a lack of literature that addresses the long-term productivity

lost before and after early and delayed operations. Furthermore, assumptions and calculations had to be made for cochlear implants because it is believed that a child with a late or no cochlear implant will be suffering from a degree of sensory disability that may impair their future life. Moreover, the retinal operations share productivity loss that might affect their results. However, no publications were found that could have enabled the researchers to build assumptions.

Evaluating the economic impact of the waiting list presidential initiative is a step toward quantifying the impact for better assessment of such projects. The methodology used is innovative and addresses the marginal costs and outcomes suitable for such massive projects. However, the researchers used minimal assumptions because of the lack of published data about specific topics, e.g., patients' utility decrement due to waiting time. Moreover, the local data could have been more abundant in certain parts, e.g., prices of surgery before delayed and before early surgery.

6. CONCLUSION

The Waiting list elimination presidential initiative is a cost-effective public health intervention from both payer and societal perspectives. Moreover, it provides an effective and equitable financial coverage mechanism for the affected population. Therefore, the researchers recommend the extension of the initiative to more preventative and curative health services while addressing broader demand and supply-side policy options to sustain the initiative's progress.

7. STUDY TEAM*

Ministry of Health and Population

Asmaa Khairy El Berri

Syreon Middle East

Ahmed Fasseeh
Amany Salem
Baher El Ezbawy
Balaz Nagy
Bertalan Nemeth

World Health Organization, Representative Office in Egypt

Ahmed Yehia Khalifa

**: The study team alone is responsible for the views expressed in this publication. All errors remain with the authors.*

8. REFERENCES

Badakhshan, A., Arab, M., Gholipour, M., Behnampour, N., & Saleki, S. (2015). Heart surgery waiting time: Assessing the effectiveness of an action. *Iranian Red Crescent Medical Journal*, *17*(8). https://doi.org/10.5812/ircmj.24851

Baker, P. N., Petheram, T., Jameson, S. S., Avery, P. J., Reed, M. R., Gregg, P. J., & Deehan, D. J. (2012). Comparison of patient-reported outcome measures following total and unicondylar knee replacement. *Journal of Bone and Joint Surgery - Series B*, *94 B*(7), 919–927. https://doi.org/10.1302/0301-620X.94B7.28436

Cohen, D. J., Van Hout, B., Serruys, P. W., Mohr, F. W., Macaya, C., den Heijer, P., Vrakking, M. M., Wang, K., Mahoney, E. M., Audi, S., Leadley, K., Dawkins, K. D., & Kappetein, A. P. (2011). Quality of Life after PCI with Drug-Eluting Stents or Coronary-Artery Bypass Surgery. In *New England Journal of Medicine* (Vol. 364, Issue 11, pp. 1016–1026). https://doi.org/10.1056/nejmoa1001508

Crowson, M. G., Semenov, Y. R., Tucci, D. L., & Niparko, J. K. (2018). Quality of Life and Cost-Effectiveness of Cochlear Implants: A Narrative Review. *Audiology and Neurotology*, *22*(4–5), 236–258. https://doi.org/10.1159/000481767

Elsisi, G. H., Kaló, Z., Eldessouki, R., Elmahdawy, M. D., Saad, A., Ragab, S., Elshalakani, A. M., & Abaza, S. (2013). Recommendations for reporting pharmacoeconomic evaluations in Egypt. *Value in Health Regional Issues*, *2*(2), 319–327. https://doi.org/10.1016/j.vhri.2013.06.014

Fasseeh, A., Elezbawy, B., Korra, N., Sedrak, A., Gamal, M., Eldessouki, R., Eldebeiky, M., Seyam, A., Abourawash, A., Abaza, S., & Kaló, Z. (2021). *Framework for Developing Cost-Effectiveness Analysis Threshold : The Case of Egypt*.

HOPE. (2001). Waiting Lists and Waiting Times in Health Care. Managing Demand and Supply Introduction. *Hope*, 49. http://www.hope.be/wp-content/uploads/2015/11/60_2001_HOPE-REPORT_Waiting-lists-and-waiting-times-in-health-care-managing-demand-and-supply.pdf

Hurst, J., & Siciliani, L. (2003). *SEM-template.id2*. 1–55.

Kotseva, K., Gerlier, L., Sidelnikov, E., Kutikova, L., Lamotte, M., Amarenco, P., & Annemans, L. (2019). Patient and caregiver productivity loss and indirect costs associated with cardiovascular events in Europe. *European Journal of Preventive Cardiology*, *26*(11), 1150–1157. https://doi.org/10.1177/2047487319834770

Retinal International. (2019). The socioeconomic impact of inherited retinal dystrophies (IRDs) in Canada. In *Deloitte* (Issue August).

