



ECONOMIC BURDEN OF CANCER CARE IN LOW AND MIDDLE-INCOME COUNTRIES: CAN MEDICINAL PLANTS PROVIDE RELIEF?

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Cancer poses a significant public health challenge worldwide, with low and middle-income countries (LMICs) bearing a disproportionate burden. The economic impact of cancer care in these regions is profound, straining already limited healthcare resources and leading to high out-of-pocket expenditures for patients and their families. The study explores the potential role of medicinal plants as a cost-effective and accessible alternative or complement to conventional cancer therapies in LMICs. We analyze the economic burden of cancer care, highlight the financial challenges faced by LMICs, and examine the therapeutic potential of medicinal plants. Evidence from various studies indicates that medicinal plants can offer affordable and culturally accepted treatment options, potentially reducing the economic strain on healthcare systems and patients. The integration of medicinal plants into cancer care strategies could improve access to treatment, enhance patient outcomes, and provide sustainable solutions to the escalating costs of cancer care in LMICs. Further research and policy support are needed to validate these benefits and facilitate the incorporation of medicinal plants into mainstream cancer treatment protocols.

Keywords: Alternative therapies, Access to care, Cancer care, Cost effectiveness, and Medicinal plants.

Introduction

Cancer poses a significant challenge for global health sector, with disproportionate burden on low and middle-income countries (LMICs). Cancer remains one of the leading causes of mortality worldwide, and its treatment imposes a substantial economic burden on patients and their families and healthcare systems. The incidence of cancer is steadily rising globally, driven by factors such as population growth, aging, urbanization, and changes in lifestyle and environmental exposures. Both the health and economic impacts of cancer are poised to escalate, as projected by the World Health Organization (WHO). WHO estimates indicate a staggering 50% rise in cancer incidence by 2040 compared to levels documented in 2020.

According to the WHO, cancer is one of the leading causes of morbidity and mortality worldwide, with an estimated 10 million deaths attributed to the disease annually, and more than half of the deaths occurring in Low-and-Middle Income countries. By 2030, nearly 75% of all cancer deaths will occur in LMICs, with one in eight people expected to experience a cancer diagnosis in their lifetime¹. The predictions suggest that LMIC's will contribute maximum number of new cancer cases for the next 50 years and will be responsible for an increase in global cancer burden².

With the advent of advanced diagnostics and innovative therapies, the cost of cancer care has surged thus leading to financial hardships for the people. The

expensive cancer treatment and high prices of the cancer medicines have a huge impact on the accessibility of cancer services in low- and middle-income countries³.

The economic impact of cancer care in these regions is profound, often straining already limited healthcare resources and pushing many families into poverty. In this context, the potential of medicinal plants as a cost-effective alternative or complementary therapy offers a promising avenue for alleviating some of the financial strain.

This study explores the economic implications of cancer care, the challenges of Low- and Middle-Income countries, and the potential economic benefits of integrating medicinal plants into conventional cancer treatment regimens.

The article is broadly divided into 5 sections; the first section deals with Economic burden of Cancer care in Low and Middle income countries, section 2 deals with challenges faced by LMIC's for cancer care delivery, section 3 deals with role of medicinal plants in providing affordable cancer care and section 4 deals with Literature review of cost of care, economic studies on cancer treatments and research on efficacy and cost effectiveness of medicinal plants and the last section deals with Policy recommendations and challenges for enhancing access to medicinal plant therapies.

The Economic Burden of Cancer in LMICs:

Cancer imposes substantial economic costs on individuals, families, healthcare systems, and economies, encompassing both direct and indirect costs. In the past two decades, India has witnessed rapid economic growth, coupled with a younger demographic profile. Consequently, there has been a noticeable uptick in cancer cases among the younger urban population. To effectively address this trend, the focus should hone in on combating cancers that exact the highest toll in terms of disability-adjusted life years

(DALYs) in India. These include breast, head-and-neck, cervix, esophagus, stomach, lung, and colorectal cancers.

Direct costs of cancer include expenses related to diagnosis, treatment, hospitalization, medications, and supportive care services. Costs for surgery, chemotherapy, radiotherapy, and other treatments form a significant portion of direct costs. For instance, the expense of chemotherapy and radiotherapy in LMICs can be prohibitively high; often requiring multiple sessions over extended periods⁴. Indirect costs of cancer refers to the cost due to lost income due to illness, transportation to treatment centers, and long-term care needs.

Therefore, understanding these costs is very crucial for developing effective policies and interventions to alleviate the financial strain on the cancer patients and their families.

The increasing cancer burden will impel all the countries to introduce, strategize and reprioritize the variables to deliver high quality and sustainable cancer care. As a result of growing burden, the worldwide national budget of health is being threatened whilst creating economic impact through disease related premature deaths and off the work hours⁵.

