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Prostate Cancer Screening, Diagnostic, Treatment Procedures and Costs in Sub-Saharan Africa: A Situational Analysis

Louise K. Makau-Barasa[1,2], Achille Manirakiza[3], Andre L. Carvalho[4], and Timothy R. Rebbeck[2]

Abstract

Purpose: Prostate cancer mortality is predicted to nearly double by 2040 in Sub-Saharan Africa (SSA). The lack of prostate cancer screening in SSA contributes to late-stage diagnosis, treatment delays, and poor survival among patients. We analyzed the availability and use of prostate cancer screening, diagnostic and treatment guidelines, procedures, and costs in few SSA countries to determine factors for consideration in the development of prostate cancer screening guidelines for SSA.

Methods: We applied mixed methods approaches to collect data through an electronic survey administered to clinicians (oncologists, urologists, pathologists, nurses, and radiation oncologists) providing prostate cancer screening, diagnosis, and treatment services in multiple sub-Saharan countries.

Results: Inconsistencies in respondents' understanding of the availability and use of prostate cancer screening guidelines in their countries were noted. Prostate Specific Antigen (PSA) and Digital Rectal Examination (DRE) were the most commonly available screening modalities. Available diagnostic procedures included a combination of prostate biopsies, transrectal ultrasonography, and DRE. Our study's data suggest that PSA and DRE exams are available for early diagnosis and screening procedures. Availability of treatment modalities with curative intent and costs for prostate cancer related procedures varied between and within countries.

Conclusions: PSA and DRE are available for detecting prostate cancer and may detect aggressive cancers early, leading to improved outcomes. However, PSA screening is also associated with overdiagnosis and over-treatment. National prostate cancer policies should consider health systems, evidence-based guidelines, population characteristics and healthcare financing to ensure access to clinically relevant and safe prostate cancer related care.

Keywords

prostate cancer, sub-Sahara Africa, screening, diagnosis, treatment, costs

Introduction

The International Agency for Research on Cancer (IARC) GLOBOCAN program estimates that Prostate Cancer (CaP) is a growing problem in Africa. CaP deaths are predicted to more than double from 47 000 in 2020 to 100 000 by 2040.[1] This projected increase is partly due to inadequate screening and treatment access, lifestyle changes associated with the continent's economic transition and socio-demographic shifts,[2-4] and an increasingly aging population of people 65 years and older, projected to reach 67 million by 2025 and 163 million

[1]West Chester University of Pennsylvania, West Chester, PA, USA
[2]Harvard TH Chan School of Public Health and Dana-Farber Cancer Institute, Boston, MA, USA
[3]King Faisal Hospital, Kigali, Rwanda
[4]International Agency of Research on Cancer, Lyon, France

Corresponding Author:
Louise K. Makau-Barasa, Harvard TH Chan School of Public Health and Dana-Farber Cancer Institute, 450 Brookline Avenue, Boston, MA 02115, USA.
Email: Lmakaubarasa@gmail.com

by 2050.[5] Majority of Sub-Saharan Africa (SSA) CaP cases are diagnosed with aggressive disease, often at late stages.[6,7] CaP screening is the process of diagnosing cancer in an asymptomatic population[8] to find cancers potentially at high risk of spreading if not treated on time.[9] Prostate Specific Antigen (PSA) test and the Digital Rectal Examination (DRE) are commonly used to screen for CaP. Studies from Europe and the US have identified potential benefits and harms but not consistently a large net benefit of CaP screening.[10,11] Findings from the 2009 European Randomized Study of Screening for Prostate Cancer (ERSPC) indicated that PSA screening resulted in a 20% lower CaP-specific mortality rate but also increased total healthcare costs for CaP, of which screening costs were a small part.[12,13] The prostate, lung, colorectal, and ovarian (PLCO) study did not find a significant mortality benefit to PSA screening, partly due to contamination of the protocol with PSA screening done outside the trial.[14] Additionally, increasing frequency of latent CaP with age can result in overdiagnosis of indolent disease and accompanying anxiety and over-treatment leading to side effects.[15]

The National Cancer Care Network (NCCN) and US Preventive Services Task Force (USPSTF), provide guidelines for CaP screening.[16,17] The American Cancer Society identifies African American (AA) men with a first-degree relative diagnosed with CaP at less than 65 years at higher risk for CaP.[18] The European Society for Medical Oncology (ESMO) recommends individualized decision making for CaP screenings and against PSA-based screening in men aged 70 years and above.[19] AA men have an aggressive disease type compared to Caucasian and Asian men.[11,12] Ongoing screening debates and CaP current guidelines for the USA, Europe, and Asia inform us about timely CaP detection and treatment approaches in these regions.