Saksena P, H. J. (2004). *Financial Risk Protection and Universal Health Coverage:Evidence and Measurement Challenges.* PLoS Med 11(9): e1001701. oi:10.1371/journal.pmed.1001701.

Stigmar, K., Dahlberg, L. E., Zhou, C., Jacobson Lidgren, H., Petersson, I. F., & Englund, M. (2017). Sick leave in Sweden before and after total joint replacement in hip and knee osteoarthritis patients. *Acta Orthopaedica*, *88*(2), 152–157. https://doi.org/10.1080/17453674.2016.1269051

Yannuzzi, N. A., Chang, J. S., Brown, G. C., & Smiddy, W. E. (2018). Cost-Utility of Evaluation for Posterior Vitreous Detachment and Prophylaxis of Retinal Detachment. *Ophthalmology*, *125*(1), 43–50. https://doi.org/10.1016/j.ophtha.2017.06.019

Disability and Employment | United Nations Enable. (2022). Un.org. https://www.un.org/development/desa/disabilities/resources/factsheet-on-persons-with-disabilities/disability-and-employment.html

Price, S. (2021, May 11). Exploring the challenges of growing healthcare waiting lists. Health Europa. https://www.healtheuropa.eu/exploring-the-challenges-of-growing-healthcare-waiting-lists/108189/

Woods, B., Revill, P., Sculpher, M., & Claxton, K. (2016). Country-Level Cost-Effectiveness Thresholds: Initial Estimates and the Need for Further Research. Value in Health, 19(8), 929–935. https://doi.org/10.1016/j.jval.2016.02.017

Sutherland, J. M., Crump, R. T., Chan, A., Liu, G., Yue, E., & Bair, M. (2016). Health of patients on the waiting list: Opportunity to improve health in Canada? Health Policy, 120(7), 749–757. https://doi.org/10.1016/J.HEALTHPOL.2016.04.017

9. ANNEXES

9.1. Annex 1

Table 35 The tool used for structured interviews

	Pre - surgery			post-surgery							comments
Outpatient/Inpatient visits											
	Proportion (%)	Frequency/year		Proportion (%)	Frequency/year				Price/visit or per day	Price /year	
G.P. visits											
Specialist visits											
Emergency department visits											
Hospital stay due to complications/ days											
ICU admission											
Other??											
Laboratory Investigations											
	Proportion (%)	Frequency/year		Proportion (%)	Frequency/year				Price/visit or per day	Price /year	
Radiological and other Investigations											
	Proportion (%)	Frequency/year		Proportion (%)	Frequency/year				Price/visit or per day	Price /year	
Medications											
Drug name	*Proportion %*	*Dose/number of boxes per month*	*Number of months*	*Proportion %*	*Dose/number of boxes per month*	*Number of months*	*Size of box*	*Unit*	*Price/Box*	*Price /year*	

9.2.Annex 2

Table 36 The health services package for each surgery

م	التشخيص	شمول الفحوصات قبل و حتى إجراء العملية	شمول العلاج قبل و بعد العملية
1	جراحات العظام و المفاصل	يشتمل علي الفحوصات حتي اجراء الجراحه	لا يشمل علاج بعد الاجراء
2	القلب المفتوح	يشتمل علي الفحوصات حتي اجراء العمليه	شامل الرعايه المركزه للقلب المفتوح بعد الجراحه حتي تمام الشفاء
3	القسطرة القلبية	يشتمل علي الفحوصات و الصبغات حتي اجراء الجراحه	ولا يشمل علاج بعد الاجراء
4	جراحات العيون	يشتمل علي الفحوصات حتي اجراء الجراحه	لا يشمل علاج بعد الاجراء
8	زرع قوقعة		شامل التدريب والتخاطب بعد الزرع

