Potential Cost-Effectiveness of Universal Access to Palliative Care for Women with Advanced Breast Cancer in Uganda

Patricia Rodriguez

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Joseph Babigumira
Marcia Weaver

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Abstract

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Patricia Rodriguez

Chair of the Supervisory Committee:
Joseph B. Babigumira MBChB, MS, PhD, Associate Professor
Global Health

Background: While Uganda has a relatively advanced palliative care system developed for people living with HIV, palliative care services are unavailable to most Ugandans who need them. Incidence of advanced breast cancer is increasing and advanced breast cancer patients may benefit from access to home-based palliative care.

Objective: We evaluated the potential cost-effectiveness of a universal, home-based, palliative care program for women with advanced breast cancer, compared to the standard of care, which involves limited access to palliative care.

Methods: We used a decision-analytic model that utilized estimates from the literature to estimate the incremental cost, incremental effectiveness, and incremental cost-effectiveness ratio (ICER) of providing universal access to palliative care. One-way and probabilistic sensitivity analyses were performed to explore the effects of parameter uncertainty.

Results: With an incremental cost effectiveness ratio (ICER) of $I 211,850 (UGX 242,753,988) per disability adjusted life year (DALY) averted, the universal palliative care program was not cost effective by the frequently cited threshold of three times gross domestic product per capita ($I 5,546). The program is relatively low cost (incremental lifetime cost per patient: $I 1,378, UGX 1,578,480). The high ICER is driven largely by a very small marginal difference in disability weight for end-of-life patients with and without palliative care. The model was also sensitive to ongoing staff and transport costs, and costs and use of Amitriptyline (antidepressant) and Biscodyl (laxative).

Discussion: Our analysis is highly sensitive to the incremental disability weight from palliative care, estimates of which vary in the literature and are not specific to our population or intervention of interest. Further research is needed on interventions to improve care at the end of life and measures of their benefits.

Introduction

Globally, breast cancer is the most common cancer occurring in women, in both high and low income countries.[1] Mortality from breast cancer is appreciably higher in developing countries than in developed countries. Late stage at diagnosis contributes to poor survival outcomes in low-income countries. 77% - 89% of breast cancer cases in Uganda present with advanced stage breast cancer (stage III or IV), at which point cure is not a realistic outcome given the absence of available treatment.[2–4] During the time between breast cancer diagnosis and death, women with advanced-stage breast cancer experience significant pain and distress. Palliative care interventions can improve quality of life for both patients and caregivers. It can include treatment of disease symptoms, such as pain, and spiritual and psychosocial support.

Uganda has achieved the highest rating possible for integration of palliative care services.[5] The Ministry of Health has been highly supportive of palliative care in Uganda, including providing morphine free of charge, allowing nurses with specialized training to prescribe morphine, and including palliative care in medical school curriculum. [6–8] Yet evidence shows that there is still a large unmet need for palliative care in the country. The Ministry of Health estimates that only 10% of people who need palliative care services are able to access them.[9] Those who do receive palliative care in Uganda have higher levels of physical and psychological distress, and a greater number of symptoms than similar patients in the US and China, with pain being the most prevalent problem.[10] At Mulago Hospital, the national referral hospital, the majority of cancer inpatients (86%) reported pain, and only 8% of those with the most severe pain were receiving morphine.[11] Under-prescribing is common, despite policy changes and provider education. [12] Ensuring availability of morphine has also been a challenge.[13–16]

While the economic evaluation literature on palliative care in high income countries is fairly robust, very few published studies have evaluated the cost-effectiveness of palliative care in low-income settings.[17] We did not identify any published cost-effectiveness-studies on palliative care for cancer patients in Uganda with benefits measured in disability-adjusted life-years. A 2006 study by Foley et al. evaluated the cost effectiveness of complete morphine coverage in Uganda, with benefits measured in pain-free days.[18] In 2012, Zelle et al. evaluated the cost effectiveness of a breast cancer control program in Ghana, which included a palliative care component.[19] The Breast Health Initiative has also published recommendations for supportive and palliative care interventions for breast cancer at varying resource levels. [20,21]

We evaluated the cost-effectiveness of universal access to a home-based palliative care program, compared to the standard of care, for women with advanced breast cancer in Uganda. We took a health sector perspective.

