

Cancer Management in Africa: The Burden of Late Presentation and the Case for Cancer Awareness

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Abstract: Cancer was at a time thought to be rare in Africa because of lack of the necessary personnel, hospitals and equipments to manage the cases which, for different reasons, also rarely got to the few existing health centers. Presently cancer, which is a global epidemic and is not limited to any category of people, is not only present in Africa but generally gets to health centres at advanced stages due mainly to lack of cancer awareness. Its frequency is even expected to rise rapidly within the next few years if adequate precautions, based on current knowledge in oncology, are not taken presently. This rise in a continent which already has many problems making cancer management very difficult necessitates satisfactory measures in order to mitigate what some are already considering as an impending tragedy or catastrophe. This paper analyses some of the elements of this impending difficult prevision and some of the possible solutions of the problem.

Key words: Cancer • Africa • Projected Increase • Management • Prevention • Burden of Late Presentation

INTRODUCTION

There was a time when cancer was thought to be rare in Africa [1]. This was in large part because many cases did not get to the hospitals; the patients preferring to search for cure with parallel health providers including fetish doctors etc [2]. This was the more so as there were very few health centres, medical equipments, Medical Practitioners and technicians to carry out the necessary diagnosis and recording of eventual cases. That time is long gone because cancer is presently regarded, correctly, as a global epidemic that is not limited to a specific category of people: it affects all ages and socio-economic groups with developing countries bearing a disproportionate burden [3]. In the case of the African continent cancer series are generally characterised by late presentation at advanced stages mainly because of lack of cancer awareness. This late presentation increases the cost of treatment and reduces the chances of a cure for a disease whose management bills remain relatively high

even in its early stages [4]. In the absence of health care financing systems, the large majority in Africa find it difficult to meet up with the costs of management of diseases particularly chronic ones like cancer even when the burden is in most cases borne not only by the patient but shared by relations and families [5]. In Africa many cancer patients consequently do not get adequate treatment even when the local health services have the necessary structures to manage them [6].

The projection from many workers that the number of African cancer cases will increase rapidly within the next few years will place African countries in a very delicate position: hedged in between the well known limited structures for managing cancer patients and this projected rapid increase of their number.

This paper intends to go through the different elements of this difficult situation and also possible proposals for solutions of what some workers have described as an imminent and impending cancer tragedy or catastrophe in Africa [7].

The Projected Increase of Cancer Cases in Africa:

The African cancer burden is unfortunately expected to grow within the next few years for different reasons, among which are the:

- Projection on the increase of cancer cases due simply to changes in demography and improvement in life expectancy [8].
- Unnecessary environmental exposures to possible carcinogens, at times at high levels, more frequent in Africa than in most other continents [9].
- Changing exposures to known risk factors, e.g., tobacco (weak regulatory regimes and legal restrictions, increasing average personal incomes, lack of awareness of the danger), diet, obesity (increase in calorie intake, dietary intake of high-energy, refined carbohydrates and high-fat diets), physical inactivity and chronic infections [10].
- Changes in reproductive factors in women (earlier menarche, delayed childbearing, reduction of the total duration of lifetime breastfeeding and lower fertility) [11].
- Low socio-economic status and deficient health care infrastructure, resulting in inadequate access to preventive and clinical services [12].

Late Presentation of Cancer Cases in Africa and its Consequences:

One of the greatest peculiarities of cancer patients in Africa is late presentation [13] due to many reasons: ignorance of the seriousness of the disease, urban location of most of the hospitals making them distant and difficult to access by most of the population, patients resorting first to alternative health providers like traditional and faith healers ‘who usually live among them’, insufficient infrastructure and equipment of the hospitals, financial constraint, fear of being told they had cancer and fear of extensive mutilating carcinologic resections [14]. Between, 60% and 95% of African cancer patients therefore reportedly present at late advanced stages [15]. The result is that, most often, cancer is fatal due to this late stage at clinical presentation [16], paradoxically reinforcing the notion that allopathic medical care is ineffective in treating cancer and other diseases [17]. Other consequences of this situation are the inadequate exposure to sufficient case-mix and case-load during training [18] as well as the absence of the early disease profile manageable by radical resection or minimal invasive techniques [19]. This places our Medical Schools and Teaching Hospitals in the unfortunate tendency of creating a group of professionals

who stand the risk of having very little experience of the management of many oncological diseases at an early stage. Many of our trainees risk ending their formation almost confined to palliative surgery in the management of cancer cases.