The budget of medicines and cost of equipment get deranged due to increased costs of treatment. Cancers affect countries' economic growth in a negative manner also. Cancers have a significant impact on the economy by affecting various facets such as reduced productivity, increased unemployment rates, labor force losses, and a decrease in capital investment. These consequences collectively contribute to the economic burden imposed by cancer across different sectors of society⁶.

The financial consequences reach far beyond immediate treatment expenses, affecting the long-term economic stability of individuals and communities. Many people

are out rightly denied access to healthcare services due to the prohibitive costs of treatment in private hospitals. This economic burden is intensified by the widespread lack of comprehensive health insurance coverage, underscoring the urgent need for effective healthcare policies and financial protection mechanisms⁷.

While high-income countries have made considerable progress in reducing cancer mortality and improving survival rates, low-and middle-income countries face increasing cancer burdens and poorer outcomes due to limited resources and healthcare infrastructure.

The impact of cancer in India extends far beyond individual health, permeating into the social and economic fabric of communities. It frequently precipitates financial hardships for affected families, pushing them towards impoverishment and exacerbating societal inequities in the country.

Challenges faced by LMIC in delivering Cancer care:

The cancer burden is concentrated in low-and middle-income countries in a disproportionate manner. The developing countries like India face challenges in delivering cancer care due to inequalities, inaccessibility and lack of funds for healthcare in these countries.

Moreover, delay in cancer treatment is caused by lack of awareness, misinformation, lack of trust in medical establishments, having to travel far to access care. The lack of involvement of the patient in making treatment related decisions and financial hardships associated with direct and indirect costs of cancer care also contributes towards delay in cancer treatments⁸.

Limited access to essential healthcare services, including cancer screening, diagnostics, and treatment, exacerbates disparities in cancer outcomes. Political instability, social inequalities, and

cultural beliefs can affect access to care, healthcare utilization, and health outcomes. Additionally, weak healthcare infrastructure, inadequate funding, and shortages of skilled healthcare professionals including oncologists, radiologists, and specialized nurses further hinder efforts to address the cancer burden effectively. The limited availability of skilled professionals means that even when diagnostic and treatment facilities are available, there are not enough experts to operate them effectively. This shortage often forces patients to travel long distances to receive care, adding to their financial and emotional burden. In the absence of universal healthcare coverage, patients frequently bear the cost of treatment themselves, adding to increased out of pocket costs and this leads to catastrophic health expenditures, driving families into debt or forcing them to forgo treatment.

The other barriers to access cancer services includes the distrust of the healthcare profession,⁹ lower level literacy, language and cultural barriers, and misconceptions and fear about cancer. Accessibility and affordability for cancer care are particularly inadequate for the financially weak sections of the society¹⁰. Even when free cancer screening is offered, acceptance rates remain low among high-risk groups¹¹. Several social barriers hinder early detection of women's cancers, including low levels of female empowerment, widespread misconceptions fear of cancer, lack of partner support for accessing healthcare, and the absence of a supportive social environment that encourages women's participation in screening programs⁸.

High out-of-pocket expenses for diagnosis, treatment, and medications deter many individuals from seeking timely care. Even when services are subsidized or offered at no cost, indirect costs such as transportation, accommodation, and lost income can be prohibitive. This financial

toxicity often leads to catastrophic health expenditures, pushing families into poverty.

Cancer research predominantly focuses on high-income countries (HICs), leaving significantly less research dedicated to addressing the issues specific to low and middle-income countries (LMICs)^{12,13}. There are top five priorities in cancer research in LMICs; reducing the burden in advanced disease patients, improvement in Quality care, accessibility and affordability of cancer treatment, new innovations and technology advancements for cancer control and value based care for combating economic burden on patients and their families¹⁴.

The Role of Medicinal Plants as a cost-effective alternative:

Plants have been used to treat a wide array of diseases since ancient times. The oldest surviving traditions include the traditional Chinese and Indian Medicine, particularly Ayurveda. The use of medicinal plants in cancer treatment has garnered significant attention due to the escalating incidence of cancer and the limitations of conventional therapies. Medicinal plants offer a wealth of bioactive compounds that can complement or even serve as alternatives to traditional anticancer treatments.

Approximately 36,000 species of plants are investigated for anti-cancerous properties by the National Cancer Institute and around 3500 plant species have shown repeatable anticancer action.

Medicinal plants have been used for centuries in traditional medicine across many cultures, including those in LMICs. Their potential to provide cost-effective cancer care solutions is gaining recognition for several reasons. Due to the accessible and affordable advantages of the natural remedies, they are widely used in low-income countries to treat cancer¹⁵.