Methods and Data

Overview of Study Design and Scope

Intervention

The intervention is a home-based palliative care program, where palliative care specialist nurses deliver care and support to patients at the end of life through home visits. Home visits occur weekly, on average, though the frequency can vary based on patient needs. Patients at the end of life in Uganda prefer to be cared for at home.[22] However, both patients and caregivers have expressed the challenges of home care, where caregivers feel they have inadequate knowledge to care for their loved ones [23] A home-based palliative care program could allow patients to stay in their homes by providing direct care to the patient and sharing knowledge with

the patient's primary caregiver. Home-based models have been effective at expanding access to palliative care in African countries. [24] Home-based palliative care can be especially effective for increasing access in rural settings, where there may be significant barriers to accessing outpatient facility based care.[25] Primary concerns related to outpatient facility-based care are long-travel times to the facility and drugs not being available at the facility.[13,26] Inpatient models are more expensive and are generally not considered appropriate in African countries.[27]

Setting and location

Uganda has seen a rapid increase in breast cancer incidence in recent decades, with incidence increasing 3.7% annually from 1991 to 2010.[28] The Global Burden of Disease study estimates annual breast cancer incidence of 17.6 (8.3 - 36.5) per 100,000 women.[29] On average, women in Uganda wait 29 months between noticing symptoms of breast cancer and seeking care.[30] With a tumor doubling time of 130 days, tumor size would double nearly 7 times during this period. [30] Treatment options are often limited to surgery and/or radiation; chemotherapy is minimally available. [3,31] Amoung patients who receive chemotherapy, only 29% complete the recommended six cycles.[3]

Palliative care options are also limited. Most palliative care service provision occurs through not-for-profit specialist palliative care organizations, who are largely funded by external donors.[8,32] Some palliative care has been integrated into the public health system, with palliative care units or programs at the national and regional referral hospitals, as well as some district hospitals.[8] At a health center level, palliative care services are limited, particularly in rural areas.[32]

Target population and subgroups

The study population is a hypothetical cohort of women diagnosed with advanced breast cancer (stage III or stage IV) in 2016 in Uganda. The cohort was derived using estimates of the female population, the annual breast cancer incidence in females, and the percent of breast cancer cases that present with stage III or IV disease. Parameter values and sources are presented in Table 1.

Comparators

The hypothetical cohort was modelled in the setting of current access to palliative care (standard of care) or universal access to palliative care (hypothetical intervention). Currently, palliative care is estimated to be available to 10% of Ugandans who need it. [9] We assumed that the same access was true for women with advanced breast cancer.

Time horizon

Costs and outcomes were considered for a lifetime time horizon for the hypothetical cohort of women in the analysis. The majority of women (65%) diagnosed with stage III or IV breast cancer in Uganda survive less than 5 years,[2] so in this case the lifetime time horizon represents a relatively short and appropriate amount of time (see 'intervention effectiveness' below).

Study perspective

The costs and benefits of the intervention were evaluated from a health sector perspective, which includes all supply-side costs, both those incurred by the government and by specialist palliative care organizations. Because we took a health sector perspective, direct non-medical costs borne by the patient, such as transportation, room and board while seeking care,

and child care were excluded. Costs accrued to informal caregivers, which may represent a significant societal cost, were not considered in this analysis.

