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Research Article

Estimation of Prostate Cancer Cost in Egypt From a Societal Perspective

Gihan Hamdy Elsisi,[1,2] Mariam Mohamed El-Attar,[1] Shaimaa Mohamed Ismaeil,[3] Mohamed El-Saeed El-Shater,[4] Mary G. Kirollos,[5] Amal S. Sedrak,[5] Hany Morad,[5] Heba Abdel-Mohsen,[3] Mohamed Abdel-Aziz,[3] Mohamed Magdy,[4] Osama Loutfy[4]

[1]HTA Office, LLC, Cairo, Egypt
[2]School of Economics, American University, Cairo, Egypt
[3]Health Insurance Organization, Cairo Egypt
[4]Nasr City Cancer Center (NCCC), Health Insurance Organization, Cairo, Egypt
[5]Health Technology Assessment Department, Egyptian Authority for Unified Procurement, Medical Supply and Management of Medical Technology, Cairo, Egypt

Address correspondence to Gihan Hamdy Elsisi (Gihan.elsisi@htaoffice.com).

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ABSTRACT

Introduction: The main objective of this study was to assess the cost of prostate cancer over a 1-year period from a societal perspective. **Methods:** We constructed a cost-of-illness model to assess the cost of different health states of prostate cancer, metastatic or nonmetastatic, among Egyptian men. Population data and clinical parameters were extracted from the published literature. We relied on different clinical trials to extract clinical data. We considered all direct medical costs, including the costs of treatment and required monitoring, in addition to the indirect costs. The unit costs were captured from Nasr City Cancer Center and Egyptian Authority for Unified Procurement, Medical Supply, and Management of Medical Technology, and resource utilization were collected from clinical trials and validated by the Expert Panel. One-way sensitivity analysis was conducted to ensure model robustness. **Results:** The number of targeted patients with nonmetastatic hormone-sensitive prostate cancer, hormone-sensitive prostate cancer, and metastatic castration-resistant prostate cancer was 215,207, 263,032, and 116,732, respectively. The total costs, in Egyptian pounds (EGP) and US dollars (USD), for the targeted patients, including drug costs and nondrug costs over a time horizon of 1 year, were EGP 41.44 billion (USD 9.010 billion) for localized prostate cancer; for metastatic prostate cancer, they doubled to EGP 85.14 billion (USD 18.510 billion), which reflects a huge burden on the Egyptian healthcare system. The drug costs for localized and metastatic prostate cancer are EGP 41,155,038,137 (USD 8.946 billion) and EGP 81,384,796,471 (USD 17.692 billion), respectively. A significant difference in nondrug costs between localized and metastatic prostate cancer was demonstrated. Nondrug costs were estimated at EGP 293,187,203 (USD 0.063 billion) for localized prostate cancer and EGP 3,762,286,092 (USD 0.817 billion) for metastatic prostate cancer. This significant difference in nondrug costs highlights the importance of early treatment due to the increased costs of progression and the burden of follow-up and productivity loss associated with metastatic prostate cancer. **Conclusion:** Metastatic prostate cancer has a huge economic burden on the Egyptian healthcare system compared with localized prostate cancer owing to the increased costs of progression, follow-up, and productivity loss. This highlights the necessity of early treatment of these patients to save costs and lighten the burden of the disease on the patient, society, and economy.

Keywords: prostate cancer, cost of illness, Egypt, societal perspective, economic burden

INTRODUCTION

Cancer is a major cause of premature death.[1] The International Agency for Research on Cancer and GLOBOCAN 2020 reported that the cancer burden was estimated at 19.3 million new cancer cases and 10 million cancer death in 2020 worldwide.[2] Uncontrolled growth of prostate gland cells results in prostate cancer.[3] Prostate

cancer is the second most common cancer in men after lung cancer, with 1.4 million new cases (7.3%) and the fifth most common cause of cancer-related death among men, with 375,000 deaths (3.8%) in 2020.[2] The incidence rates per 100,000 population of prostate cancer in men reported in Lower, Middle, and Upper Egypt in the National Population-Based Registry Program of Egypt 2008–2011 were 4.84%, 2.66%, and 5.92%, respectively, and the reported incidence rate of prostate cancer for all sites was 4.27%.[4] GLOBOCAN 2020 stated that the number of new cases of prostate cancer in Egypt was 4767, with 2227 deaths.[5] The estimated prevalence of prostate cancer among Egyptian men starting from 50 years of age is 22%.[6] Age over 50 is a major risk factor for prostate cancer.[7] The peak of prostate cancer occurs at 60 to 70 years old.[8]