One of the primary advantages of medicinal plants is their affordability and accessibility. Unlike synthetic drugs, which

can be prohibitively expensive, medicinal plants are often readily available and cost-effective. This is particularly beneficial in low and middle-income countries (LMICs) where access to conventional cancer treatments may be limited. Local cultivation and traditional knowledge of these plants can further reduce costs and ensure a steady supply.

The various currently used therapeutic strategies such as chemotherapy medicines and radiation show adverse effects along with the cure of the disease that can significantly impact a patient's quality of life^{16,17}. As a result, the search for alternative medicines for cancer has come up and shifted to natural products. For example, compounds found in turmeric (*Curcuma longa*) and green tea (*Camellia sinensis*) has been shown to exert anticancer effects with fewer adverse reactions. This can improve patient compliance and overall well-being during treatment.

Medicinal plants can be used alongside conventional treatments to enhance their efficacy and mitigate side effects. For instance, the inclusion of ginger (*Zingiber officinale*) can help alleviate chemotherapy-induced nausea and vomiting. This complementary approach not only enhances the effectiveness of standard treatments but also supports patients' holistic health.

Numerous studies have confirmed the anticancer efficacy of natural bioactive compounds^{18,19,20}. Medicinal plants contain a multitude of bioactive compounds that work through various mechanisms to combat cancer. These include inducing apoptosis (programmed cell death), inhibiting cell proliferation, preventing metastasis, and modulating the immune system. The diversity of these mechanisms can make it harder for cancer cells to develop resistance, a common issue with conventional single-target drugs.

In many parts of the world, traditional medicine systems such as

Ayurveda, Traditional Chinese Medicine (TCM), and indigenous healing practices have long used medicinal plants. These practices are culturally accepted and trusted, which can facilitate the integration of plant-based therapies into modern healthcare systems. This cultural acceptance can enhance patient trust and compliance with treatment regimens. Integrating medicinal plants into cancer care can align with local health practices and beliefs.

In addition to being affordable and accessible, medicinal plants can also be more cost-effective over the long term. The cultivation and processing of medicinal plants typically involve lower costs than the production of synthetic drugs, which require expensive research, development, and manufacturing processes. Furthermore, because many medicinal plants can be grown locally, they reduce the need for costly imports and associated logistics, which can significantly lower healthcare expenditures. This cost-effectiveness makes medicinal plants a practical solution for

healthcare systems struggling with limited budgets and high demand for cancer treatments.

The scientific research continues to validate and expand the understanding of these natural compounds and going forward the medicinal plants are poised to play an increasingly cost-effective role in the global fight against cancer.

The antioxidant properties help in cancer prevention and also lower the risk of cancer progression. Plants such as Indian gooseberry (*Phyllanthus emblica*) and garlic (*Allium sativum*) have potent antioxidant properties that can reduce oxidative stress and inflammation, thereby lowering the risk of cancer progression.

Many medicinal plants can be grown sustainably and harvested with minimal environmental impact, contributing to an eco-friendlier approach to healthcare.

Table 1 illustrates the various plants which have anti-cancer properties and can be used for treatment for the specific type of cancer.

Table 1: Medicinal Plants having anti-cancer properties.

Plant name	Common name	Family	Extract	Cancers
<i>Acorus calamus</i>	Vacha	Acoraceae	Rhizome	Prostate Cancer, Gastric Cancer
<i>Ajuga parviflora</i>	Bugleweed	Lamiaceae	Whole Plant	Leukamia
<i>Aloe Vera</i>	Ghrit Khumara	Asphodelaceae	Leaves	Ovarian cancer, Colon Cancer and Breast Cancer
<i>Asparagus racemosus</i>	Satavari	Asparagaceae	Roots	Breast cancer , Prostate Cancer
<i>Artemisia herba-alba</i>	White wormwood	Asteraceae,	Leaf extract	Carcinoma of urinary bladder, Carcinoma of larynx, Human myelogenous leukaemia (K-562) cell, Brain tumour
<i>Artemisia annua</i>	Sweet Wormwood	Asteraceae	Leaves	Leukemia, Breast, Prostate
<i>Boswellia serrata</i>	Guggal	Burseraceae	Gum resin extract	Carcinoma of Larynx, Carcinoma of bladder, Carcinoma, Human myelogenous leukaemia.
<i>Centella asiatica</i>	Brahmi	Apiaceae	Leaf extract	Oral cancer
<i>Catharanthus roseus</i>	Sadabahar	Apocynaceae	Flower extract	Lymphoma and Acute Leukaemias.
<i>Camellia sinensis</i>	Green Tea	Theaceae	Leaves	Prostate, Breast, Liver
<i>Curcuma longa</i>	Turmeric	Zingiberaceae	Rhizome	Colon cancer and Breast cancer, Lung cancer