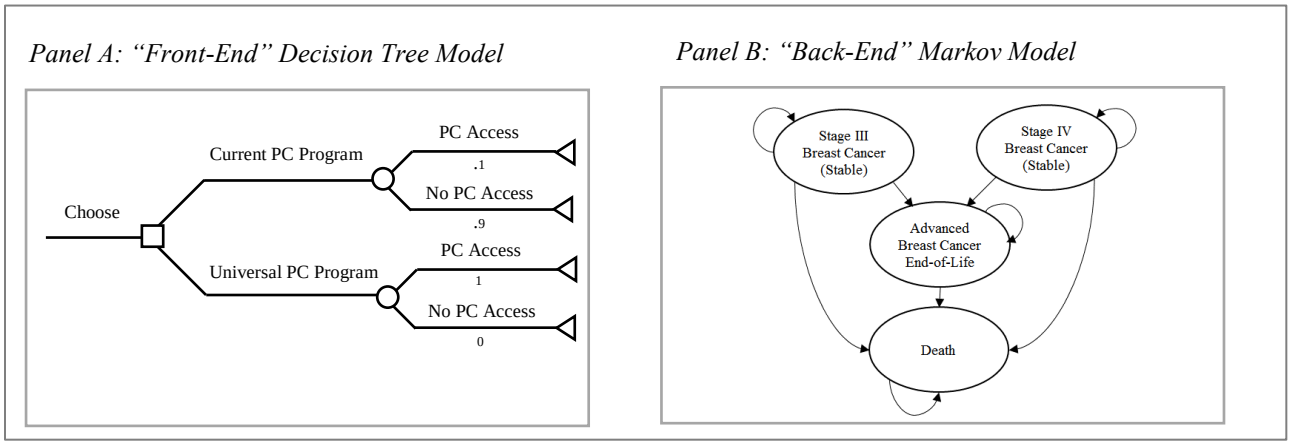
Analytic Approach

Model

We evaluated the universal palliative care intervention using a decision analytic model. We modeled access to palliative care in a "front-end" decision tree and disease progression in a "back-end" Markov model. Modeling was performed using TreeAge Pro 2017.

The "front-end" decision tree (Figure 1, Panel A) was used to model access to palliative care under the current program and the intervention. Under both the current and universal palliative care programs, patients may either have access to palliative care or not.

Figure 1: Decision Model



The "back-end" Markov model (Figure 1, Panel B) models the progression from stage III or IV cancer diagnosis to death, in order to estimate costs and outcomes. This simple Markov model includes four mutually exclusive health states: stage III breast cancer (stable), stage IV breast cancer (stable), advanced breast cancer (end-of-life), and death. While breast cancer

presents many possible paths and complications, simple Markov models have been common in economic evaluations of breast cancer in low-income countries.[19,33–35]

The cohort begins in the stable breast cancer states, either stage III or stage IV. All individuals dying of breast cancer transition to the end-of-life state for the final 90 days of their life. This transition is defined by survival parameters, described in 'intervention effectiveness' below. The end-of-life state is modeled a tunnel state, requiring individuals to stay in the end-of-life state for 3 time steps (3 months). While consensus has not been reached on the definition of end-of-life, this model assumes the end-of-life is defined as the final 90 days of life.[36] An earlier cost-effectiveness study, Foley et al. estimated that on average, patients with cancer in Uganda require morphine for 90 days.[18] Individuals who die of unrelated causes (background mortality) can move from stable breast cancer (stage III or IV) to death. Background mortality rates are based on the probability of death by five year age band[37], divided by 60 to obtain the monthly probability of death.

The model uses a one-month cycle time. Because a lifetime time horizon is used, the number of cycles is defined by the amount of time for all patients to progress to the death state. Traditional half-cycle correction was used to account for transitions occurring throughout the cycle, rather than at the beginning or end.

Sensitivity Analysis

One-way sensitivity analysis was conducted to identify the individual parameters to which the model is most sensitive. Uncertainty ranges were based on 95% confidence intervals when available. If confidence intervals were not reported, we assumed a variance of +/- 50% of baseline for costs and +/- 20% of baseline for probabilities and percentage values.[38,39]

As recommend by the Second Panel on Cost-Effectiveness in Health and Medicine, we also performed probabilistic sensitivity analysis (PSA) to characterize parameter uncertainty in our model.[40] The PSA was performed with 1,000 draws. Parameters and selected distributions are presented in Table 1. We used a beta distribution for parameters that could only take values between 0 and 1 and a gamma distribution for costs. For the incremental difference in the disability weight with and without palliative care, described in detail below, we used a uniform distribution. A normal distribution was used for other parameters. To specify each parameter's distribution, we used the base-case value as the mean, and estimated standard error by assuming the range (see Table 1) approximated a 95% confidence interval. [38] We did not vary survival or background mortality in our sensitivity analysis. These transition probabilities are the same between the intervention and standard of care, and vary based on time and age, respectively.