Compared with hepatic cancer, with an overall prognosis of less than 20%, prostate cancer has the best overall prognosis, with a 5-year survival rate of approximately 100%,[9] while the 5-year survival rate of distant metastatic prostate cancer is 30%.[9] Therefore, early management of prostate cancer is highly beneficial.[10] In addition, the risk of COVID-19 complications increases in patients with comorbidities.[11] Among other genitourinary malignancies, COVID-19–positive prostate cancer patients are at a high risk of developing complications, including hospitalization and/or mortality.[12]

Most cases of prostate cancer show early lower urinary tract symptoms and impotence.[13] Initial patient examination during a physician visit requires a digital rectal exam to check the prostate.[14] A blood test called prostate-specific antigen (PSA) is performed as the level of PSA increases in the blood, and the risk of developing prostate cancer also increases.[15] The National Health Service in the United Kingdom and the American Cancer Association consider the PSA test an inaccurate measurement of prostate cancer because it may miss 15% of cancer cases.[15,16] The PSA test has limited specificity because it is organ-specific but not prostate cancer–specific; results are also elevated in benign prostatic hyperplasia and prostatitis.[17,18]

The Centers for Disease Control and Prevention state prostate cancer is mainly diagnosed by prostate biopsy.[19] Transrectal ultrasound-guided prostate biopsy or magnetic resonance imaging is used to guide the biopsy. Biopsy-related complications include infections, such as urinary tract infections, prostatitis, and sepsis, which may lead to hospitalization, urine retention, bleeding, and erectile dysfunction.[20] A systematic review of prostate biopsy–related complications showed imperative patient preparation before biopsy by both pain management and antimicrobial prophylaxis.[21] Infection occurred in 10.3% of patients without antibiotic prophylaxis and 3.7% who received prophylactic antibiotic management.[21]

Prostate cancer may spread to other organs through the blood or lymphatic system.[22] Once the biopsy confirmed prostate adenocarcinoma, staging was performed to detect localized or metastatic cancer. Results from a digital rectal exam, PSA, biopsy, and Gleason score for grading prostate cancer will determine whether X-rays, bone scans, computerized tomography (CT) scans, or magnetic resonance imaging are needed to detect metastasis.[23] The most common site for prostate cancer metastasis is the bone (84%), followed by distant lymph nodes (10.6%), liver (10.2%), and thorax (9.1%).[24] Usually, replication and metastasis of prostate cancer are slow.[25] Thus, an early-stage disease without symptoms or metastasis is considered an optimal chance for disease management.[7]

Hormone-sensitive prostate cancer, either metastatic (mHSPC) or nonmetastatic (nmHSPC), indicates that cancer depends on androgen for its growth, which means that blockage of male sex hormones will help to suppress cancer growth.[26] Castration-resistant prostate cancer (CRPC), either metastatic (mCRPC) or nonmetastatic (nmCRPC), means that even with blockage of male sex hormones, prostate cancer will find a way to regrow.[26]

Cost of illness studies are essential to evaluating alternative demands on scarce healthcare resources. Indicating that the disease burden has value in setting priorities in research, prevention, and treatment. In Sweden, a cost-of-illness study, from a societal perspective, calculated both the direct and indirect annual costs and showed that the proportion of the direct medical cost is 62% of the total cost, and 10% of total cost reflected productivity loss because the number of long-term prostate cancer sick leaves was more than 14 days.[27]

To provide decision-makers with evidence to build their decisions on, and given that efficient spending in healthcare is well known to be a direct predictor of better health outcomes and national wealth, we conducted our study to evaluate the cost of illness associated with different types of prostate cancer among Egyptian men from a societal perspective. To the best of our knowledge, this is the first study to assess the cost of prostate cancer in Egyptian men from a societal perspective.

Our study was conducted to assess only the cost of illness for different types of prostate cancer over a 1-year period. The total cost of the disease was considered from a societal perspective, the direct costs (including treatment, diagnosis, follow-up, and complications management) and indirect costs. The prevalence of prostate cancer among Egyptian men and the standards of care in each health state were considered inputs for this study.

METHODS

Study Design

This study was exempt from ethical committee approval. A cost of illness (COI) model was built to

estimate the costs and consequences of different health states of patients with prostate cancer in Egypt. Prostate cancer has different health states due to the nature of the disease. Each health state has different costs due to the medications received, so it should be calculated accurately in a state transition model based on disease progression. Cost quantification of the disease in Egypt was achieved using a prevalence-based method, the most used method. In this method, the cost of the disease is estimated over a 1-year time horizon. The target population was men aged 65 years and older diagnosed with localized or metastatic prostate cancer. Our COI study was conducted to simulate the same age-specific target population presented in clinical trials to accurately measure the management costs of each health state based on progression status.