<i>Taxus bacata</i>	Thuner	Taxaceae	Bark	Hepatocellular, Cutaneous, Colorectal, Gallbladder, Breast, Gastric, and Pancreatic malignancies.
<i>Tinospora cordifolia</i>	Giloe or Guduchi	Menispermaceae	Stems	Tumour of brain, Intestine, Breast, Head, Vaginal, Prostate & Neck cancer.
<i>Withania somnifera</i>	Ashwagandha	Solanaceae	Root, Stem and Leaves	Breast cancer, Lung cancer, Colon cancer
<i>Taxus bacata</i> (Thuner) <i>Taxus brevifolia</i>	Pacific Yew	Taxaceae	Leaves	Colorectal cancer , Breast cancer , Pancreatic cancer
<i>Tinospora cordifolia</i>	Giloe or Guduchi	Menispermaceae	Stems	It is used in brain, intestine, breast, head, vaginal, prostate & neck cancer.
<i>Withania somnifera</i>	Ashwagandha	Solanaceae	Root	Breast, Lung, Colon
<i>Vinca rosea</i>	Madagascar Periwinkle	Apocynaceae	Leaves, Stems	Leukemia, Lymphoma
<i>Phyllanthus emblica</i>	Indian Gooseberry	Phyllanthaceae	Fruit	Liver, Breast, Skin
<i>Glycyrrhiza glabra</i>	Licorice	Fabaceae	Root	Prostate, Breast, Liver
<i>Allium sativum</i>	Garlic	Amaryllidaceae	Bulb	Stomach, Colorectal, Prostate
<i>Zingiber officinale</i>	Ginger	Zingiberaceae	Rhizome	Colon, Ovarian, Pancreatic
<i>Panax ginseng</i>	Ginseng	Araliaceae	Root	Lung, Liver, Pancreatic
<i>Catharanthus roseus</i>	Rosy Periwinkle	Apocynaceae	Leaves, Stems	Leukemia, Lymphoma
<i>Annona muricata</i>	Soursop	Annonaceae	Leaves, Fruit	Breast, Prostate, Liver
<i>Nigella sativa</i>	Black Cumin	Ranunculaceae	Seeds	Colon, Pancreatic, Lung

The cost of cancer care using *Simarouba glauca* phytomedicine is significantly lower compared to the prohibitive expenses associated with conventional cancer treatments. Traditional therapies, such as chemotherapy and radiation, not only impose severe financial burdens—often amounting to several lakhs of rupees—but also cause considerable mental and physical distress, including trauma and changes in physical appearance. In contrast, the cost of treatment with *Simarouba glauca* phytomedicine is less than 10% of the conventional system's expenses. For instance, if conventional cancer care costs Rupees One lakh, *Simarouba glauca* treatment would cost less than Rs. 10,000²¹.

Challenges and Considerations for use of Medicinal plants:

The increasing prevalence of medication-resistant cancers highlights a critical need

for the development of more effective anticancer agents. Herbal medicines present a highly viable alternative to modern treatments for combating cancer²².

While the potential of medicinal plants is significant several challenges exist for their use as anti-cancer medications. Few medications are taken along with conventional treatment of cancer without acknowledging the healthcare practitioners. This can lead to serious side effects during the treatment phase. Effective integration of medicinal plants into mainstream healthcare requires training for healthcare providers and the development of treatment protocols that incorporate traditional and modern practices. Rigorous clinical trials are needed to validate the efficacy and safety of medicinal plants in cancer treatment. This requires investment in research and collaboration between traditional medicine practitioners and

modern scientists. The problem arises due to the improper usage of herbal goods, misidentification of botanical products and mislabeling of plant materials²³. Ensuring quality control and standardization of medicinal plant products is crucial. Regulatory frameworks must be developed and enforced to protect patient safety. To avoid overharvesting and ensure the sustainability of medicinal plant use, cultivation practices must be managed responsibly.

Conclusion

The diverse mechanisms of action and potential for personalized medicine further enhance their appeal. As scientific research continues to validate and expand our understanding of these natural compounds, medicinal plants are poised to play an increasingly important role in the global fight against cancer.

The benefits of medicinal plants as anticancer medicines are manifold. Their affordability, accessibility, and reduced side effects make them a valuable resource, especially in resource-limited settings. The economic burden of cancer care in low and middle-income countries is a pressing issue that demands innovative solutions. Medicinal plants offer a promising, cost-effective alternative that can complement existing treatments and potentially reduce overall healthcare costs. By addressing the challenges of validation, regulation, integration, and sustainability, LMICs can harness the therapeutic benefits of medicinal plants, providing relief to patients and healthcare systems alike. Continued research and policy support are essential to realize the full potential of this approach, paving the way for more accessible and affordable cancer care in resource-limited settings. Integrating these natural remedies with conventional treatments can offer a holistic and effective approach to cancer care, benefiting patients and healthcare systems alike^{24,25}.

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