Despite predicted increase in CaP mortality in SSA, limited data exists on using CaP screening on the continent. Additionally, given the low levels of screening noted in African countries it is also very likely that patients present only when symptomatic and are therefore screened.[20-22] There have been no randomized trials of PSA or DRE in SSA to inform their potential impact on CaP mortality, nor any implemented or evidence-based screening guidelines developed using data from SSA. However, in 2019 NCCN and Africa Cancer Coalition published Harmonized Guidelines for Sub-Sahara Africa: Prostate Cancer screening, diagnosis, and treatment[23] based on consensus discussion. Data on current CaP screening practices, costs, benefits, and health systems in SSA are needed to advance responsive CaP screening guidelines and policies. Therefore, we analyzed the practices and costs related to CaP screening in SSA aimed at providing an evidence-base for CaP screening and treatment policies for SSA populations. The study goals included (1) identifying SSA's current CaP screening practices; (2) understanding how SSA's health systems and costs affect CaP screening and treatment services; and (3) identifying factors and potential solutions in designing CaP screening programs in SSA.

Materials and Methods

A survey with questions on CaP screening policies, practices, procedures, and costs was designed and electronically disseminated to clinicians providing CaP screening, diagnosis, and treatment services in SSA. The survey included questions on available CaP-specific treatment services; number of men screened; estimates of those screened referred for diagnostics; screening, diagnostic, and treatment costs; and considerations for developing responsive CaP services in each participant's location. Supplementary Information 1 and 2 contain copies of the survey. Criteria for participant countries included viability of data collection in countries with known interest in CaP prevention and control based on the availability of national cancer control plans, geographical diversity within SSA (East, West, and Southern Africa), and variety in spoken official languages (English and French).

Informed consent to participate in the study was obtained from participants over the phone (verbally) and in writing (email), using protocols approved by the Harvard T.H. Chan School of Public Health and West Chester University institutional review boards.

We evaluated relationships between CaP screening and management costs and their subsequent approaches. Kruskal-Wallis equality of populations rank tests was used to understand the relationship between (1) availability of CaP screening guidelines and numbers screened annually stratified by country; (2) availability of screening guidelines and costs; and (3) differences in diagnostic costs by country. For all tests, rejection of the null hypothesis was inferred when a two-sided alpha level of $P<.05$ was observed.

Where only data on the monthly number of patients screened were provided, an estimate of the annual number screened was calculated. Key themes were identified from responses to the open-ended question. Excel 2016 and SPSS 24 were used to perform statistical analysis. CaP screening, diagnostic, and treatment costs were obtained through the survey in local currencies. An online currency converter (www.OANDA.com) was used to convert local currency to United States dollars (US$). Foreign exchange rates corresponding to survey responses dating between July 12, 2018, and March 06, 2020, were applied.

Results

Survey respondents were identified from 12 SSA countries through the Men of African Descent Prostate Cancer (MADCaP) network, African Organization of Research and Training in Cancer (AORTIC) network, referrals from study participants, and personal contacts. An online survey link was sent to 60 potential participants from July 2018 to January 2020. Fifty surveys were completed during this period in 11 of the 12 surveyed countries. Of these, 48 (out of 50) surveys representing 96% of the surveys were completed online; one (2%) completed on a preloaded tablet (kiosk); and one (2%) completed on paper and entered manually into the online

survey portal by the PI. While some of the participants' institutions were identifiable during the consent process, this information was delinked to eliminate risks associated with information linkage, bias and to protect participants.

Table 1 summarizes the participating countries, survey response rates, and availability of national cancer guidelines in each respondents' countries. Responses from Kenya accounted for 24% (n=12), Tanzania 20% (n=10), Ghana 12% (n=6), Nigeria 6% (n=6), Zambia 6%(n=3) Zimbabwe 8%(n=4), Rwanda 6% (n=3) Ethiopia and Botswana each 4% (n=2), Ivory Coast and Senegal each 2% (n=1). No responses were obtained from Malawi.

As shown in the Table 1, 46% (n=23) of respondents were aware of national guidelines for CaP screening in their countries. While responses from Tanzania, Zimbabwe, Ghana, Rwanda, and Nigeria indicated general differences in the awareness of CaP guidelines within countries, a review of each country's guidelines indicated that their national cancer control guidelines mentioned CaP control and management.

Clinician Category and Screening Practices

Table 2 describes the distribution of specialties engaged in screening. Respondents noted that 30% of CaP screening is performed by urologists, 28% by general practitioners, 20% by oncologists, 14% by clinical officers, and 7% by nurses at their health facilities. Respondents in 6 countries also noted that, internists, public health specialists, medical officers, community physicians, and NGO workers conduct CaP screening.