9.3. Annex 3

Table 37 Model inputs included in the DSA

Display Name	Parameter
QALYs post delayed-surgery Cardiac Catheterization	u_QoL_ad_Cath
QALYs post delayed-surgery Cochlear implantation	u_QoL_ad_Cochlear
Cost of early Cardiac Catheterization	c_CS_e_Cath
QALYs pre-surgery Cardiac Catheterization	u_QoL_b_Cath
Pts days lost post early Cardiac Catheterization	O_Ld_ae_Cath
Cost of delayed Cardiac Catheterization	c_CS_d_Cath
Cost of early Ophthalmic surgeries (Retina)	c_CS_e_Retina
Care days lost post early Cardiac Catheterization	O_Ldc_ae_Cath
QALYs post delayed-surgery Ophthalmic surgeries (Retina)	u_QoL_ad_Retina
Avg age early Cardiac Catheterization	O_ageSurg_e_Cath
QALYs pre-surgery Ophthalmic surgeries (Retina)	u_QoL_b_Retina
QALYs post delayed-surgery Open Heart Surgeries	u_QoL_ad_Open
Avg age death post delayed Cardiac Catheterization	O_Age_death_ad_Cath
Pts days lost post early Orthopedic (joint replacement) surgeries	O_Ld_ae_joint
Cost of early Orthopedic (joint replacement) surgeries	c_CS_e_joint
Cost of early Open Heart Surgeries	c_CS_e_Open
Pts days lost post delayed Open Heart Surgeries	O_Ld_ad_Open
Avg age early Open Heart Surgeries	O_ageSurg_e_Open
Pts days lost post early Ophthalmic surgeries (Retina)	O_Ld_ae_Retina
Cost of delayed Ophthalmic surgeries (Retina)	c_CS_d_Retina
QALYs post delayed-surgery Orthopedic (joint replacement) surgeries	u_QoL_ad_joint
Pts days lost post early Open Heart Surgeries	O_Ld_ae_Open
QALYs pre-surgery Open Heart Surgeries	u_QoL_b_Open
Care days lost post early Open Heart Surgeries	O_Ldc_ae_Open
Reduced days Ophthalmic surgeries (Retina)	O_Wtd_Retina

Cost of delayed Orthopedic (joint replacement) surgeries	c_CS_d_joint
Mortality averted Cardiac Catheterization	p_redMo_Cath
Average number of working days per year	O_Wdy
Cost of med manag post Cardiac Catheterization	c_CM_ad_Cath
Cost of delayed Open Heart Surgeries	c_CS_d_Open
Pts days lost post delayed Cochlear implantation	O_Ld_ad_Cochlear
Mortality averted Open Heart Surgeries	p_redMo_Open
Cost of early Cochlear implantation	c_CS_e_Cochlear
QALYs pre-surgery Orthopedic (joint replacement) surgeries	u_QoL_b_joint
Pts days lost post early Cochlear implantation	O_Ld_ae_Cochlear
Cost of delayed Cochlear implantation	c_CS_d_Cochlear
Pts days lost pre Cardiac Catheterization	O_Ld_b_Cath
Reduced days Orthopedic (joint replacement) surgeries	O_Wtd_joint
Reduced days Cardiac Catheterization	O_Wtd_Cath
Avg age early Orthopedic (joint replacement) surgeries	O_ageSurg_e_joint
Pts days lost post delayed Cardiac Catheterization	O_Ld_ad_Cath
Cost of med manag post Open Heart Surgeries	c_CM_ad_Open
Avg age death pre Catheterization	O_Age_death_b_Cath
Avg age death post delayed Orthopedic (joint replacement) surgeries	O_Age_death_ad_joint
Mortality averted Orthopedic (joint replacement) surgeries	p_redMo_joint
Pts days lost post delayed Orthopedic (joint replacement) surgeries	O_Ld_ad_joint
Avg age death post delayed Open Heart Surgeries	O_Age_death_ad_Open
Care days lost pre Cardiac Catheterization	O_Ldc_b_Cath
Care days lost pre Open Heart Surgeries	O_Ldc_b_Open
Utilty decrement Cardiac Catheterization	u_Ud_Cath
Cost of med manag pre Cardiac Catheterization	c_CM_b_Cath
Avg age death post delayed Cochlear implantation	O_Age_death_ad_Cochlear
Reduced days Open Heart Surgeries	O_Wtd_Open