However, if a single possible common denominator to the different reasons for this late presentation is to be picked out this should probably be lack of cancer awareness. Sufficient cancer awareness, in our opinion, would have enabled and encouraged many more patients to make the ‘extra,’ necessary effort or the required sacrifice to get to health centres earlier despite all the other factors.

Necessity of Creating Cancer Awareness in Africa:

Many recent papers have insisted very much on the necessity of creating cancer awareness in our continent in order to mitigate the projected increase of cancer cases which has been described as an imminent and impending cancer tragedy or catastrophe in Africa [20]. Lack of cancer awareness manifests itself at different levels. At the population level, it is one of the major reasons for late presentation of cancer patients to medical centers. At the level of health care providers, lack of cancer awareness can sometimes lead to delays in management: institutional and physician related delays were present in over 40 % of the cases in two Nigerian series on breast cancer [21]. It was even noted that patients who were referred from, or received initial treatment at, peripheral hospitals had longer delays than those who came for first consultation at the teaching hospital [22]. Twenty four per cent of late presenters in another series on breast cancer from East Africa said they had earlier visited medical personnel who had reassured them falsely that their case was benign without the benefit of biopsy [23]. The effect can be felt higher up the decisional ladder. A general lack of cancer awareness among policy makers and international private or public health agencies concerning the magnitude of the current and future cancer burden and its economic impact may also partly explain the relatively low public health priority cancer receives in Africa [24].

Improvement of cancer awareness will greatly help in the down staging of cancer cases seen in medical centres in Africa [25]. This in turn will improve the prognosis and reduce the mortality. It will also reduce the cost of cancer management which is always very high and often beyond the reach of the average African patient who generally foots the bill for the management in a setting where the majority have no social security system.

The Difficulties That Would Be Encountered:

Creating cancer awareness will not go without difficulties which have to be addressed. One basic difficulty is the establishment of cancer registries which are presently very few in Africa [26-27].

The weight of traditional medicine has to be overcome. This includes the general tendency for patients to go first to the fetish doctors, traditional healers and sometimes prayer houses before turning to the hospital with late stage cancer, when palliation is the only treatment option [28]. It also comprises the situation of some traditional healers claiming to treat every condition including cancer and refusing to refer cancer patients to the hospitals [29].

There are also psychological barriers to be dealt with like the taboo associated with certain organs or regions of the body (sex organs and the like: testicle, penis, breast, scrotum) making it difficult to talk of diseases affecting those parts. Another example is the stigmatisation felt by some patients who consider cancer as a spiritual punishment from God for some wrongs committed [30]. It is also sometimes considered a taboo to talk to others about serious Diseases [31].

Cultural barriers exist too and have to be dealt with. Africans generally have a weak perception of chronic disease and consequently find it difficult to accept the idea of chronicity as far as diseases are concerned [32]. Another example is the cultural (?), inborn (?) belief that discomfort, in particular pain, is the exact, correct mathematical ‘barometer’ of the seriousness of a disease condition which makes many patients delay going to hospital at the early stage of cancer because it is painless [33]. There is further the high level of misconceptions, misinformation and erroneous beliefs, like the idea that coins put in the brassieres can increase a woman’s risk of getting breast Cancer [10]. Language difficulties come in too: it is estimated that most of Africa’s 200 dialects and 2000 languages have no word for cancer [24, 25], making one commentator ask how our continent can hope to diagnose and treat, let alone fight to prevent a disease that has no name. [24]

There are also financial constraints both on the health care systems (limited resources and other pressing public health problems, insufficient number of health care centers, lack of necessary equipments, insufficient personnel, lack of structured health care financing system for chronic diseases) and on individual levels (difficulties in meeting up with the high out-of-pocket health-related expenditures in countries without social security systems) [5, 6, 10, 12, 24]. One must not forget the inertia associated with any change in line with new ideas.

Ways of Getting over These Difficulties: But this long list of problems should not constitute a hindrance because, fortunately, there are certain facts that will help advance the case for the urgent necessity of creating cancer awareness in Africa.