Partitioned-Survival Model

A cohort-based economic analysis was built as a partitioned-survival model, including the following three health states: progression-free state, progression state, and death for nmHSPC, mHSPC, and mCRPC. All transitions between health states were assumed to occur during the 4-week cycle period. The 4-week cycle was chosen based on the nature of the disease and treatment duration to accurately estimate any change in costs or outcomes. The partitioned survival approach allows for direct modeling of progression-free survival (PFS) and overall survival (OS) based on the endpoints of clinical trials of nonmetastatic prostate cancer,[28,29] metastatic naive prostate cancer,[30] and metastatic-resistant prostate cancer.[31] The model was developed using Microsoft Excel 365.

Population Data

The prevalence of prostate cancer in Egypt among the target population was obtained from the International Agency for Research on Cancer, affiliated with the World Health Organization.[6] The number of patients with localized, metastatic castration-naive, and castration-resistant prostate cancer was captured from the Expert Panel comprising payers recruited from the Egyptian Authority for Unified Procurement, Medical Supply and Management of Medical Technology, and key oncologists recruited from Nasr City Cancer Center affiliated with the Health Insurance Organization (HIO), reflecting real-life clinical practice settings (Fig. 1). The percentages of low- and intermediate-high-risk localized prostate cancer patients were extracted from the Surveillance, Epidemiology, and End Results database of 437,150 prostate cancer patients identified in the United States.[32] The percentage of localized prostate cancer that progressed to castration-resistant was extracted from a clinical trial conducted on a cohort of 120 high-risk localized prostate cancer patients treated with androgen deprivation therapy (ADT) and external beam radiation therapy (EBRT).[33,34]

Our study included treatments used during PFS and disease progression (treatment duration was obtained from clinical trials and validated by the Expert Panel). We used a well-structured questionnaire to extract insights from the panel and then conducted data validation by comparing it with the local practice reported by the experts (Table 1).

This analysis was conducted over a period of 1 year, including the total direct costs, such as disease management, treatment-related costs (acquisition, monitoring, and adverse events), and total indirect costs. The direct healthcare costs included treating patients with localized and metastatic prostate cancer who were receiving first-line treatment of the standard of care from a societal perspective.

Clinical Parameters

All model parameters are presented in Table 2. The clinical parameters of PFS and OS for localized and two types of metastatic prostate cancer were extracted from recent and strong evidence trials, matching our local clinical practice.[28–31] Biochemical relapse-free survival of newly diagnosed localized prostate cancer patients was extracted from a phase 3, randomized controlled trial, and patients were divided into the following two groups: group A received ADT for a duration of 6 months starting 4 months before EBRT, and group B received 6 months of ADT started with radiotherapy.[29] The choice of ADT was oral antiandrogen of bicalutamide 50 mg once daily followed by 10.8 mg of goserelin given subcutaneously (SC).[29] OS of localized prostate cancer was captured from a research study based on data from the National Cancer Comprehensive Network of localized high-risk prostate cancer patients treated with ADT and EBRT.[28] The cohort was divided into the following three arms according to the initiation time of ADT before EBRT: more than 11 weeks before EBRT, 11 to 8 weeks before EBRT, or less than 8 weeks before EBRT.[28] We relied on ADT more than 11 weeks before EBRT, matching our local practice. The clinical data of newly diagnosed, metastatic, hormone-sensitive prostate cancer were extracted from a phase 3 randomized, double-blind, placebo-control trial comparing ADT with 1000 mg of abiraterone acetate daily with 5 mg of daily prednisone versus ADT alone.[30] OS and PFS data of mCRPC patients were extracted from a retrospective analysis of mCRPC patients comparing 75 mg/m^2 of docetaxel every 3 weeks received 5 mg of prednisone twice daily during the first day and through treatment with ADT against docetaxel and prednisone without ADT.[31]

All inputs for the selection, duration, and distribution of subsequent treatments were also validated by a local Expert Panel consisting of key oncologists and payers. The experts were interviewed through a questionnaire (Table 1) to collect insights and consensus on all the inputs used to represent local clinical practice. The clinical parameters of PFS and OS (transition probabilities) for each medication received in each cycle of