QALYs pre-surgery Cochlear implantation	u_QoL_b_Cochlear
Pts days lost pre Ophthalmic surgeries (Retina)	O_Ld_b_Retina
Pts days lost pre Open Heart Surgeries	O_Ld_b_Open
Care days lost post delayed Cardiac Catheterization	O_Ldc_ad_Cath
Care days lost post early Cochlear implantation	O_Ldc_ae_Cochlear
Pts days lost post delayed Ophthalmic surgeries (Retina)	O_Ld_ad_Retina
Utilty decrement Open Heart Surgeries	u_Ud_Open
Utilty decrement Ophthalmic surgeries (Retina)	u_Ud_Retina
Avg age death pre Open Heart Surgeries	O_Age_death_b_Open
Avg age death post delayed Ophthalmic surgeries (Retina)	O_Age_death_ad_Retina
Pts days lost pre Orthopedic (joint replacement) surgeries	O_Ld_b_joint
Reduced days Cochlear implantation	O_Wtd_Cochlear
Avg age early Ophthalmic surgeries (Retina)	O_ageSurg_e_Retina
Avg age early Cochlear implantation	O_ageSurg_e_Cochlear
Cost of med manag pre Open Heart Surgeries	c_CM_b_Open
Pts days lost pre Cochlear implantation	O_Ld_b_Cochlear
Utilty decrement Orthopedic (joint replacement) surgeries	u_Ud_joint
Missed surgeries Cardiac Catheterization	p_miSurg_Cath
Missed surgeries Open Heart Surgeries	p_miSurg_Open
Missed surgeries Ophthalmic surgeries (Retina)	p_miSurg_Retina
Missed surgeries Orthopedic (joint replacement) surgeries	p_miSurg_joint
Care days lost post delayed Open Heart Surgeries	O_Ldc_ad_Open
Care days lost pre Cochlear implantation	O_Ldc_b_Cochlear
Care days lost post delayed Cochlear implantation	O_Ldc_ad_Cochlear
Missed surgeries Cochlear implantation	p_miSurg_Cochlear
Male to female Open Heart Surgeries	p_MF_R_Open
Male to female Cardiac Catheterization	p_MF_R_Cath
Male to female Cochlear implantation	p_MF_R_Cochlear
Male to female Ophthalmic surgeries (Retina)	p_MF_R_Retina

Male to female Orthopedic (joint replacement) surgeries	p_MF_R_joint
Mortality averted Cochlear implantation	p_redMo_Cochlear
Mortality averted Ophthalmic surgeries (Retina)	p_redMo_Retina
Cost of med manag pre Cochlear implantation	c_CM_b_Cochlear
Cost of med manag pre Ophthalmic surgeries (Retina)	c_CM_b_Retina
Cost of med manag pre Orthopedic (joint replacement) surgeries	c_CM_b_joint
Cost of med manag post Cochlear implantation	c_CM_ad_Cochlear
Cost of med manag post Ophthalmic surgeries (Retina)	c_CM_ad_Retina
Cost of med manag post Orthopedic (joint replacement) surgeries	c_CM_ad_joint
Care days lost pre Ophthalmic surgeries (Retina)	O_Ldc_b_Retina
Care days lost pre Orthopedic (joint replacement) surgeries	O_Ldc_b_joint
Care days lost post early Ophthalmic surgeries (Retina)	O_Ldc_ae_Retina
Care days lost post early Orthopedic (joint replacement) surgeries	O_Ldc_ae_joint
Care days lost post delayed Ophthalmic surgeries (Retina)	O_Ldc_ad_Retina
Care days lost post delayed Orthopedic (joint replacement) surgeries	O_Ldc_ad_joint
Average salary of patients per year	c_Avg_Sal
Average Salary of Caregiver per year	c_Avg_Sal_C
Males to females ratio as Caregivers	p_MF_Ratio_C
Retirement age	O_Age_Ret
Labor Force Participation Rate (total)	p_LFPR_Total
Unemployment rate(total)	p_UR_total
Labor Force Participation Rate (males)	p_LFPR_males
Labor Force Participation Rate(females)	p_LFPR_females
Average number of days per year	O_Dy