Table 3 presents available CaP screening practices in the 11 study countries. PSA was reported available in the respondents' health facilities by 48% of study participants and DRE by 45% though it was unclear if these are done separately or as a single workup. The availability of Mi Prostate Score Urine Test (MiPS) and blood tests (4K) panel was reported in Nigeria, Ghana, Rwanda, and Zimbabwe.

Characteristics of Population Screened and Post-Screening Follow-up

Figure 1 summarizes the age ranges of men screened for CaP in the surveyed countries and the average number screened per year. Men between the ages of 55–65 years comprise the majority (33%) of those screened, with some countries (n=5) also screening men between 35 and 45 years.

The estimated number of men screened per year varied by respondent within each country with some noting screening less than 100 cases per year (n=4); between 100 and 500 men per year (n=23); and between 900 and 2400 cases per year (n=7). Responses were grouped and averaged by respondents' country Figure 2. However, due to the limited number of study participants, this data is not representative of the total number of people screened in each country.

Multiple clinicians conducted post-screening follow-up Table 4. Respondents indicated that most follow-up is conducted by urologists followed by oncologists and general practitioners/family doctors and to a lesser degree by clinical officers and nurses.

Diagnostic Procedures and Treatment Modalities

Reported available diagnostic procedures included DRE (n=40) and prostate biopsies (n=38). The use of transrectal ultrasonography was cited by 30 of the 46 respondents, and Positron Emission Tomography (PET) was reportedly available in Kenya and Tanzania, though it remains unclear if Tanzania had PET scan capabilities when data were collected Table 5. Though PSA was not mentioned as a diagnostic procedure, its use for screening or diagnosis is sometimes conflated. The modalities used to determine clinical stage were not asked in the survey.

Availability of treatment modalities with curative intent varied between and within countries as shown in Figure 3. During this study, these included the availability of cryotherapy in 2 countries (Tanzania and Nigeria), External Beam Radiation Therapy (ERBT) in all but Ivory Coast and Rwanda (EBRT is now available in Rwanda), brachytherapy in 5 countries (Kenya, Tanzania, Ghana, Nigeria and Zambia), surgery/prostatectomy in all but Rwanda, and chemotherapy and hormone therapy in all participant countries. Watchful waiting (n=9) and active surveillance (n=9) were reported, though it is unclear on whether they are applied in a standard manner among respondent countries.

Costs and Payment Modalities

Table 6 describes the mean cost of screening, diagnosis, and treatment as reported by the survey respondents. The majority of these CaP costs were paid for out-of-pocket, mean cost (m=$45.11, ±SD=$33.3) and through public health insurance schemes (m=$26.72, ±SD=$24.19). A combination of insurance and out-of-pocket (co-pays) (m=$17.28, ±SD=$21.82) and private insurance (m=$11.2, ±SD=$9.28) were least commonly used to pay for these services. Variations in payment modalities between countries were also reported based on the respondents' health facilities. Respondents from Ethiopia, Ghana, Nigeria, and Zimbabwe reported that at least 80% of prostate cancer patients treated at their facilities pay for services out-of-pocket. However, the study did not collect data identifying the respondents' type of health facility. Consequently, we are unable to determine differences in costs based on type of health facility.

Variation in costs within and between countries were noted, with Botswana reporting free cancer services and Tanzania and Zambia reporting free services in government health facilities. Screening modality costs also varied with PSAs ranging from $10 in public hospitals to $30 in private hospitals, DREs starting at a $10, and Transrectal Ultrasonography (TRUS) at

Table 1. Respondents by Country and Availability of National Guidelines for CaP Screening (n=50).