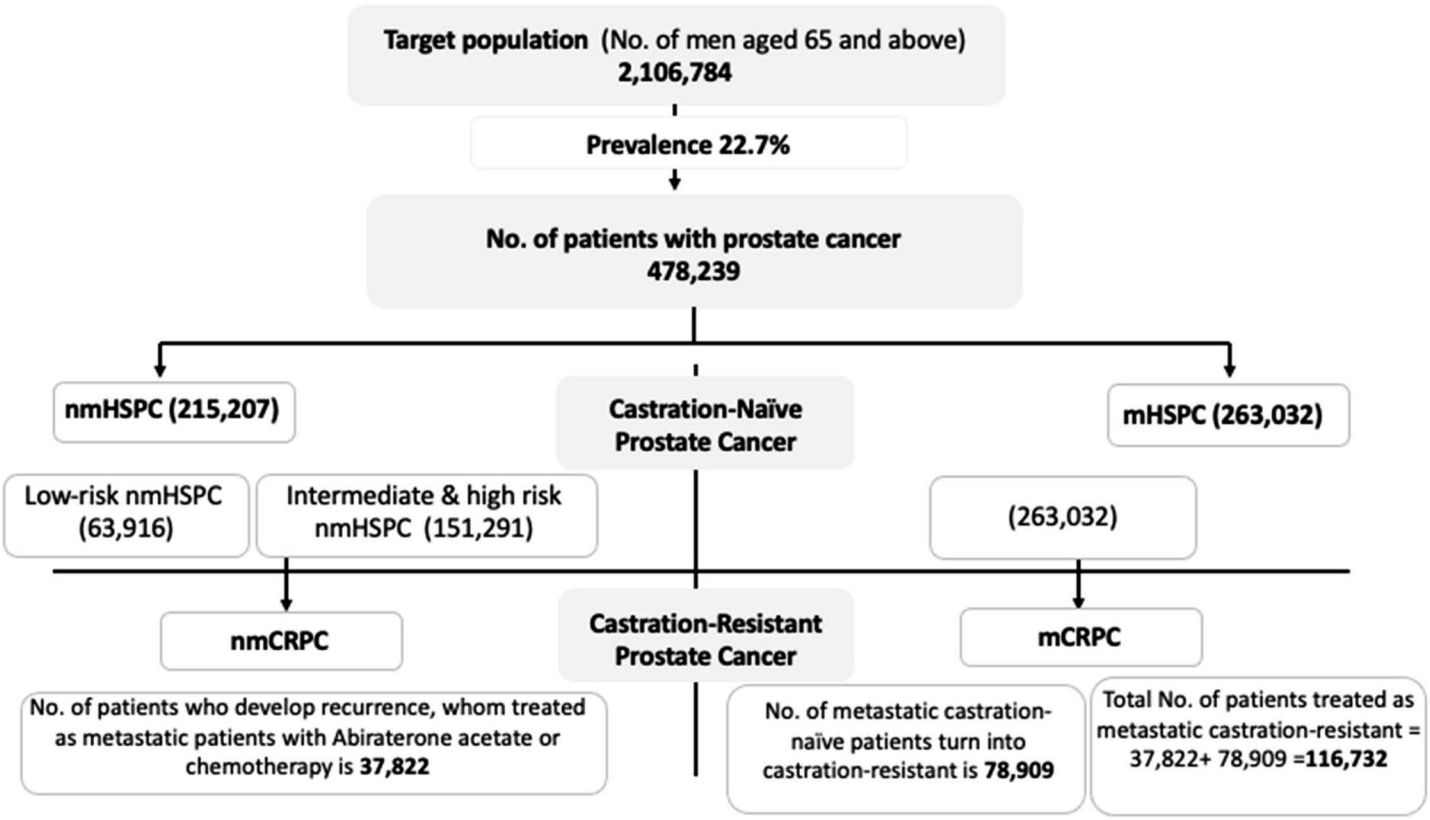

Figure 1. Target population. mCRPC: metastatic castration-resistant prostate cancer; mHSPC: metastatic hormone-sensitive prostate cancer; nmCRPC: nonmetastatic castration-resistant prostate cancer; nmHSPC: nonmetastatic hormone-sensitive prostate cancer.

health state were required to determine whether the patient would stay in a progression-free health state, progress to an advanced stage (progression state), or eventually die. The PFS and OS Kaplan-Meier (KM) survival data for patients with localized and metastatic prostate cancer in the clinical trials were extrapolated using parametric extrapolations by digitizing the relevant KM curves to recreate individual patient data. The probabilities obtained from KM curves by digitization were already in months and converted to reflect the applied cycle (4 weeks) in our COI study. We tested the exponential, Log-logistic, and Weibull parametric extrapolations using Akaike information criteria to verify the best-fitting parametric curves obtained from the KM curves. The Exponential distribution for localized PFS and Weibull distribution for localized OS were used to provide similar goodness of fit to the KM curve values.[28,29] The exponential distribution was used for both PFS and OS in patients with metastatic-naive prostate cancer, and the exponential distribution for OS and Log-logistic distribution for PFS was used for patients with metastatic-resistant prostate cancer.[30,31]