9.4. Annex 4

Table 38 Model inputs included in the PSA

Display Name	Parameter
QALYs post delayed-surgery Cardiac Catheterization	u_QoL_ad_Cath
QALYs post delayed-surgery Cochlear implantation	u_QoL_ad_Cochlear
Cost of early Cardiac Catheterization	c_CS_e_Cath
QALYs pre-surgery Cardiac Catheterization	u_QoL_b_Cath
Pts days lost post early Cardiac Catheterization	O_Ld_ae_Cath
Cost of delayed Cardiac Catheterization	c_CS_d_Cath
Cost of early Ophthalmic surgeries (Retina)	c_CS_e_Retina
Care days lost post early Cardiac Catheterization	O_Ldc_ae_Cath
QALYs post delayed-surgery Ophthalmic surgeries (Retina)	u_QoL_ad_Retina
Avg age early Cardiac Catheterization	O_ageSurg_e_Cath
QALYs pre-surgery Ophthalmic surgeries (Retina)	u_QoL_b_Retina
QALYs post delayed-surgery Open Heart Surgeries	u_QoL_ad_Open
Avg age death post delayed Cardiac Catheterization	O_Age_death_ad_Cath
Pts days lost post early Orthopedic (joint replacement) surgeries	O_Ld_ae_joint
Cost of early Orthopedic (joint replacement) surgeries	c_CS_e_joint
Cost of early Open Heart Surgeries	c_CS_e_Open
Pts days lost post delayed Open Heart Surgeries	O_Ld_ad_Open
Avg age early Open Heart Surgeries	O_ageSurg_e_Open
Pts days lost post early Ophthalmic surgeries (Retina)	O_Ld_ae_Retina
Cost of delayed Ophthalmic surgeries (Retina)	c_CS_d_Retina
QALYs post delayed-surgery Orthopedic (joint replacement) surgeries	u_QoL_ad_joint
Pts days lost post early Open Heart Surgeries	O_Ld_ae_Open
QALYs pre-surgery Open Heart Surgeries	u_QoL_b_Open
Care days lost post early Open Heart Surgeries	O_Ldc_ae_Open
Reduced days Ophthalmic surgeries (Retina)	O_Wtd_Retina
Cost of delayed Orthopedic (joint replacement) surgeries	c_CS_d_joint
Mortality averted Cardiac Catheterization	p_redMo_Cath
Average number of working days per year	O_Wdy
Cost of med manag post Cardiac Catheterization	c_CM_ad_Cath
Cost of delayed Open Heart Surgeries	c_CS_d_Open
Pts days lost post delayed Cochlear implantation	O_Ld_ad_Cochlear
Mortality averted Open Heart Surgeries	p_redMo_Open
Cost of early Cochlear implantation	c_CS_e_Cochlear
QALYs pre-surgery Orthopedic (joint replacement) surgeries	u_QoL_b_joint
Pts days lost post early Cochlear implantation	O_Ld_ae_Cochlear
Cost of delayed Cochlear implantation	c_CS_d_Cochlear
Pts days lost pre Cardiac Catheterization	O_Ld_b_Cath
Reduced days Orthopedic (joint replacement) surgeries	O_Wtd_joint
Reduced days Cardiac Catheterization	O_Wtd_Cath
Avg age early Orthopedic (joint replacement) surgeries	O_ageSurg_e_joint
Pts days lost post delayed Cardiac Catheterization	O_Ld_ad_Cath

Cost of med manag post Open-Heart Surgeries	c_CM_ad_Open
Avg age death pre Catheterization	O_Age_death_b_Cath
Avg age death post delayed Orthopedic (joint replacement) surgeries	O_Age_death_ad_joint
Mortality averted Orthopedic (joint replacement) surgeries	p_redMo_joint
Pts days lost post delayed Orthopedic (joint replacement) surgeries	O_Ld_ad_joint
Avg age death post delayed Open Heart Surgeries	O_Age_death_ad_Open
Care days lost pre Cardiac Catheterization	O_Ldc_b_Cath
Care days lost pre Open Heart Surgeries	O_Ldc_b_Open
Utilty decrement Cardiac Catheterization	u_Ud_Cath
Cost of med manag pre Cardiac Catheterization	c_CM_b_Cath
Avg age death post delayed Cochlear implantation	O_Age_death_ad_Cochlear
Reduced days Open Heart Surgeries	O_Wtd_Open
QALYs pre-surgery Cochlear implantation	u_QoL_b_Cochlear
Pts days lost pre Ophthalmic surgeries (Retina)	O_Ld_b_Retina
Pts days lost pre Open Heart Surgeries	O_Ld_b_Open
Care days lost post delayed Cardiac Catheterization	O_Ldc_ad_Cath
Care days lost post early Cochlear implantation	O_Ldc_ae_Cochlear
Pts days lost post delayed Ophthalmic surgeries (Retina)	O_Ld_ad_Retina
Utilty decrement Open Heart Surgeries	u_Ud_Open
Utilty decrement Ophthalmic surgeries (Retina)	u_Ud_Retina
Avg age death pre Open Heart Surgeries	O_Age_death_b_Open
Avg age death post delayed Ophthalmic surgeries (Retina)	O_Age_death_ad_Retina
Pts days lost pre Orthopedic (joint replacement) surgeries	O_Ld_b_joint
Reduced days Cochlear implantation	O_Wtd_Cochlear
Avg age early Ophthalmic surgeries (Retina)	O_ageSurg_e_Retina
Avg age early Cochlear implantation	O_ageSurg_e_Cochlear
Cost of med manag pre Open Heart Surgeries	c_CM_b_Open
Pts days lost pre Cochlear implantation	O_Ld_b_Cochlear
Utilty decrement Orthopedic (joint replacement) surgeries	u_Ud_joint
Missed surgeries Cardiac Catheterization	p_miSurg_Cath
Missed surgeries Open Heart Surgeries	p_miSurg_Open
Missed surgeries Ophthalmic surgeries (Retina)	p_miSurg_Retina
Missed surgeries Orthopedic (joint replacement) surgeries	p_miSurg_joint
Care days lost post delayed Open Heart Surgeries	O_Ldc_ad_Open
Care days lost pre Cochlear implantation	O_Ldc_b_Cochlear
Care days lost post delayed Cochlear implantation	O_Ldc_ad_Cochlear
Missed surgeries Cochlear implantation	p_miSurg_Cochlear
Male to female Open Heart Surgeries	p_MF_R_Open
Male to female Cardiac Catheterization	p_MF_R_Cath
Male to female Cochlear implantation	p_MF_R_Cochlear
Male to female Ophthalmic surgeries (Retina)	p_MF_R_Retina
Male to female Orthopedic (joint replacement) surgeries	p_MF_R_joint
Mortality averted Cochlear implantation	p_redMo_Cochlear
Mortality averted Ophthalmic surgeries (Retina)	p_redMo_Retina
Cost of med manag pre Cochlear implantation	c_CM_b_Cochlear