Intervention Effectiveness

Health outcomes were measured in terms of disability-adjusted life-years (DALYs). This measure incorporates both length of life and quality of life. DALYS allow for comparison of health outcomes across interventions, making them more useful to policy-makers than outcomes measured in natural units such as pain-free days. DALYs were selected (over quality-adjusted life-years) due to the availably of disability weights for terminal phase cancer with and without medication.

The hypothetical benefits of palliative care could include both small extensions in survival time and increases in quality of life. While some studies suggest that palliative care interventions could be associated with increased survival,[41,42] most research finds no difference in survival between patients who receive palliative care and those who do not.[43–47] In addition,

prolonging survival is not a goal of palliative care. As such, we assumed survival did not vary between the intervention and standard of care.

Local survival data was used to determine the transition probability from breast cancer diagnosis to end-of-life for both the intervention and standard of care. A study by Galukande et al. provided probability of survival at 12, 24, 36, 48, and 60 months from diagnosis, by stage at diagnosis for breast cancer patients at a tertiary care facility in Kampala.[2] From this we calculated probability of death at each time, given survival up to that time. We divided these annual probabilities of death by 12 to obtain the monthly probability of death. This assumes that probability of death is constant from 1-12, 13-24, 25-36, 37-48, and 49+ months. For all cycles after 60 months, we used the probability of death at 60 months. Due to limited survival information, we assumed that the time-dependent probability of death was equivalent to the probability of progressing to end-of-life, in effect delaying the time-to-death by 3 months. Because progression and survival do not vary between the standard of care and intervention, this assumption has minimal impact on the outcomes of our model

To estimate difference in quality of life associated with receiving palliative care, we considered data from several sources. In a review of the literature, we did not identify any studies that measured utility for end-of-life cancer patients receiving palliative care and patients not receiving palliative care. For our baseline analysis, we relied on the difference in disability weights from the Global Burden of Disease (GBD) 2013 study for the health states 'terminal phase: with medication (for cancers, end-stage kidney or liver disease)' with a disability weight of 0.54 and 'terminal phase: without medication (for cancers, end-stage kidney or liver disease)' with a weight of 0.57. [48] This difference is .03, or 3%.

Evidence from other studies and expert opinion suggests that the difference in disability weights estimated by GBD is too small. During the final months of life, patients with cancer can experience a multitude of physical and emotional symptoms that reduce quality of life, including moderate to severe constant pain.[49–51] In a study by Patrick et al, many participants (both healthy individuals and nursing home residents) rated constant pain as equal to or worse than death, meaning a disability weight of one or more.[52] Another small study on the utility of opioid pain relief found that the utilities of health states with well controlled pain were consistently 0.26 to 0.31 higher than states with the same side effects and poorly controlled pain (on a 0-1 scale).[53] To reflect the uncertainty of the incremental difference in quality of life in the literature, we assigned a broad sensitivity range for this parameter, from 0.03 – 0.46. We used a uniform distribution in our PSA, meaning all values from .03 to .46 are equally likely.

Table 1: Parameter Estimates

Parameter	Baseline Value	Range	Distribution	Source
Epi				
Breast Cancer Incidence (per 100,000)	17.62	8.3 - 36.5	Gamma	[29]
Age at diagnosis	45	40.5 - 49.5	Normal	[54]
% of all BC cases stage 3 at diagnosis	72.7%	69% - 78%	Beta	[2]
% of all BC cases stage 4 at diagnosis	16.7%	16% - 22%	Beta	[2]
Background Mortality (5-year prob. of death, by age)				
15 - 19	0.01	-	-	[37]
20 - 24	0.02	-	-	[37]
25 - 29	0.02	-	-	[37]
30 - 34	0.03	-	-	[37]
35 - 39	0.03	-	-	[37]
40 - 44	0.04	-	-	[37]
45 - 49	0.04	-	-	[37]
50 - 54	0.05	-	-	[37]
55 - 59	0.06	-	-	[37]
60 - 64	0.09	-	-	[37]
65 - 69	0.13	-	-	[37]
70 - 74	0.21	-	-	[37]
75 - 79	0.32	-	-	[37]