Costs

The direct medical and indirect costs were also considered. We did not include nonmedical costs because they are not paid by the healthcare system or the main payer (health insurance organization). Direct costs include the cost of diagnosis, standard care management, progression, and follow-up tests. Indirect costs were measured; however, the target population in our study ranged from 60 to 70 years, but most patients worked in private companies after retirement or could volunteer their time in charity services. Thus, these costs represent the loss of productivity over each treatment cycle, either progressed or died, estimated from the product of the number of productivity hours lost and the Egyptian patient's average wage per hour. The number of men aged over 65 was extracted from Egyptian population demographics.[35] The Egyptian average wage per hour was estimated using the most recently published gross domestic product published by the World Bank in 2020.[36] The work hours missed per cycle were calculated from a longitudinal analysis linking 2005 to 2012 medical and pharmacy claims and workplace absence data in patients in the United States.[37] The patient average wage per hour was calculated by dividing the gross domestic product per capita by 12 months, then by 22 (the number of monthly working days for one governmental employee), and then by 6 working hours per day. The total costs in EGP were converted to international dollars using the purchasing power parity rate to compare results across countries.[38]

Table 1. Expert Panel questions

Information About Diagnosis:
1. Mention all investigations required for prostate cancer diagnosis. Clarify if there is any standard of care.
2. Mention any prophylaxis, side effect management required, or hospitalization required for prostate cancer diagnosis.
3. Mention all investigations required for detection of prostate cancer metastasis. Clarify if there is any standard of care.
4. Mention any precaution or side effect management for investigation required for metastasis detection.

Hormone-Sensitive Prostate Cancer (Localized and Metastatic):
1. Mention eligible criteria used to determine type of treatment used in case of nmHSPC and mHSPC.
2. Mention therapeutic lines used in management of low risk nmHSPC, its standard of care, dose, any side effect and its management, case monitoring tests and its frequency and arbitrary end point. If reached, another management will be required.
3. Mention therapeutic lines used in management of high risk nmHSPC, its standard of care, dose, any side effect and its management, case monitoring tests and its frequency and arbitrary end point. If reached, another management will be required.
4. Mention therapeutic lines used in management of low risk mHSPC, its standard of care, dose, any side effect and its management, case monitoring tests and its frequency and arbitrary end point. If reached, another management will be required.
5. Mention therapeutic lines used in management of high risk mHSPC, its standard of care, dose, any side effect and its management, case monitoring tests and its frequency and arbitrary end point. If reached, another management will be required.

Castration-Resistant Prostate Cancer (Localized and Metastatic):
1. Mention therapeutic lines used in management of nmCRPC, its standard of care, dose, any side effect and its management, case monitoring tests and its frequency and arbitrary end point. If reached, another management will be required.
2. Mention therapeutic lines used in management of mCRPC, its standard of care, dose, any side effect and its management, case monitoring tests and its frequency and arbitrary end point. If reached, another management will be required.
3. In case of concomitant diseases, such as cardiovascular disease or any other comorbidities, would the medication change? If yes, please clarify.
4. Is there any further follow-up test required for comorbidities with prostate cancer treatment?

mCRPC: metastatic castration-resistant prostate cancer; mHSPC: metastatic hormone-sensitive prostate cancer; nmCRPC: nonmetastatic castration-resistant prostate cancer; nmHSPC: nonmetastatic hormone-sensitive prostate cancer.

The Egyptian Clinical Practice

Our prevalence-based cost of illness study represents all costs used over a 1-year period. The unit costs of diagnostic tests, follow-up tests, and hospitalization day care were provided by Nasr City Cancer Centre (NCCC; HIO, Cairo, Egypt). The unit costs of drug acquisition were extracted from the Egyptian Authority for Unified Procurement, Medical Supply and Management of Medical Technology tender lists, multiplied by the utilization of each drug extracted from the clinical trials and validated by the Expert Panel in NCCC based on the local clinical practice. The Expert Panel provided the frequency of follow-up based on local clinical practice.

All patients with prostate cancer require some diagnostic tests, including pelvic abdominal ultrasound, total and free PSA tests, and transrectal ultrasound-guided prostate biopsy, which require complete blood count (CBC), prothrombin time, international normalized ratio (INR), and twice-daily antibiotic prophylaxis for 5 days to reduce the risk of a complication-induced biopsy. According to the Gleason score calculated from the biopsy at the first diagnosis, a CT scan was performed for localized prostate cancer, while a bone scan was conducted for metastatic prostate cancer.

Once the patient was diagnosed with localized prostate cancer, he was considered castration-naive or nmHSPC because he had never received hormone treatment. Staging localized prostate cancer into low-intermediate or intermediate-high depends on the performance status, life expectancy, age, and biopsy results. Low-intermediate-risk patients applied the active surveillance method because no medication was given during this period, only monitoring with a PSA test every 6 months. Intermediate-high-risk patients underwent ADT with prostatectomy or radiotherapy. According to patient preferences and the Expert Panel, ADT with EBRT was considered the standard of care for localized prostate cancer. ADT was 3.6 mg of gonadotropin-releasing hormone agonist (goserelin) injected SC and taken monthly with antiandrogen (50 mg of bicalutamide) once daily for 6 months to downstage the size of the prostate cancer, then receiving 35-cycles of EBRT. At this stage, the required monitoring for these patients was total and free PSA plus CT scan every 3 months. With continuous monitoring and follow-up, an increase in PSA levels may occur. Therefore, testosterone level measurements and bone scans should be performed once during progression. If the testosterone level is less than 50 ng/mL, it indicates that the patient developed nmCRPC managed by ADT with radiotherapy again only if applicable; otherwise, the patient was treated as a metastatic prostate cancer patient by ADT with abiraterone acetate or chemotherapy.