Cost of med manag pre Ophthalmic surgeries (Retina)	c_CM_b_Retina
Cost of med manag pre Orthopedic (joint replacement) surgeries	c_CM_b_joint
Cost of med manag post Cochlear implantation	c_CM_ad_Cochlear
Cost of med manag post Ophthalmic surgeries (Retina)	c_CM_ad_Retina
Cost of med manag post Orthopedic (joint replacement) surgeries	c_CM_ad_joint
Care days lost pre Ophthalmic surgeries (Retina)	O_Ldc_b_Retina
Care days lost pre Orthopedic (joint replacement) surgeries	O_Ldc_b_joint
Care days lost post early Ophthalmic surgeries (Retina)	O_Ldc_ae_Retina
Care days lost post early Orthopedic (joint replacement) surgeries	O_Ldc_ae_joint
Care days lost post delayed Ophthalmic surgeries (Retina)	O_Ldc_ad_Retina
Care days lost post delayed Orthopedic (joint replacement) surgeries	O_Ldc_ad_joint
Average salary of patients per year	c_Avg_Sal
Average Salary of Caregiver per year	c_Avg_Sal_C
Males to females ratio as Caregivers	p_MF_Ratio_C
Retirement age	O_Age_Ret
Labor Force Participation Rate (total)	p_LFPR_Total
Unemployment rate(total)	p_UR_total
Labor Force Participation Rate (males)	p_LFPR_males
Labor Force Participation Rate(females)	p_LFPR_females
Average number of days per year	O_Dy

11.5. Annex 5

11.5.1. Partial normative food spending method

The partial normative food-spending method deduces a standard food spending from each household's budget. This standard amount is based on the average per equivalent person food spending of households whose food share of total household expenditure is between the 45th and 55th percentiles of the total sample. This aims to arrive at a standard expenditure level representing basic needs. The annual partial normative food spending (45%-55% percentile in Egypt) is 17,918 EGP

11.5.2. Normative spending on food, housing, and utility method

The normative spending on food, housing, and utility method considers housing (rent) and utilities (water, electricity, gas, and other fuels) as representative of basic needs, in addition to food. The method calculates average spending on these items among households between the 25th and 35th percentiles of the total sample. A standard amount is deducted from all households that spend on food, rent, and utilities. Annual normative spending on food, housing, and utilities in Egypt (25%-35% percentile) is 21,903 EGP

Table 39 Percentage who could afford the surgeries according to partial normative and normative calculation methods

Surgery details		**Affordability**	
surgery	Number of patients	Affordability (Food)	Affordability (Food + housing)
Open heart surgeries	17,003	1.00%	1.00%
Cardiac catheterization	118,802	4.00%	4.00%
Cochlear implantation	2,113	0.50%	0.50%
Ophthalmic surgeries (Retina)	133,804	5.00%	4.00%
Orthopedic (joint replacement) surgeries	16,595	0.80%	0.80%

*Table 40 Percentage who could **not** afford the surgeries according to partial normative and normative calculation methods*

Surgery details		**Catastrophic health expenditure**	
surgery	Number of patients	Catastrophic health expenditure (food)	Catastrophic health expenditure (food + housing)
Open heart surgeries	17,003	99.00%	99.00%
Cardiac catheterization	118,802	96.00%	96.00%
Cochlear implantation	2,113	99.50%	99.50%
Ophthalmic surgeries (Retina)	133,804	95.00%	96.00%
Orthopedic (joint replacement) surgeries	16,595	99.20%	99.20%