80 - 84	0.47	-	-	[37]
Costs				
Morphine				
Morphine - Cost per month	$I 11.94	$I 5.97 - 17.91	Gamma	[55]
Morphine - % requiring	80%	64% - 96%	Beta	[18]
Other Pharmaceuticals				
Antidepressant - Cost per mg	$I 0.14	$I 0.07 - 0.21	Gamma	[56]
Antidepressant - mg per dose	75	37.5 - 112.5	Beta	[57]
Antidepressant - % requiring	41%	33% - 49%	Beta	[19]
Antiemetic - Cost per mg	$I 1.93	$I 0.97 - 2.9	Gamma	[56]
Antiemetic - mg per dose	1.5	0.75 - 2.25	Beta	[57]
Antiemetic - % requiring	35%	28% - 42%	Beta	[19]
Laxative - Cost per mg	$I 0.34	$I 0.17 - 0.51	Gamma	[56]
Laxative - mg per dose	10	5 - 15	Beta	[57]
Laxative - % requiring	100%	75% - 100%	Beta	[19]
Morphine - Cost per month	$I 11.94	$I 5.97 - 17.91	Gamma	[55]
Morphine - % requiring	80%	64% - 96%	Beta	[18]
Ongoing Program Costs*	$I 300.92	$I 150.46 - 451.38	Gamma	[55]
One-Time Program Costs*	$I 4.89	$I 2.45 - 7.34	Gamma	[55]
Disability weights				
Incremental disability without PC	.03	.03 - .46	Uniform	[52,53,58]
Other				
Exchange Rate (2016 UGX to 2016 $I)	1,145.8	-	-	[59]
Exchange Rate (2016 UGX to 2016 USD)	3,420.1	-	-	[59]
Discount Rate	3%	-	-	[40]

* Values have been adjusted to reflect per patient per month costs

Intervention Cost and Resource Use

We reported all costs in 2016 international dollars and Ugandan shillings (UGX). International dollars adjust for purchasing power parity, allowing for comparison across countries. Prices provided in USD were first converted to 2016 Ugandan Shillings using official exchange rates from the World Bank, then converted to international dollars using the 2016 Purchasing Power Parity (PPP) conversion factor published by the World Bank.[59] All costs used in this analysis were originally reported in 2016 currency, so we did not adjust for changes in the consumer price index over time.

Costs were derived from published sources. Due to limited information, both gross costing and micro costing methods were used, based on availability of cost information. Because survival is assumed to be the same regardless of intervention, we focused exclusively on costs related to the intervention, as recommended by the Second Panel on Cost-Effectiveness in Health and Medicine.[40] We did not include unrelated costs, such as differences in other health or non-health resources used between the two intervention arms. We divided health costs into four categories: morphine costs, other pharmaceutical costs, ongoing program costs, and one-time program costs.

Morphine Costs

We identified appropriate pain management drugs and doses based on the literature.[57,60,61] While use of the WHO analgesic ladder is recommended for pain management, published sources suggest that morphine alone can be used for pain management in end-stage cancer patients in Uganda, because step 1 drugs are not effective in end-of-life cancer patients[61] and the step 2 analgesic, codeine, is substantially more expensive than the step 3 analgesic, morphine.[56,61] Morphine preparation in Uganda uses morphine powder mixed with water, a cheaper preparation than tablets.[6,18] Hospice Africa Uganda is responsible for preparing this morphine formulation for the whole country. Injectable morphine is not used.[6]

Morphine is paid for by the government and provided free of charge to patients, so market prices are not available. The most reliable information about morphine costs came from Hospice Africa Uganda. It estimates the cost of morphine for a palliative care patient for be $2 USD (I$ 5.97) per week in 2016. 80% of patients are estimated to require morphine.[18]

Other Pharmaceutical Costs

Three other pharmaceuticals were included to address pain not responsive to morphine or side effects of opioids: a tricyclic antidepressant for neuropathic pain (Amitryiptyline), a laxative (Bisacodyl), and an antiemetic (haloperidol). Other side effects of opioids, such as sedation, respiratory depression, and hallucinations are assumed to be managed through adjustments to opioid dosing, rather than additional pharmaceuticals, as is recommended in Uganda.[61]