The death toll of cancer is very high; it presently accounts for one in every eight deaths worldwide-more than HIV/AIDS, tuberculosis and malaria combined according to one estimate [26]. This is in big contrast to three different observations: First of all, many cancers are presently curable on condition that they are discovered early [5, 6, 18, 26]. Secondly, it has been estimated that only 5-10% of all cancer cases are due to genetic defects, the remaining 90-95% being due to environment and lifestyle and therefore potentially preventable [27]. Finally, the fight against the HIV-AIDS pandemic brought with it certain lessons which will shorten the learning curve for the prevention and control of non-communicable diseases like cancer [28, 29].

The experience gained in the process of transforming the HIV-AIDS pandemic from a new and unknown disease to virtually a house hold word, in such a relatively short time, can form a reproducible basis, with some adaptations and modifications, to enable plan better the fight against cancer which is a much ‘older’ killer. The HIV-AIDS pandemic has effectively highlighted certain facts:

- The fight against diseases such as HIV–AIDS is global and solutions can emerge from anywhere. Conducting research only in high-income countries neglects the possibilities of elucidating variability in the causes of and risk for noncommunicable diseases among populations worldwide, of enabling high- and low-income countries to learn from each other and of leveraging global resources in the development of low-cost, contextually appropriate behavioral, diagnostic and biomedical interventions [28-30].
- The value of societal engagement: successful programs have actively involved the affected communities, harnessed the goodwill and support of high-profile celebrities, and energized advocacy and political support and will [29, 30].
- The use of mobile phones to send SMS for education and awareness and in support of public health and behavioural change campaigns. SMS is also used to deliver information to health workers [30, 31].
- The importance of linking detection, prevention and treatment and the integration of behavioral and biomedical approaches [29].

Other ways that could be effective in a continent like Africa with weak cancer infrastructure is the organization of information sessions in other structures outside the health centres like churches, mosques, schools, universities and markets to create cancer awareness [25].

Advantages Presented by the African Continent in the Fight Against Cancer: In the fight against cancer, Africa can constitute a particularly useful area and fertile ground for the study of certain cancers to the benefit of all humanity for different reasons:

- The effect of certain environmental factors on genetic variation is thought to make Africa a useful area for studying cancer aetiology through epigenetics, a new branch of Genetics [5].
- Some African environment may provide settings to study agents for which carcinogenic effects are so far inconclusive like possible and not classifiable substances belonging to the International Agency for Research on Cancer [IARC] Groups 2B and 3 carcinogens [8].
- The incidence of certain cancers (those related to tobacco, obesity and altered reproductive patterns) are expected to rise in Africa because of changing lifestyles [5, 6, 9]. Africa can, in this way constitute a background for prospective research, including aetiological studies, on these cancers before and during the expected increase in their incidence.
- The lack of good health systems for noncommunicable diseases in many low- and middle-income countries may, paradoxically, offer opportunities for testing innovative models in ways that cannot be done in high-income countries with mature systems [30].
- Many infection-related cancers are much more frequent in Africa than elsewhere [5, 9]. The continent can therefore provide a suitable setting for studies, including aetiological studies, on these infection-related cancers.
- The diversity of the African population with regards to culture, dietary patterns and other environmental factors and the very limited prior efforts to study cancer aetiology in this population can offer opportunities to identify novel cancer risk factors or even protective factors that could advance cancer prevention measures worldwide [6, 16].

Measures Based on Present Day Knowledge That Can Be Taken to Curb this Projected Increase:

There is presently scope for activities aimed at cancer control in African countries on the basis of current knowledge. Infection-associated cancers account for almost 26% of cancers in Africa [5, 27]. These cancers can be controlled in different ways. Screening for precancerous cervical lesions through visual inspection, or once affordable, identification of high-risk women by HPV DNA testing [5, 6, 9, 26], can control cervical cancer. Adequate vaccinations against HPV (cervical cancer) and HBV (hepatocellular carcinoma) offer protection against some cancers. [5, 6, 9, 26, 27]. The fight against agents like schistosome (bladder cancer), HIV (non-Hodgkin lymphoma, Burkitt lymphoma, Kaposi sarcoma) and Helicobacter pylori (stomach cancer) connected with certain cancers can give some protection against these malignancies [5, 6, 9, 26].