A newly diagnosed mHSPC received 3.6 mg of goserelin injected SC and taken monthly with 50 mg of bicalutamide once daily plus 1000 mg of abiraterone acetate daily plus 5 mg of prednisolone daily. The required monitoring conducted at this stage was a PSA test every 3 months and a CT scan every 6 months. This patient developed metastatic castration resistance, confirmed by testosterone levels of less than 50 ng/mL.

Standardized management for mCRPC was 3.6 mg of goserelin injected SC and taken monthly with 50 mg of bicalutamide once daily plus 75 mg/m^2 of docetaxel

Table 2. Model input parameters for eligible patients

Parameter	Mean	Low Value	High Value	Source
Age (y)	65	60	70	[8]
Body surface area (m^2)	1.8	1.44	2.16	Expert Panel
Men aged ≥ 65 y (*n*)	2,106,784	1,685,427	2,528,140	[34]
Prevalence of prostate cancer among target population (%)	22.7	18.2	27.2	[6]
nmHSPC (%)	45	36	54	Expert Panel
Low-risk nmHSPC (%)	30	24	36	[27]
Intermediate and high-risk nmHSPC (%)	70	56	84	[27]
mHSPC, *n* (%)	263,031 (55)	210,425 (44)	315,638 (66)	Expert Panel
Metastatic become castration resistant (%)	30	24	36	Expert Panel
nmCRPC (%)	25	20	30	[28,29]
Treatment regimens and monitoring costs				
Pelvic abdominal ultrasound	50	40	60	NCCC
Total + free prostate-specific antigen	95	76	114	NCCC
Transrectal ultrasound biopsy	500	400	600	NCCC
Levofloxacin xx mg tablet	12	9.6	14.4	UPA
Complete blood count	35	28	42	NCCC
Prothrombin time + INR	50	40	60	NCCC
Computed tomography scan	250	200	300	NCCC
Bone scan	1260	1008	1512	NCCC
Goserelin, 3.6 mg SC	557	445	668	UPA
Bicalutamide, 50-mg tablet	18	15	22	UPA
Radiotherapy EBR/session	7440	5952	8928	NCCC
Testosterone level measurement	50	40	60	NCCC
Abiraterone acetate, 250-mg tablet	177	141	212	UPA
Prednisolone, 5-mg tablet	0.225	0.18	0.27	UPA
Cost of docetaxel vial, 80 mg	720	576	864	UPA
Dexamethasone administered with chemotherapy, 8 mg	1.6	1.28	1.92	UPA
Direct bilirubin	15	12	18	NCCC
Total bilirubin	15	12	18	NCCC
AST	20	16	24	NCCC
ALT	20	16	24	NCCC
Urea	15	12	18	NCCC
Creatinine	15	12	18	NCCC
Zoledronic acid infusion	1188	950	1425	UPA
Cost of hospital administration for infusion (day care)	450	360	540	NCCC
Survival parameters of localized prostate cancer				
Gamma_localized_PFS "Exponential"	−0.0012079297420	−0.00096634	−0.001449516	[31]
Lambda_localized_OS "Weibull"	1.6699625539912	1.33597004	2.003955065	[30]
Gamma_localized_OS "Weibull"	0.0002382286112	0.00019058	0.000285874	[30]
Survival parameters of metastatic sensitive prostate cancer				
Gamma_metastatic_naive_PFS "Exponential"	−0.0223328	−0.01786628	−0.026799418	[32]
Gamma_metastatic_naive_OS "Exponential"	−0.01256224	−0.01004979	−0.015074684	[32]
Survival parameters of metastatic castration-resistant prostate cancer				
Gamma_metastatic_resistant_OS "Exponential"	−0.02427083221	−0.01941667	−0.029124999	[33]
Gamma_metastatic_resistant_PFS "Loglogistic"	0.10200500861	0.08160401	0.12240601	[33]
Lambda_metastatic_resistant_PFS "Loglogistic"	2.703004189	2.1624033	3.24360502	[33]
Indirect costs				
Egyptian patient average daily wages	215	172	259	[35]
No of hours lost in per person quarter in cancer progression	31	25	37	[36]