A micro-costing approach was used to estimate the cost of these drugs. The African Palliative Care Association (APCA) handbook was used to estimate doses and preferred drugs. Unit costs are from the Joint Medical Stores Uganda current price catalogue, which represents the market price for these drugs.[56] Published sources were used to estimate the percent of the population requiring each.[19,61]

Ongoing Program Costs

Ongoing program costs include all non-drug costs related to delivery of home-based care, including labor and transportation. A gross-costing approach was used to estimate these costs, as reliable micro-cost data was not available. Hospice Africa Uganda reports a per patient per week cost of USD $26 (I$ 75.23).[62]

One-Time Costs

Increasing access to palliative care will require an increase in the workforce able to prescribe morphine. To legally prescribe morphine, nurses must complete a nine-month program in palliative care. Tuition for this program was included as training costs.[55] Training costs were annuitized over a five year period.[63] Because of a shortage of trained palliative care nurses in Uganda[26], we assumed these nurses would be fully utilized. We estimated a nurse can see 120

patients a year (30 patients at a time[64], each seen for 3 months[18]), resulting in 600 patients seen per nurse over 5 years. We assumed no change in capital costs.

Discount rate

Future costs and outcomes were discounted at a rate of 3% annually as recommended by the Second Panel on Cost-Effectiveness in Health and Medicine.[40]

Results

Our cohort included 2,780 (1,302 – 5,761) women with stage III or IV breast cancer at diagnosis. The average age at diagnosis was 45 years. 81.3% of our cohort had stage III breast cancer at diagnosis (72.7% / 89.4%), while 18.7% percent had stage IV (16.7% / 89.4%). The median time to death in our cohort was 39 months, which is consistent with findings by Galukande et al.[2] When our stage distribution (81.3% stage III, 18.7% stage IV) is applied to the findings by Galukande et al., survival is 51.4% at 36 months 48.8% at 48 months, compared to our model results of 52.1% and 47.2%, respectively.

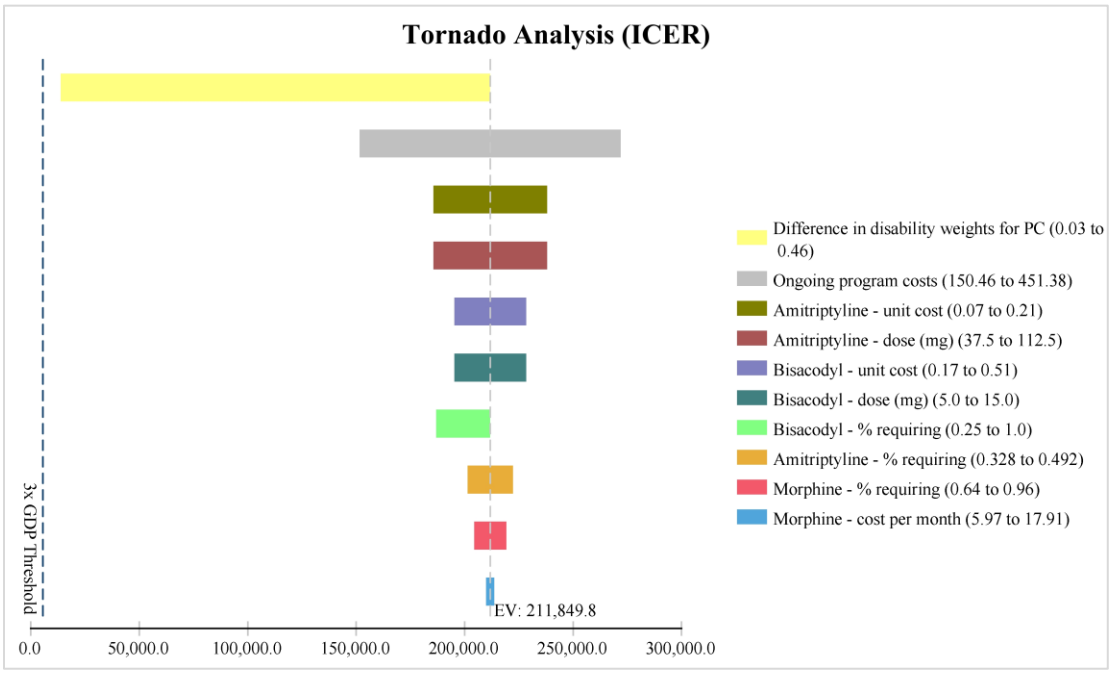
The incremental cost of universal palliative care in our model is $I 1,377 (UGX 1,578,480) per patient. The incremental benefit is 0.0065 DALYs averted per patient. This results in an ICER of $I 211,850 (UGX 242,753,988) per DALY averted. Compared to a cost-effectiveness threshold of 3 times GDP per capita[65] ($I 5,546), the intervention would not be considered cost effective. The ICER is 38.2 times the threshold ($I 211,850/$I 5,546).