Tobacco use increases the risk of developing at least 14 types of cancer [27]. It is estimated to be responsible for about 30% of cancers, 20% to 30% of cancer deaths worldwide [5, 6, 9, 26] and, presently, for ‘only’ about 6% of cancer deaths in Africa [5, 6] but 87% of deaths from lung cancer worldwide [27]. Its consumption, which is growing in Africa (weak regulatory regimes and legal restrictions, increasing average personal incomes, lack of awareness of the danger), [5, 6, 9, 27], should be controlled (legal restrictions, education and awareness).

Obesity and physical inactivity, which are risk factors for development of certain cancers (including breast, endometrium, oesophagus [adenocarcinoma], kidney and colon), are spreading in many low resource African countries because of urbanization and a more westernized lifestyle [5, 6, 9, 26]. They also have to be controlled.

The efficiency of cancer control programs can be enhanced, at least when possible, by integrating them with other established disease control programs: integration of HBV vaccination into infant immunization programs in Africa and other parts of the world, integration of HPV prevention to ongoing HIV prevention programs since unsafe sexual practice is a risk factor for both diseases thus arriving at some aspects of cervical cancer prevention programs in Sub-Saharan African countries [6].

Cancer survivors, whose very existence is proof to the general population that favourable cancer outcomes are possible, can also be used as communicators regarding the relevance and impact of early detection [17].

The Advantages of Managing Cancer at Early Stages:

Managing cancer at early stages has many advantages. Some of these are peculiar to our African setting and have been mentioned earlier on: the possibility for our trainees and trainers to perform curative cancer surgery; that is radical resections and minimal invasive techniques and not be limited strictly (or almost) to palliative surgery in the management of cancer cases. But there are other advantages [32].

- As the cancer stage advances, management costs as well as mortality increase. The latter often tend to increase in a sort of geometrical rather than arithmetic progression.
- The amelioration of the global survival of treated cancer patients is generally more as a result of the downgrading of cases rather than the improvement of management methods. These management methods, with time, tend to bring better comfort and less mutilating surgery (which are important factors) for the patients. Their effect on regression of mortality within each cancer stage tends to be less obvious.
- For the specific case of carcinoma of the uterine cervix, the improvement of the 5-year survival over the years seems in general to be more important in stage I cases than in stage II and in the latter compared to stage III. The “Annual report on the results of treatment in carcinoma of the uterus” which was edited annually for many years in Sweden, reported the evolution of 5-year survival rate in cancer management centres whose number increased in the 1967 edition to 124 from 26 countries spread all over the globe. [33] The reports are plotted in graphs sometimes going as far back as 1920! Assessment of the general appearance of these graphs shows that the improvement over the years of the 5-year survival for carcinoma of the cervix of the uterus in general decreases as the stage advances. This tendency could possibly apply for some other cancers and not just uterine cervix cancers alone.

CONCLUSION

It is generally well known that cancer patients present themselves to medical centres in Africa at advanced stages for many reasons among which is lack of cancer awareness. This lack of awareness is probably the only single possible common denominator to all the other reasons for this late presentation to hospital.

In addition to late presentation of patients, cancer cases are projected to increase rapidly in Africa within the next few years. It is therefore necessary for African countries to strive to put in more effort towards cancer control and awareness than is presently the case in order to downgrade cancer cases and also prevent the projected increase in cancer incidence in Africa. This they can do with the help of the International Community and the knowledge gained from the fight against HIV-AIDS pandemic. The observation that only

5-10% of all cancer cases are a result of genetic defects, the remaining 90–95% being due to the environment and lifestyle and therefore potentially preventable opens a gateway for a serious and concerted effort to eliminate cancer. With a well packaged plan and the help of international partners, Africa can offer a very good setting for a programme in this fight against cancer to the benefit of all humanity.