ALT: alanine transaminase; AST: aspartate aminotransferase; EBRT: external beam radiation therapy; INR: international normalized ratio; mCRPC: metastatic castration-resistant prostate cancer; mHSPC: metastatic hormone-sensitive prostate cancer; NCCC: Nasr City Cancer Center; nmCRPC: nonmetastatic castration-resistant prostate cancer; nmHSPC: nonmetastatic hormone-sensitive prostate cancer; OS: overall survival; PFS: progression-free survival; SC: subcutaneously; UPA: Unified Procurement, Medical Supply and Management of Medical Technology.

every 21 days; there was a week off in addition to 8 mg of dexamethasone on days 0, 2, 3, and 4 to decrease the side effects generated from chemotherapy for 6 months, and then back to previous therapy. The required monitoring for each chemotherapy cycle included CBC, creatinine, urea, AST, ALT, total and direct bilirubin, PSA testing every 3 months, and CT scan. A bone scan was performed every 6 months. Bone strengthening agents were administered at this stage as a monthly zoledronic acid infusion, requiring hospital admission. In all treatment lines, the resources associated with health status were independent of the standard of care. All unit costs were measured in EGP in the financial year 2021.

Table 3. Total costs of both metastatic and localized prostate cancer over 1 year

Prostate Cancer	Drug Cost	Nondrug Cost	Total Costs
Localized			
EGP	41,155,038,137	293,187,203	41,448,225,341
USD	8,946,747,421	63,736,349	9,010,483,770
Metastatic			
EGP	81,384,796,471	3,762,286,092	85,147,082,564
USD	17,692,347,059	817,888,281	18,510,235,340

EGP: Egyptian pounds; USD: US dollars.

RESULTS

The number of targeted patients with nmHSPC, mHSPC, and mCRPC was 215,207; 263,032; and 116,732, respectively. The total costs for the targeted patients, including drug costs and nondrug costs over a time horizon of 1 year, were EGP 41.44 billion (USD 9.010 billion) for localized prostate cancer; for metastatic prostate cancer, they were doubled to EGP 85.14 billion (USD 18.510 billion; Table 3), which reflects a huge burden on the Egyptian healthcare system when compared with localized prostate cancer. The indirect costs for patients with localized and metastatic prostate cancer were 0.14% and 3%, respectively. The direct medical costs for patients with localized and metastatic prostate cancer represent 98.6% and 97% of the total cost, respectively.

Figure 2 shows the drug costs, nondrug costs, and total costs for localized prostate cancer and metastatic prostate cancer. It shows a large difference in nondrug costs between localized and metastatic prostate cancer. Nondrug costs were estimated at EGP 293,187,203 (USD 0.063 billion) for localized prostate cancer and EGP 3,762,286,092 (USD 0.817 billion) for metastatic prostate cancer. This significant difference in nondrug costs highlights the importance of early treatment due to the increased costs of progression and the burden of follow-up and productivity loss associated with metastatic prostate cancer.

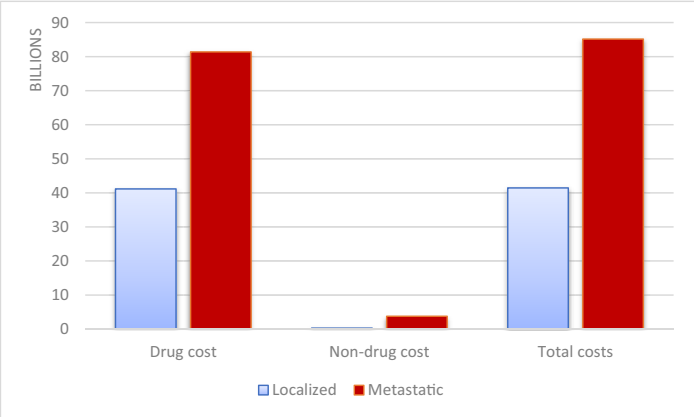

Figure 2. The total costs of localized and metastatic prostate cancer over 1 year.

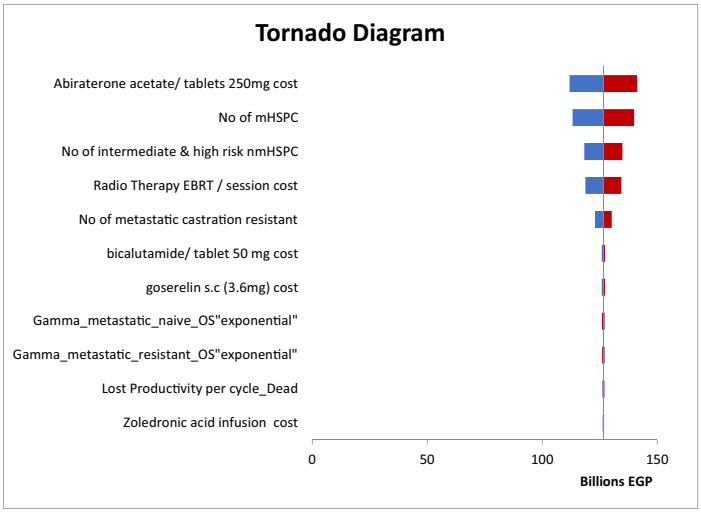

Figure 3. Results of the one-way sensitivity analyses in prostate cancer. EBRT: external beam radiaotherapy; mHSPC: metastatic hormone-sensitive prostate cancer; nmHSPC: nonmetastatic hormone-sensitive prostate cancer; OS: overall survival; SC: subcutaneously.