Country	Number of Respondents	Guidelines yes (Y)	Guidelines No (N)	Links to Guidelines	Comments
Botswana	2		✓	Botswana Multi-Sectoral Strategy for the Prevention and Control of Non-Communicable Diseases 2018–2023	2 responses A national plan for the prevention and control of non-communicable diseases. Guidelines on CaP management (screening, diagnostic, treatment) not included
Ethiopia	2		✓	Ethiopia's National Cancer Control Plan (2016–2020)	2 responses—A national plan on cancer control. Guidelines on CaP management not included
Ghana	6		✓	National Strategy for Cancer Control in Ghana 2012–2016	6 responses: 5 no; 1 yes A national cancer control strategy inclusive of a strategy to screen and treat CaP. However, guidelines on CaP management not included
Ivory Coast	1		✓	Plan Stratégique Intégré de Prévention et de Prise en Charge des Maladies non-Transmissibles en Côte D'Ivoire 2015–2019	1 response: No A national plan for the prevention and control of non-communicable diseases. Guidelines on CaP management not included
Kenya	12	✓		National Guidelines for Cancer Management Kenya National Guidelines for the Prevention and Management of Cervical, Breast and Prostate Cancer (2012)	12 responses all yes Detailed clinical guidelines for cancer screening, diagnostic, staging and treatment, and lists of potential cancer drugs
Nigeria	6	✓	✓	Nigeria National Cancer Control Plan 2018–2022	6 responses: 5 no; 1 yes A national plan on cancer control. Guidelines on CaP management not included
Rwanda	3	✓	✓	Rwanda Non-communicable Diseases National Strategic Plan 2014–2019	3 responses: 2 no, 1 yes A national plan for the prevention and control of non-communicable diseases. Guidelines on CaP management not included
Senegal	1		✓	Plan Stratégique de Lutte Contre le Cancer 2015–2019	1 response: No A national cancer control plan. Guidelines on CaP management not included
Tanzania	10	✓	✓	National Cancer Control Strategy 2013–2022	10 responses: 7 no; 3 yes A national cancer control plan. Guidelines on CaP management not included
Zambia	3	✓		Zambia's National Cancer Control Plan 2016–2021	3 responses all yes A national cancer control strategy inclusive of a strategy to screen and treat CaP. However, guidelines on CaP management not included
Zimbabwe	4	✓	✓	National Cancer Prevention and Control Strategy for Zimbabwe 2013–2017	4 responses: 2 yes; 2 no A national cancer control plan. Guidelines on CaP management not included

$40. However, based on the Kruskal-Wallis equality of populations rank tests Table 7, no significant difference in screening costs was noted between countries with and without CaP screening guidelines (P=.2717).

Diagnostic procedures included tissue biopsies, Magnetic Resonance Imaging (MRI), tumor markers, histology, and TRUS, with costs varying across countries, depending on the procedure. Table 8 indicates that using the Kruskal-Wallis

Table 2. Summary of the Distribution of Specialties delivering CaP Screening in 10 of 11 Study Participant Countries (n=47).

Patients screen by (SSA)	Ethiopia n=2	Ghana n=6	Ivory Coast n=1	Kenya n=11	Nigeria n=6	Rwanda (n=3)	Senegal (n=1)	Tanzania (n=10)	Zambia (n=3)	Zimbabwe (n=4)	Frequencies	Frequency percentage, %
Clinical officer	1	4	-	6	3	-	-	3	3	-	20	14
General practitioner/ Family doctor	2	6	-	10	5	3	-	6	3	4	39	28
Nurse	-	-	-	2	1	1	-	2	3	1	10	7
Oncologist	2	6	1	9	1		-	4	3	2	28	20
Urologist	2	6	1	9	5	3	1	7	3	4	41	30

Table 3. Frequency of Available Screening Procedures by Respondents in the Participating Countries (n=50).

Types of tests	Botswana (n=2)	Ethiopia (n=2)	Ghana (n=6)	Ivory Coast (n=1)	Kenya (n=12)	Nigeria (n=6)	Rwanda (n=3)	Senegal (n=1)	Tanzania (n=10)	Zambia (n=3)	Zimbabwe (n=4)	Frequencies	Frequency percentage, %
Blood tests (4K panel)	-	-	1	-	1	1	1	-	-	-	-	4	4
Digital rectal exam (DRE)	1	2	6	1	11	6	3	1	8	3	4	46	45
Measuring other urine (MiPS)	-	-	1	-	-	1	1	-	-	-	1	4	4
PSA test	1	2	6	1	12	6	3	1	10	3	4	49	48

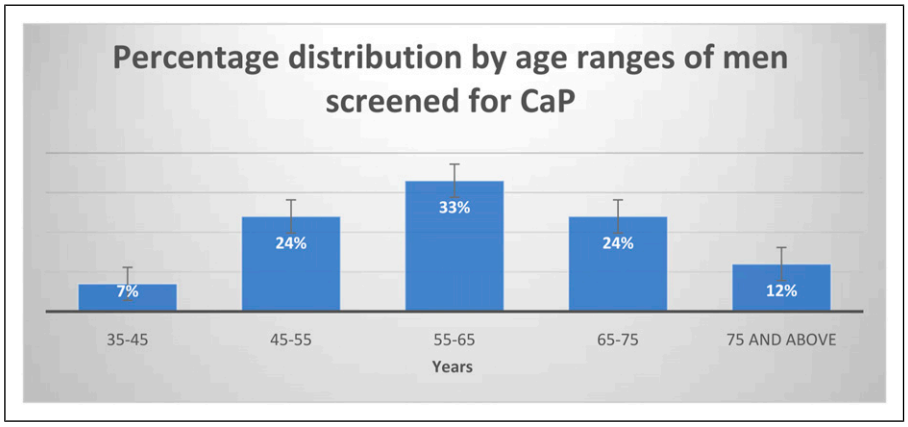

Figure 1. Age ranges of men screened for prostate cancer in participant countries (n=11).