REFERENCES

1. Renner, W., 1910. The Spread of cancer among the descendants of the liberated Africans or Creoles of Sierra Leone. *BMJ*, Sept 3, 1910, pp: 587-589. Accessed 31 May 2013 from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2335990/pdf/brmedj07872-0007.pdf>
2. His Majesty's Stationery Office, 1905. *Cancer in British Colonies*, London: Darling and Son, 1905. *Br Med J*. 1905 February 18; 1(2303): 362-363. Accessed 1 June 2013 from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2319194/>
3. SOCRON (Society of Oncology and Cancer Research of Nigeria), 2013. 2013 World cancer day key message. Accessed 13 June 2013 from: <http://www.socron.net/socron/wcd.php>
4. Tangka, F.K., J.G. Trogdon, L.C. Richardson, D. Howard, S.A. Sabatino and E.A. Finkelstein, 2010. Cancer treatment cost in the United States: has the burden shifted over time? *Cancer*, 116: 3477-84.
5. Sambo, L.G., J.M. Dangou, C. Adebamowo, C.F. Albrecht, C. Gombé-Mbalawa, T. Ngoma, M. Moeti and B.H. Sambo, 2012. Cancer in Africa: a preventable public health crisis. *Afr. J. Cancer*, 4: 127-136.
6. Jemal, A., F. Bray, D. Forman, M. O'Brien, J. Ferlay, M. Center and M. Parkin, 2012. Cancer burden in Africa and opportunities for prevention. *Cancer*, 118: 4372-4384.