Sensitivity analyses were performed to test the uncertainty of the input parameters and their effect on the results to ensure robustness. Several parameters were varied, with a plausible range above or below the base-case values. The parameters tested were the population data, PFS, and OS of the standard care treatment, required follow-up and monitoring, unit costs, and resource utilization. Our analysis showed that the prevalence of prostate cancer and the number of intermediate- and high-risk localized prostate cancer patients are the most powerful parameters that can affect the results (Fig. 3).

DISCUSSION

The economic burden of prostate cancer ranges from diagnosis to management up to the end of life. Although the optimal management of localized prostate cancer is still debatable, available treatments include watchful waiting, surgery, hormone therapy, and radiotherapy.[39] These patients most likely progress to metastatic prostate cancer over time after incurring different consequences and costs. Our results show that the total cost of metastatic prostate cancer over a time horizon of 1 year was more than double that of localized prostate cancer, reflecting a huge burden on the Egyptian healthcare system and highlighting the importance of early treatment of localized prostate cancer.

A retrospective cohort study with a follow-up period of 5 years after diagnosis of localized prostate cancer in the United States showed that the cost of initial management in year 1 by hormone + radiotherapy is considered to be the highest cost (USD 17,474),

followed by surgery (USD 15,197), and the lowest cost of watchful waiting (USD 4270). The total cost of management over a period of 5 years showed that hormone therapy alone was considered the highest-cost treatment option (USD 26,896), similar to our results. Hormone plus radiotherapy had the second highest management cost over 5 years (USD 25,097), although only 70% of the total cost was only in year 1.[40] Thus, treatment choice influences the cost consequences over the short term (cost of each treatment strategy) and long term (due to pathological conditions requiring further management).[41,42] Similar results were found in another cohort of diagnosed prostate cancer patients in France with a 5-year follow-up from the perspective of the healthcare payor; they measured the direct costs and showed that 49% up to 82% of the total cost was represented by treatment, while follow-up because of determined treatment strategy represents 3% up to 11% and 2% to 3% for side effect management.[43]

An assessment of out-of-pocket expenses among patients with newly diagnosed prostate cancer with a follow-up period of 3, 6, 12, and 24 months, managed by either radical prostatectomy or EBRT, showed that the first 3 months of radical prostatectomy costs were greater than EBRT (USD 5576 vs. USD 2010). Then these costs decreased gradually over the follow-up period.[44] Furthermore, the burden of advanced metastatic prostate cancer patients mostly increases at the end of life and the time of most required healthcare management. The average number of days for prostate cancer hospitalization is 19, with a at least two palliative therapies to manage upper urinary tract obstruction caused by prostate cancer.[10] These elevated direct and indirect management costs are inversely proportional to prostate-specific health-related quality of life.[10]

Another health economic study conducted in Canada to assess the cost of different phases of prostate cancer showed that the direct cost of prostate cancer would increase during the 12 months after diagnosis with a distinct increase at 18 months before death.[10] Thus, treating patients with prostate cancer as early as possible is fundamentally important to save the progression and end-of-life costs. A similar conclusion was reached in our study.

The strengths of this study include that the clinical trials used were validated by the Expert Panel of highly reputable oncologists working in NCCC to ensure that it reflects the patient's journey and the local clinical practice in HIO. To our knowledge, this is the first study to assess the cost of prostate cancer in Egypt, which aimed to guide decision-makers to the necessity of early treatment of localized prostate cancer to lighten the burden of this disease.

The main limitation was the difficulty in estimating resource use, the number of low- and intermediate-high-risk localized prostate cancer patients, and the progressed patients in HIO owing to the lack of electronic medical records in most hospitals. Thus, we relied on international data. Another challenge faced was the inability to estimate the lost productivity of caregivers due to the lack of national registries calculating the precise prevalence of prostate cancer and its subtypes. Thus, we were obliged to rely on the Expert Panel to estimate the prevalence. It is difficult to generalize the study results because of the differences in treatment patterns, healthcare systems, resource utilization, and unit costs across different countries in the same region.

CONCLUSION

Metastatic prostate cancer has a huge economic burden on the Egyptian healthcare system compared with localized prostate cancer due to the increased costs of progression, follow-up, and productivity loss. This highlights the necessity of early treatment of these patients to save costs and lighten the burden of the disease on the patient, society, and economy.

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