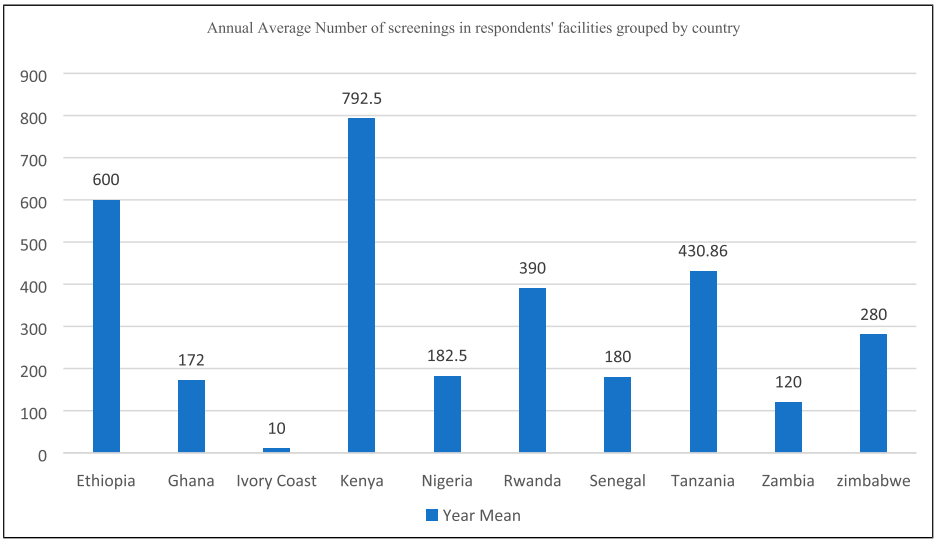

Figure 2. Average Number of Screenings Per Year Reported by Study Participants (n=34) in their Institutions by Country.

equality of populations rank tests, we noted a significant difference in diagnostic costs between countries that had guidelines and those that did not, P=.0265

Apart from Botswana, Zambia, and Tanzania, where prostate cancer treatment is also free, in 7 of the 11 countries the average cost of radiation therapy was US $2276 while surgery/prostatectomy averaged US $1428. Medical castration averaged US $824 monthly while surgical castration averaged US $512. Chemotherapy averaged US $1,168, though in Nigeria cost is dependent on drugs used with docetaxel, costing US $138 for three-week course.

Factors for Consideration if Developing National CaP Screening Programs in SSA

An open-ended survey question asked respondents' opinions of factors to consider in developing national CaP screening programs. Analysis identified three main themes from the 18 participant responses: (1) a need for culturally and linguistically relevant CaP information; (2) local evidence-based solutions to barriers to CaP screening services; and (3) the need to coordinate and regulate screening practices and ensure that downstream diagnosis, monitoring , and treatment modalities are made available.

Discussion

CaP in males of African descent has been extensively documented as being aggressive at presentation, corresponding to high mortality rates.[24,25] Elevated incidence of late-stage CaP in SSA, due partly to lack of screening, highlights the need for accessible and affordable early detection programs. Our findings indicated variations in the availability of prostate cancer services and costs. In countries like Kenya with prostate cancer screening guidelines, clinicians are likely to engage in screening,

Table 4. Summary of the Frequency of Responses by Study Participants on Patient Follow-up by Clinician Category in 10 of 11 Countries with CaP Screening (n=48).

Patient Follow-Up	Ethiopia (n=2)	Ghana (n=6)	Ivory Coast (n=1)	Kenya (n=12)	Nigeria (n=6)	Rwanda (n=3)	Senegal (n=1)	Tanzania (n=10)	Zambia (n=3)	Zimbabwe (n=4)	Frequencies	Frequency percentage, %
Clinical officer	1	1	-	1	1	1	-	1	1		7	7
General practitioner/ Family doctor	1	2	-	8	3	1	-	3	1	2	21	22
Nurse				1	1		-	1	2	1	6	6
Oncologist	2	2	1	6	1	1	-	4	1	3	21	22
Urologist	1	6	1	10	6	2	1	8	1	-	39	41

Table 5. Frequency of Available Diagnostic Procedures by Respondents in the Participating Countries (n=46).