7. Kmietowicz, Z., 2007. Tackle cancer in Africa now to prevent catastrophe, say health activists. *BMJ*, 334: 1022-102.
8. McCormack V.A. and J. Schüz, 2012. Africa's growing cancer burden: environmental and occupational contributions. *Cancer Epidemiol*, 36: 1-7.
9. Sylla, B.S. and C.P. Wild, 2012. A million Africans a year dying from cancer by 2030: what can cancer research and control offer to the continent? *Int. J. Cancer*, 130: 245-50.
10. Opoku, S.Y., M. Benwell and J. Yarney, 2012. Knowledge, attitudes, beliefs, behaviour and breast cancer screening practices in Ghana, West Africa. *Pan Afr. Med. J.*, 11: 28. Epub 2012 Feb 17.
11. Olapade-Olaopa, E.O. and K.A. Onawola, 2006. Challenges for urology in sub-Saharan Africa in 2006. *J. Mens Health Gend.*, 3: 109-116.
12. Ezeome, E.R., 2010. Delays in presentation and treatment of breast cancer in Enugu, Nigeria. *Niger J. Clin. Pract.*, 13: 311-6.
13. Ukwenya, A.Y., L.M.D. Yusufu, P.T. Nmadu, E.S. Garba, A. Ahmed, 2008. Delayed Treatment Of Symptomatic Breast Cancer: The Experience from Kaduna, Nigeria. *S. Afr. J. Surg.*, 46: 106-110.
14. Otieno, E.S., J.N. Micheni, S.K. Kimende, K.K. Mutai, 2010. Delayed presentation of breast cancer patients. *East Afr. Med. J.*, 87: 147-150.
15. Thumbs, A., E. Borgstein, L. Vigna, T.P. Kingham, A.L. Kushner, K. Hellberg, J. Bates and T.J. Wilhelm, 2012. Self-expanding metal stents (SEMS) for patients with advanced esophageal cancer in Malawi: an effective palliative treatment. *J Surg Oncol.*, 105: 410-4. doi: 10.1002/jso.23003. Epub 2011 Dec 12.
16. Pezzatini, M., G. Marino, S. Conte and V. Catracchia 2007. Oncology: a forgotten territory in Africa. *Ann Oncol.*, 18, 12: 2046-2047.
17. Anderson, B.O., 2010. Editorial. Understanding social obstacles to early breast cancer detection is critical to improving breast cancer outcome in low- and middle resource countries. *Cancer*, 116: 4436-4439.
18. Sankaranarayanan R., R. Swaminathan, H. Brenner, K. Chen, K.S. Chia, J.G. Chen, S.C. Law, Ahnyo, Xiang, B.B.R. Yeole, V.H. Shanta, N. Martin, Y. Sumitsawan, H.O. Sriplung, S. Eser, B.M. Nene, K. Suwanrungruang, P. Jayalekshmi, R. Dikshit, H. Wabinga, D.B. Esteban, A. Laudico, Y. Bhurgri, E. Bah and N. Al-Hamdan, 2010. Cancer survival in Africa, Asia and Central America: a population-based study. *Lancet Oncol*, 11: 165-73, Epub 2009 Dec 10.
19. Cooper, M., S. Harding, K. Mullen and C. O'Donnell, 2012. A chronic disease is a disease which keeps coming back?...?it is like the flu': chronic disease risk perception and explanatory models among French- and Swahili-speaking African migrants. *Ethn Health.*, Nov 15. [Epub ahead of print]
20. Roberts, R., 2011. Bridging the urological divide. *Infectious agents cancer* 6, (Suppl 2), art. no. S4
21. Ouattara, A., R. Hodonou, J. Avakoudjo, D. Cisse, B. Zango, I. Gandaho, F.D. Hodonou, M. Yevi, A. Vodonou, P.P. Hounnasso and C.E. Akpo, 2012. Épidémiologie des cancers urologiques au Centre national hospitalier universitaire Hubert Koutoukou Maga Cotonou, Bénin. Analyse d'une série hospitalière de 158 cas *Prog Urol.*, 22: 261-5. doi: 10.1016/j.purol.2011.12.003. Epub 2012 Jan 20.
22. Birhan, W., M. Giday, T. Teklehaymanot, 2011. The contribution of traditional healers' clinics to public health care system in Addis Ababa, Ethiopia: a cross-sectional study. *J. Ethnobiol. Ethnomed.*, 7: 39. doi: 10.1186/1746-4269-7-39.
23. Ross, E., 2008. Traditional healing in South Africa: ethical implications for social work. *Soc Work Health Care*, 46: 15-33.
24. Kelland, K. Insight: Cancer in Africa: Fighting a nameless enemy, 2012. Accessed 15 June 2013 from: <http://www.reuters.com/article/2012/05/01/us-cancer-africa-ghana-idUSBRE8400ET20120501> <http://www.blackherbals.com/atcNewsletter612.pdf>
25. Miranda, D., 2011. How does Africa tackle cervical cancer? *Guardian UK*, Monday 20 June Accessed 20 June 2013 from: <http://www.guardian.co.uk/science/2011/jun/20/africa-cervical-cancer>.
26. American Cancer Society. Cancer facts and figures, 2012. Accessed 22 May 2013 from: <http://www.cancer.org/acs/groups/content/@epidemiologysurveillance/documents/document/acspc-031941.pdf>
27. Anand, P., B. Sung, A.B. Kunnumakara, C. Sundaram, K.B. Harikumar, S.T. Tharakan, O.S. Lai, B.B. Aggarwal, 2008. Cancer is a preventable disease that requires major lifestyle changes. *Pharm, Res.*, 25: 2097-2116.
28. Gotch, F. and J. Gilmour, 2007. Science, medicine and research in the developing world: a perspective. *Nat Immunol.*, 8: 1273-6.
29. Narayan, K.M.V., M.K. Ali, C. Del Rio, J.P. Koplan, J. Curran, 2011. Perspective. Global noncommunicable diseases-lessons from the HIV-AIDS experience. *N. Engl. J. Med.*, 365: 876-8.

30. Hellström, J., The Innovative Use of Mobile Applications in East Africa. *Sida Review* 2010: 12 Accessed 30 June 2014 from: http://www.texttochange.org/sites/default/files/newsfiles/sr2010-12_sida_hellstrom.pdf
31. Mahmud, N., 2013. How the cell phone can improve health care. Accessed 3 February 2013 from: <http://edition.cnn.com/2012/09/28/opinion/mahmud-mobile-medic/index.html>.
32. Mgbakor, A.C., 1976. The cancer of the uterine cervix in the Ivory Coast. A clinicopathologic and epidemiological study of 166 cases. Perspectives for the future. [Le cancer du col utérin en Côte d'Ivoire. Étude anatomo-clinique et épidémiologique de 166 cases. Perspectives pour l'avenir]. MD thesis. University of Abidjan.
33. Kottmeier, H.L., (1967)(Ed). Annual Report on the Results of treatment in carcinoma of the uterus and vagina. Fourteenth Volume,. Statements of the results obtained in 1951 to 1960, inclusive (collated in 1966). Radiumhemmet, Stockholm, pp: 60.