11.5.3. Affordability details

Table 41 Affordability of selected surgeries

Surgery details			Partial normative food spending		Normative spending on food, housing, and utilities	
surgery	Number of patients	Surgery cost	% Who can afford	% Who face catastrophic health expenditure	% Who can afford	% Who face catastrophic health expenditure
Orthopedic (joint replacement) surgeries	16,595	EGP 55,631	0.80%	99.20%	0.80%	99.20%
Cardiac Catheterization	118,802	EGP 21,874	4.00%	96.00%	4.00%	96.00%
Cochlear implantation	2,113	EGP 137,980	0.50%	99.50%	0.50%	99.50%
Ophthalmic surgeries (Retina)	133,804	EGP 20,884	5.00%	95.00%	4.00%	96.00%
Orthopedic (joint replacement) surgeries	16,595	EGP 55,631	0.80%	99.20%	0.80%	99.20%

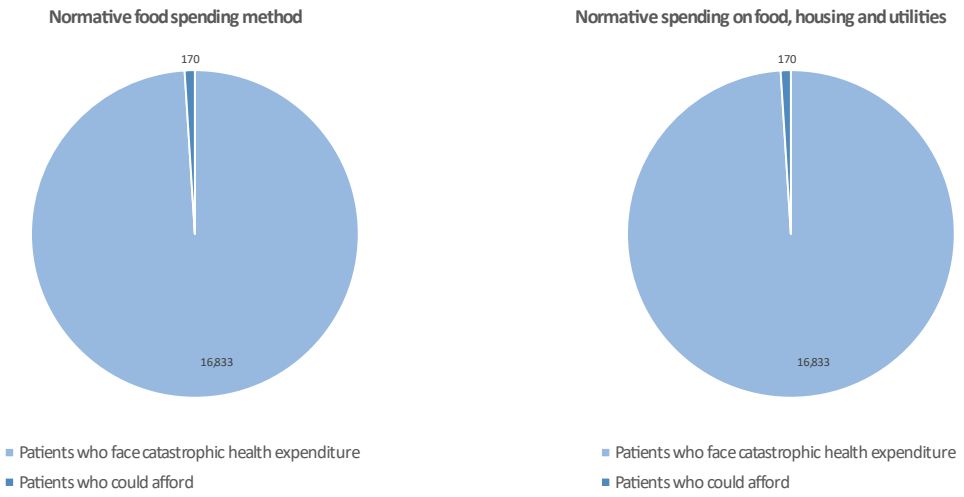


Figure 11 Affordability of open-heart surgeries in Egypt (no. of patients)

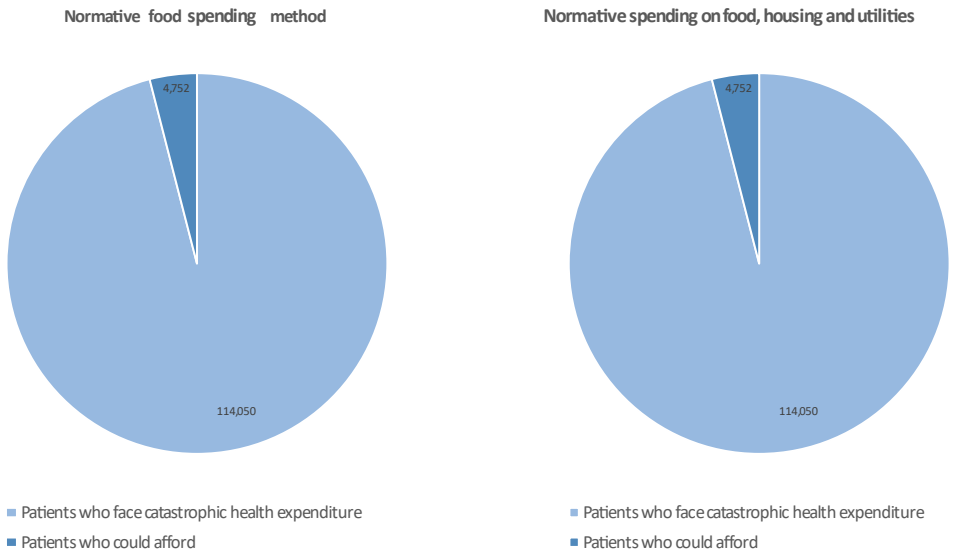


Figure 12 Affordability of cardiac catheterization in Egypt (no. of patients)