Available Diagnostic Procedures (Facility Level)	Botswana (n=2)	Ethiopia (n=2)	Ghana (n=6)	Kenya (n=11)	Nigeria (n=6)	Rwanda (n=2)	Senegal (n=1)	Tanzania (n=9)	Zambia (n=3)	Zimbabwe (n=4)	Frequencies	Frequency percentage, %
Rectal examination	1	2	6	10	5	2	1	9	2	2	40	35
Prostate biopsy	1	2	6	10	6	1	1	7	1	3	38	34
Transrectal ultrasonography		1	6	10	5	1	1	5	1		30	27
Others								1	1	1	3	3
Positron emission tomography				1				1			2	2

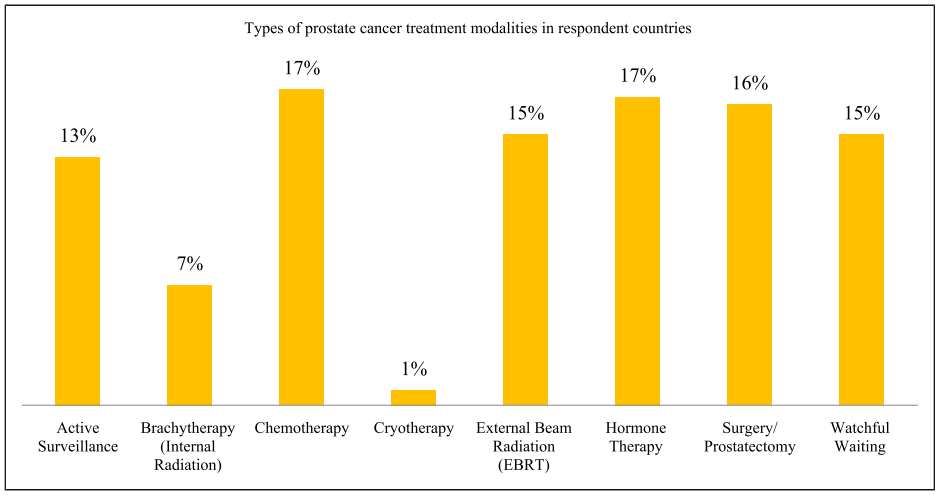

Figure 3. Types of prostate cancer treatment modalities available in respondent countries (n=11).

however, this could vary by patient load, costs, location of health facility and other factors. However, our study respondents from Botswana indicated that no screening is conducted, and clinicians only perform diagnostic procedures, an indicator of presentation by symptomatic patients. One avenue to timely detection is to develop national Cap screening guidelines that aim to reduce harm from unnecessary screening, diagnostic procedures and treatments, and applying these guidelines to the highest-risk men. However, based on the PLCO and ESRPC studies, the number of patients needed to screen to save 1 life is large, and the mortality benefit is low to non-existent.[10] Controversial in the US and Europe, this severely limits the ability to make recommendations and is particularly true in SSA due to lack of data from a randomized trial assessing the role of PSA/DRE on CaP mortality.

Variation in CaP Screening Practices

Our study reports variation in the delivery of CaP screening with most screening performed by trained medical personnel and in some cases by non-clinicians outside the medical system. Given the significance of CaP screening and timely access to treatment in optimizing patient outcomes, screenings outside of clinical settings jeopardize patients' health.

Evidence-based guidelines and policies should be developed that include a focus on regulating screening practices as part of harm reduction and protecting patients from unnecessary procedures with poor outcomes. While the present study did not evaluate screening data, some of the recommendations from study participants pointed to the need for evidence-based guidelines considerate of population and health system characteristics in each country. Consequently, we were unable to determine whether screening procedures identified cases for diagnostics and if procedures would identify tumors in need of treatment.

PSA and DRE as Primary CaP Screening Methods

Most screening programs abide by common prevention guidelines with PSA and DRE, and the age range at screening follows ranges reported in major screening trials undertaken outside of SSA.[26] Controversies surrounding the use of PSA testing for CaP screening can contribute to gaps in screening practices in SSA countries without specific CaP screening guidelines. Our study indicated availability of PSA and DRE testing for both screening and diagnosis. Some studies have recommended the use of PSA test results to establish baselines for follow-up.[27,28] While we did not measure median PSA levels in each country, studies indicate that PSA levels in SSA tend to be high partly because many tests are done for diagnostic purposes. Thus, the PSA values often reflect advanced disease.[29] Future studies can determine median PSA levels among African men in SSA and apply this information to develop CaP screening guidelines and protocols for SSA.