After identifying the baseline universal palliative care intervention was not cost-effective, we performed several scenario analyses to evaluate the impact of more limited programs. While we adjusted the services provided, we did not adjust the effectiveness of the intervention because the limited interventions still meet the health state description in the Global Burden of Disease

study.[48] In a program that provides only morphine and no other pharmaceuticals, the incremental cost of the intervention is $I 820 (UGX 939,940), resulting in an ICER of $I 126,145 (UGX 144,546,622) per DALY averted, or 22.7 times the threshold ($I 126,145/ $I 5,546). In a more restricted scenario that includes morphine drug costs only (eliminating personnel and delivery costs), the mean incremental cost of universal coverage is $I 25 (UGX 27,272), resulting in an ICER of $I 3,821 (UGX 4,378,754). Compared to a threshold of three times GDP per capita, the cost of morphine alone is cost-effective at 0.69 times the threshold ($I 3,821/$I 5,546).

One-way sensitivity analysis results are presented in the Tornado diagram, which compares high and low-values to the base case. In one-way sensitivity analyses, the model is highly sensitive to the difference in the disability weights for end-of-life with and without palliative care. Still, the highest value for this parameter, 0.46, results in an ICER that exceeds the cost-effectiveness threshold. The model is also sensitive to ongoing program costs (staff and transport) and the cost, dose, and use of Amitriptyline and Bisacodyl.

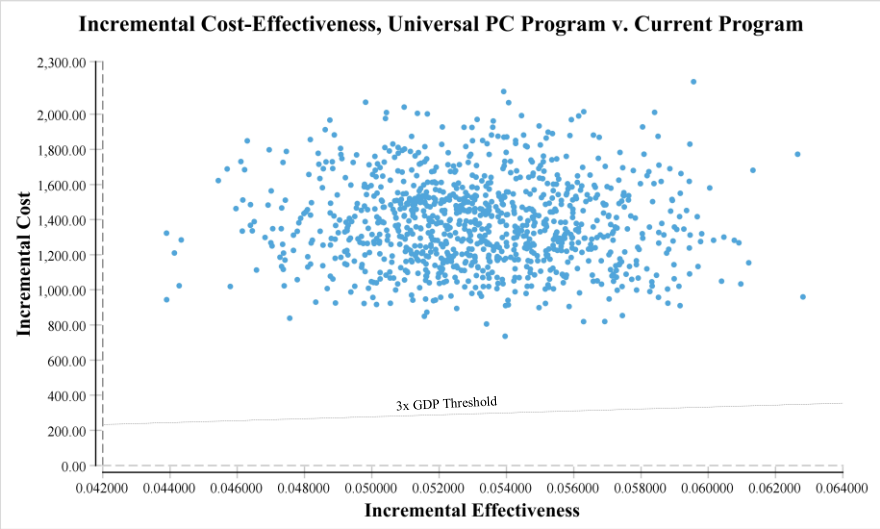
Figure 2: One-way Sensitivity Analysis



Probabilistic Sensitivity Analysis

Our probabilistic sensitivity analysis yielded an ICER of $I 25,921, a result much lower than the baseline ICER of $211,849. This result still exceeds the cost-effectiveness threshold by 4.67 times ($I 25,921/ $I 5,546). The lower ICER is a result of the probability distribution for the incremental difference in disability weights from palliative care. Our base case used a value of .03, while our PSA used a uniform distribution with a range of .03 - .46. The incremental cost and incremental effectiveness for each draw are shown in Figure 3. Results for all draws exceeded the three times GDP per capita threshold.

