Catastrophic expenditure related to the burden of cancer drugs on patients in Senegal

Issa Wone, Doudou Diouf, Haoua Djouma Adama, Ahmadou Dem

ABSTRACT

Aims: Among the non-communicable diseases, cancer is one of the most challenging in Senegal. It has a significant economic cost that is often overlooked. In Senegal, its epidemiologic and socioeconomic burdens are widely unknown. We explore, through the present work, the capacity of patients to afford chemical treatment, based on the six most frequent cancers in Senegal.

Methods: For this purpose, we conducted a retrospective study, based on the archives of the National Purchasing Office for Essential Drugs, and the archives of Drug Purchasing Centers for the pharmacies of Le Dantec and Fann Hospitals, the main ones in the Senegalese capital, Dakar. We used 40% of salary income as the threshold for catastrophic health expenses, compared to the average wage of a farm worker and the minimum wage of a civil servant of Senegal.

Results: To treat breast cancer, oncologists use three treatment protocols in Senegal. The salary days required for the treatment exceeded two times the catastrophic expenditure threshold for the agricultural worker and a civil servant for two protocols. For colorectal cancer, one of the protocol was applied with salary days required for treatment exceeding 12 times the catastrophic expenditure threshold for the agricultural worker and 10 times for a civil servant minimum wage.

Conclusion: Our results, which only considered the cost of drugs, confirm other studies in developing countries, particularly in Asia, which show how cancer depletes households by diverting savings to care, and leading them to debt.

Keywords: Cancer, Catastrophic expenditure, Drug, Senegal

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INTRODUCTION

Cancer belongs to the group of non-communicable diseases (NCDs), also known as chronic diseases, tends to be long-term, expensive to treat. Cardiovascular disease is responsible for the largest number of deaths from NCDs, 17.9 million per year, followed by cancers (9 million), respiratory diseases (3.9 million), and diabetes (1.6 million) [1].

The situation of cancer in Senegal is not well known. Data from Global Cancer Observatory (GCO) in 2012 reported an impact of 6800 expected new cases per year in Senegal. All types of cancer are found, in higher or lower proportions depending on which type. Uterus and breast cancers are the most commonly found among the population.

In a recent assessment, numerous challenges have been identified in the management of cancer in Senegal, including the capacity of patients to afford treatment [2]. These challenges are more obvious since the introduction of anti-cancer drugs to the National List of Essential Drugs and Products in Senegal, making them available at subsidized prices in hospitals.
Cancer is a disease that has a significant economic impact for both patients and the government. The total annual cost of the disease was estimated in 2010 at around 1160 billion dollars (US$) [3]. For society as a whole, and for people with cancer and their loved ones, cancer has a significant economic cost that is often overlooked. This economic impact is related to a decreased productivity leading to a lower employment rate for the patients, to the increase of the expenses of families due to direct and indirect costs related to care, to premature deaths [4].

We study here the affordability of anticancer drugs through the spending capacity of a farm worker and a government worker for complete courses of treatment of the main cancers encountered in Senegal.

MATERIALS AND METHODS

The study was carried out in two main University Hospital Centers in Dakar, Dantec and Fann Teaching Hospitals.

Type of study

The study was conducted using a retrospective approach, based on the archives of the National Purchasing Office for Essential Drugs, and the archives of Drug Purchasing Centers for the pharmacies of Le Dantec and Fann Hospitals, the main ones in the Senegalese capital, Dakar.

Explored variables

Accessibility (financial)\(^1\) [5]: represents the cost of treatment relative to population income. In this evaluation, two elements were considered for the comparison: (1) The minimum wage of a government worker and (2) The minimum wage of a farm worker.

These items were compared to the cost of a defined treatment for a given condition (treatment of an episode of illness)\(^2\).

Catastrophic health expenditure: several definitions or approaches can be used to measure catastrophic health expenditures: (1) Households face catastrophic expenses if the ratio of total health expenditure to the difference between income and food expenditure exceeds the 40% threshold [6]. (2) When direct payments for health services consume a large portion of a household’s disposable income, leading to poverty [7]. (3) They are also described as part of the health care budget that exceeds a predefined threshold [8].

We have used 40% of salary income as the threshold for catastrophic health expenses, compared to the average wage of a farm worker and the minimum wage of Senegal.

\(^1\)Adapted from WHO & HAI definition.

\(^2\)Presidential Decree No. 96-154 of 19 February 1996.

Data collection

Drug data

Drug data were collected using an Excel file, which included a list of all cancer drugs available in Senegal, published on the National List of Essential Drugs and Products [9]. These data are included in the column of information about the drug, according to the nomenclature of the National Purchasing Office for Essential Drugs: number, code, International Nonproprietary Name of the product, dosage form, packaging, and specialty name. Columns dedicated to the calculation of study variables are: number of days of rupture and costs per conditioning.