Our study's data and other literature suggest that PSA and DRE exams are available in the study countries and potentially used more opportunistically for early diagnosis procedures than for screening. NCCN guidelines recommend not using DRE as a stand-alone test but as a secondary screening in men with elevated PSA levels.[14] However, using PSA in conjunction with DRE may enhance early CaP detection.[30] The extent to which these two exams are used together merits further investigation due to evidence supporting their efficacy in the early detection of CaP and in determining existing and required resource levels that would make these tests sufficiently available in response to SSA's predicted CaP burden.

Paying for CaP Screening, Diagnostic and Treatment

Screening, diagnostic, and treatment costs are a major barrier for some SSA populations that pay out-of-pocket.[19] Financial

Table 6. Mean Screening, Diagnostic and Treatment Costs by Respondents'. Country (USD) in 7 of 11 Study Participant Countries (n=40).

	Ethiopia (n=2)	Ghana (n=6)	Kenya (n=11)	Nigerian (n=6)	Senegal (n=1)	Tanzania (n=10)	Zimbabwe (n=4)	Total Mean Costs Based on Study Responses
Screening	7.66 (0–15.33)	30.03 (17.67–53.00)	30.69 (9.9–49.5)	127.71 (11.07–415.31)	44.53	32.85 (4.37–50.00)	129.33 (10–358)	61.14 (0–415.31)
Diagnostic exam	108.11 (62.88–153.33)	61.83 (17.67–141.34)	76.86 (5.37–237.62)	316.42 (27.69–969.05)	71.26	132.96 (21.87–437.31)	30.72 (20–41.45)	136.15 (5.74–969.05)
Radiation therapy	94.32	4350.70 (1590.11–9893.99)	971 (6.93–2079.21)	1108 (276.87–1664.83)	-	2623.83 (1311.92–3498.45)	3535 (70.46–7000)	2276.18 (6.93–9894)
Surgery/ prostatectomy	31.44	1233 (0–3533.57	1403.46 (19.8–2970.30)	1995.96 (410.66–6243.10)	1247.09	465.97 (43.73–1311.92)	7000 (7000–7000)	1427.87 (0–7000)
Medical castration	279.09 (251.53–306.65)	1382.51 (265.02–3180.21)	1579.21 (178.22–2970.30)	332.61 (69.37–692.18)	178.16	983.93 (174.92–2.623.83)	213.81 (27.63–400)	823.57 (27.63–3180.21)
Surgical castration	84.52 (15.72–153.33)	265.01 (88.34–530.04)	1452.15 (891.09–2475.25)	445.35 (69.37–1079.80)	178.16	306.64 (65.6–874.61)	1500 (1500–1500)	511.98 (15.72–2475.25)
Chemotherapy	235.81 (235.81–235.81)	1098.94 (265.02–2650.18)	2599.01 (1485.15–4455.45)	796.83 (138.74–1661.24)	1068.94	869.15 (153.06–1749.22)	340.79 (331.58–350)	1168.61 (138.74–4455.45)

Table 7. Kruskal-Wallis Equality of Populations Rank Test-Differences in Screening Costs between Countries with or Without Screening Guidelines.

Guidelines	Observations	Rank sum
Botswana	2	20.00
Ethiopia	2	35.00
Ghana	5	165.00
Ivory Coast	1	10.00
Kenya	12	235.00
Nigeria	6	203.00
Rwanda	3	62.50
Senegal	1	40.00
Tanzania	10	243.50
Zambia	3	65.00
Zimbabwe	3	9700

chi-squared = 12.203 with 10 d.f.
probability = .2717.
chi-squared with ties = 13.011 with 10 d.f.
probability = .2231.

Table 8. Kruskal-Wallis Equality of Populations Rank Test—Differences in Diagnostic Costs by Country.

Country	Observations	Rank sum
Botswana	2	17.00
Ethiopia	2	73.00
Ghana	5	149.00
Ivory Coast	1	8.50
Kenya	12	217.00
Nigeria	6	219.00
Rwanda	3	25.50
Senegal	1	36.00
Tanzania	10	285.50
Zambia	2	27.50
Zimbabwe	2	50.00

chi-squared = 20.307 with 10 d.f.
probability = 0.0265.
chi-squared with ties = 21.196 with 10 d.f.
probability = 0.0198.

toxicity remains a challenge for many cancer patients.[31,32] In SSA, financial costs are one of the barriers to cancer care, contributing to sub-optimal screening, low patient follow-up, and incomplete treatments.[33] Although our study indicates that CaP screening (considering the screening test) is relatively inexpensive, diagnostic and treatment cost could deter populations from screening. Appropriate use of screening aimed at high-risk men can help mitigate financial toxicity compared with experiencing a late-stage cancer diagnosis in the interest of improving patient outcomes, quality of life, and survival.[34] Some actions could include disclosing treatment costs to patients, influencing insurance policies including national universal health care (UHC) policy, and negotiating drug prices and costs of palliative care.