Figure 3: PSA Results



Discussion

Our decision model found that providing universal access to palliative care for women with advanced breast cancer is not cost-effective compared to the standard of care. Findings of one-way sensitivity analysis and probabilistic sensitivity analysis also found the intervention is not cost effective. While the cost of providing palliative care, especially morphine, is low, the

incremental utility provided by the intervention is very small and the intervention does not extend life.

These findings are similar a study by Zelle et al. in Ghana, which found that palliative care for breast cancer is not cost-effective. To compare our results to those of Foley et al, we limited our analysis to drug costs only and presented outcomes in pain days avoided. We also adjusted the original results of Foley et al (0.60 – 1.35 USD per pain day avoided) to 2016 international dollars using an inflation rate of 3% annually and the exchange rates above. The incremental cost per pain day avoided was higher in our model ($I 9.33) than the adjusted Foley et al results ($I 2.41 – 5.41). Foley et al used the same drug costs in Uganda, Romania, and Chile, while our costs are specific to Uganda, which may partially account for differences in results. Prices for these drugs may have also changed at different rates than overall inflation. Recommendations from the Breast Health Global Initiative were based on clinical guidelines at various resource level[20]. The packages recommended for limited resource countries are substantially more intensive than our intervention, which was not cost effective.

Both our analysis and others have used disability weights from the Global Burden of Disease study to estimate the incremental difference in quality of life for patients receiving palliative care. However, there are limitations to using these estimates in our analysis. Published literature on pain and quality of life suggests the 3% difference in disability weights estimated by the Global Burden of Disease study underestimates the value of palliative care.[49,52,53] The lay health state descriptions used to measure preferences for these health states are with and without pain medication and do not align exactly with the health states with and without palliative care.[48] In addition, these disability weights are global measure that may not be reflective of our location and population of interest. A recent systematic review underscored the lack of information on

quality of life improvements from specialist palliative care interventions in high-income countries.[66] The evidence base is even more limited for low-income countries. Further research is needed to explore the effects of palliative care on quality of life in low-income settings, particularly in Sub-Saharan Africa.

Another limitation of our analysis is that it did not include costs and benefits for caregivers. Numerous studies have documented the burden of end-of-life care on caregivers[23] however, we were unable to identify locally appropriate estimates of the quality-of-life or cost burden, so we did not include these. Inclusion of caregiver impacts would lead to a more favorable ICER, by reducing societal costs for caregivers and increasing their quality of life.

While our analysis was specific to breast cancer, expanding palliative care services would likely also reach people with a variety of end-of-life conditions, including all cancers and AIDS. Inclusion of other patients who use palliative care services could also result if a more favorable ICER, as fixed costs are spread over a larger population base.

While we recognize the importance of complete palliative care, gains could be made simply by increasing access to morphine. Morphine, especially in the formulation used in Uganda, is an inexpensive drug that yields large gains in pain-free days for cancer patients.[18] Others have taken this approach in cost-effectiveness studies[18] and care providers have cited morphine as the most critical component of their programs.[64]

Still, to increase access to morphine, additional investment is required by the government. Government spending on health in Uganda is 1.4% of GDP, which falls short of the recommended global target of 5%.[67] While the government has supported palliative care policy and provides free morphine, the Ministry of Health budget for palliative care (in addition to morphine) is

only UGX 15 million ($I 13,090),[68] an amount far less than the cost of a universal palliative care program for women with advanced breast cancer. Additional financial investment from the government would be needed for progress on palliative care to be possible. The Ministry of Health could consider funding training for additional palliative care specialist nurses and supporting ongoing delivery of home-based palliative care programs.

Conclusion

Universal access to palliative care for women with advanced breast cancer in Uganda was not cost effective in our base case or sensitivity analyses. The pharmaceutical components of palliative care, particularly morphine, are inexpensive, but delivery of these drugs requires an increase in the number of prescribers and ongoing costs for salaries and transport, which previous studies have not included.[18] Our findings are limited by the availability of information on the benefit of palliative care. Further research is needed on the benefits of palliative care programs at the end-of-life for cancer patients in low-income countries.

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