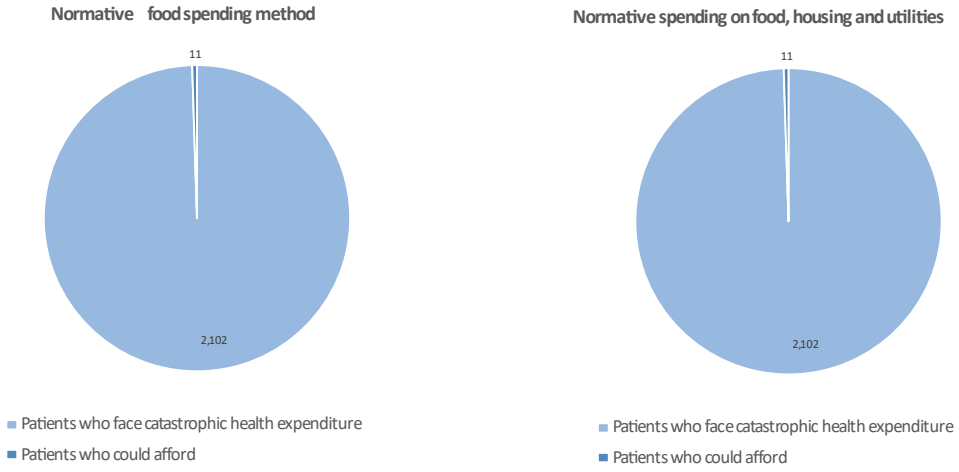


Figure 13 Affordability of cochlear implantation surgeries in Egypt (no. of patients)

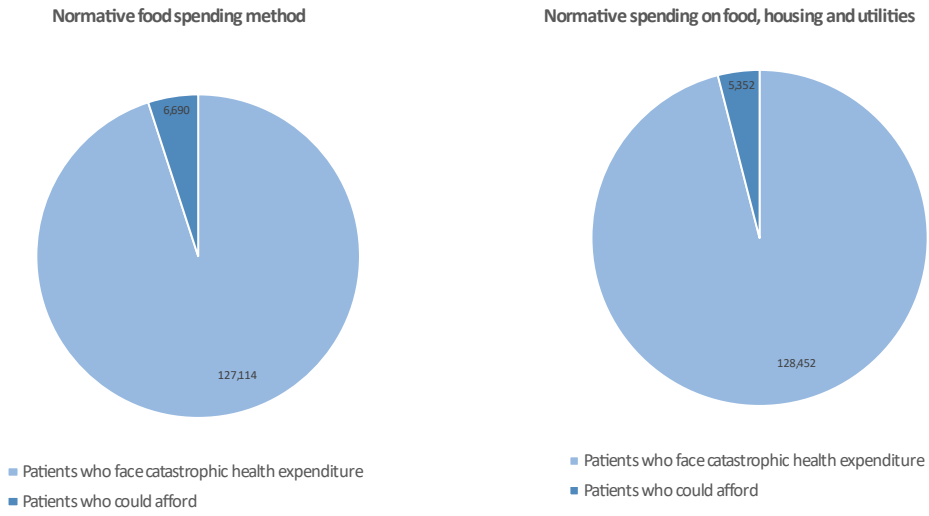


Figure 14 Affordability of ophthalmic surgeries in Egypt (no. of patients)

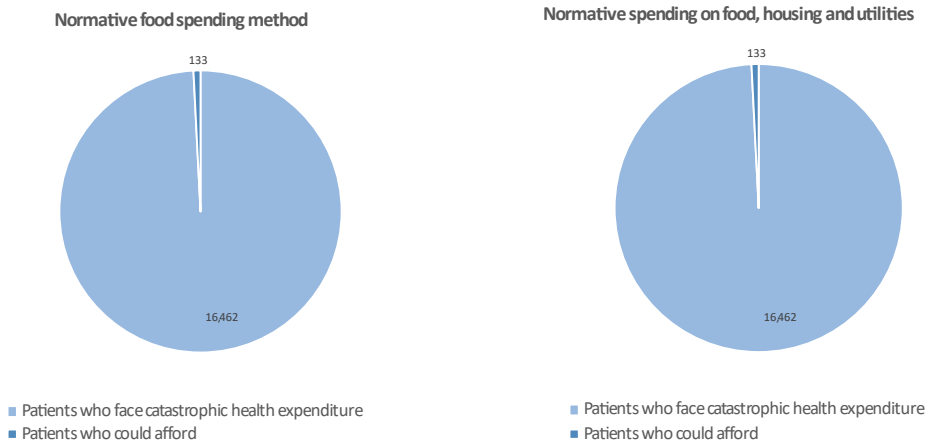


Figure 15 Affordability of orthopedic surgeries in Egypt (no. of patients)





World Health Organization

Egypt