While treatment modalities in our participant countries are unchanged, Rwanda has since added EBRT, though it is not part of the country's free cancer treatment program. Given the projected increase in CaP cases and deaths in SSA and the continent's positive economic growth,[35] there is a need for SSA CaP guidelines to address costs related to cancer services. Global attention for UHC and Sustainable Development Goals[36] (SDGs) require countries to take actions to improve access to quality health services while lessening financial hardship.[37,38]

While this study provides important insights into the availability of prostate cancer prevention and control services in the participant countries, it also has several limitations. These include the fact that key informants were mostly clinicians and, a focus on this population could mean that the actual costs of screening and management services remain unknown in these countries. We also recognize that the data set is not representative of all hospitals or care centers in the participants' countries. In addition, the lack data on the type of health facility impeded our ability to fully analyse the costs and availability of prostate cancer screening, diagnosis and treatment services across each study participant country. Data on the age categories of people seeking prostate cancer services resulted in the potential inclusion of people in more than one group. As such, the results presented here are limited and not generalizable to the study countries and sub-Sahara Africa. Including administrative staff and focusing on countries with similar payment mechanisms can improve our understanding of the impact of costs on CaP screening while informing policy actions.

We recognize that the data set is not representative of all hospitals or care centers in the studied countries. In addition, not all health facilities in each country provide cancer screening, diagnostic and treatment.

Factors for Consideration if Developing National CaP Screening Guidelines in SSA

That there will be a large randomized controlled trial of PSA/DRE to assess CaP mortality benefits in SSA is unlikely in the foreseeable future. Thus, data of that kind presented here as well as observational study data may be required to recommend whether to screen or not.

Provider-patient communication can educate patients about CaP screening and promote informed decision making.[39] Our study found that culturally and linguistically relevant community-based education on CaP should be considered when developing national CaP screening guidelines, indicating a need for evidence-based solutions grounded in local research.

Free or subsidized screenings and inclusion in national insurance schemes were cited as solutions to screening and treatment costs. Respondents shared concerns about erratic screening practices in some locations and called for

standardized procedures and regular auditing of centers conducting CaP screening to ensure compliance and accurate interpretation of results.

Conclusion

Our results suggest that PSA and DRE are available for early diagnosis and screening. However, the use of these tests should be improved with data from evidence-based practices leading to timely detection, treatment, and better clinical outcomes. Observed variations in the costs of oncology services within and between countries could be potentially attributed to differences between public and private facilities, subject to data identifying costs based on types of institutions. National CaP screening programs should be evidence-based and consider the country's population characteristics, CaP epidemiology, health system, and financing model.

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Author's Note

Where authors are identified as personnel of the International Agency for Research on Cancer/World Health Organization, the authors alone are responsible for the views expressed in this article and they do not necessarily represent the decisions, policy or views of the International Agency for Research on Cancer/World Health Organization.

Ethics Approval

This study was approved by the Harvard T.H. Chan School of Public Health on 05/03/2018 under protocol # IRB 18-0367 and West Chester University institutional review boards on 08/15/2018 under protocol ID # 20180816A.

Statement of Informed Consent

Written and verbal informed consent was obtained from study participants in line with the IRB approvals.

ORCID iD

Louise K. Makau-Barasa https://orcid.org/0000-0002-4044-6459

Supplemental material

Supplemental material for this article is available online.

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Abbreviations

Nomenclature

AA	African American
AORTIC	African Organization of Research and Training in Cancer
CaP	Prostate Cancer
DRE	Digital Rectal Examination
EBRT	External Bean Radiation Therapy
ERSPC	European Randomized Study of Screening for Prostate Cancer
ESMO	The European Society for Medical Oncology
IARC	The International Agency for Research on Cancer
MADCaP	Men of African Descent Prostate Cancer
MiPS	Mi Prostate Score Urine Test
MRI	Magnetic Resonance Imaging
NCCN	The National Cancer Care Network
NGO	Non-Governmental Organization
PET	Position Emission Tomography
PLCO	Prostate, Lung, Colorectal and Ovarian
PSA	Prostate Specific Antigen
SDG	Sustainable Development Goals
TRUS	Transrectal Ultrasonography
UHC	Universal Health Care
US$	United States Dollars
USPSTF	US Preventive Services Task Force