Data for the assessment of affordability

The diseases targeted for evaluation were established by mutual agreement with an oncologist at the Cancer Institute of Dakar; it also allowed to retain the precise protocols for each of these diseases, selected according to: (1) their frequency in Senegal and (2) their chemo-sensitivity.

The selection is indicated in Table 1: The data collection on affordability was done using a standard form, based on the method proposed by World Health Organization (WHO) and healthcare-associated infections (HAI), reporting the cost of standard treatment of each of the tracer diseases, the number of days of minimum wage of a government worker, and the average income of a Senegalese farmer.

For each condition, the unit prices displayed at the central drug purchasing center were recorded by the investigator.

Table 1: Type of cancer and therapeutic protocols used for the assessment of affordability

<table>
<thead>
<tr>
<th>Type of cancer</th>
<th>Therapeutic protocol</th>
<th>Drug (INN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>FAC</td>
<td>5-Fluorouracil&lt;br&gt;Doxorubicin&lt;br&gt;Cyclophosphamide</td>
</tr>
<tr>
<td></td>
<td>FEC</td>
<td>5-Fluorouracil&lt;br&gt;Epirubicin&lt;br&gt;Cyclophosphamide</td>
</tr>
<tr>
<td></td>
<td>Taxotere</td>
<td>Docetaxel</td>
</tr>
<tr>
<td>Uterine cervix</td>
<td>Carbotaxol</td>
<td>Carboplatin&lt;br&gt;Paclitaxel</td>
</tr>
<tr>
<td>Prostate</td>
<td>Taxotere</td>
<td>Docetaxel</td>
</tr>
<tr>
<td>Colorectal</td>
<td>FOLFIRI</td>
<td>5-Fluorouracil&lt;br&gt;Irinotecan&lt;br&gt;Calcium folinate</td>
</tr>
<tr>
<td>Esophagus</td>
<td>Carbotaxol</td>
<td>Carboplatin&lt;br&gt;Paclitaxel</td>
</tr>
</tbody>
</table>
Other parameters required for the assessment of affordability were standardized for the evaluation: (1) Protocols: the protocol is developed according to the consensus of an international scholarly society of oncologists. The discussion of the protocol is established in advance, by consultation between the different specialists taking care of the patient. (2) Number of units required for treatment: calculated on the basis of the standard duration of treatment for each of the conditions. (3) Daily minimum wage of a government worker in Senegal. (4) Average daily income of a farm worker in Senegal.

### Data processing and analysis

The financial data were entered on Excel sheets, compiled and analyzed according to the study’s objectives. This analysis was based on that proposed by WHO for the affordability of medicines.

The analysis of affordability was done through the data collection on: (1) Patient transfer price. (2) The cost of chemotherapy treatment has been compared to the minimum wage of a government worker and the minimum income of a Senegalese agricultural worker. Therefore we will analyze the capacity of these two categories of individuals to pay, in particular the portion treatment takes in their respective daily average and minimum income.

The cost of treatment could thus be translated into “number of daily wages.” In an arbitrary way, the 72-day salary threshold for a given treatment was considered to signal a catastrophic health expense. This threshold represents 40% of the total duration of the treatments (180 days).

### Ethical aspects

No confidential or private data were collected in this study. No interaction between investigators and patients took place. The study protocol was previously validated by the steering committee of the National Purchasing Office for Essential Drugs before its implementation.

### RESULTS

The financial accessibility of cancer drugs in Senegal varied according to the type of cancer and the therapeutic protocol applied. Total cost in CFA francs\(^6\) of drugs for a complete cure is presented in Table 2.

The total cost of treatment ranged from 97,000 (FAC protocol for breast cancer) to 1,262,400 (FOLFIRI protocol for colorectal cancer). The average cost was 440,893 ± 293,863.

### Table 2: Total cost of drugs per therapeutic protocol

<table>
<thead>
<tr>
<th>Type of cancer</th>
<th>Therapeutic protocol</th>
<th>Total costs of drugs (in CFA)</th>
<th>Total costs of drugs (in USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>FAC</td>
<td>97,200</td>
<td>173.65</td>
</tr>
<tr>
<td></td>
<td>FEC</td>
<td>208,800</td>
<td>373.03</td>
</tr>
<tr>
<td></td>
<td>Taxotere</td>
<td>180,800</td>
<td>323.00</td>
</tr>
<tr>
<td>Uterine cervix</td>
<td>Carbotaxol</td>
<td>513,600</td>
<td>917.56</td>
</tr>
<tr>
<td>Prostate</td>
<td>Taxotere</td>
<td>271,200</td>
<td>484.51</td>
</tr>
<tr>
<td>Colorectal</td>
<td>FOLFIRI</td>
<td>1,262,400</td>
<td>2255.31</td>
</tr>
<tr>
<td>Esophagus</td>
<td>Carbotaxol</td>
<td>513,600</td>
<td>917.56</td>
</tr>
<tr>
<td>Ovary</td>
<td>Carbotaxol</td>
<td>513,600</td>
<td>917.56</td>
</tr>
<tr>
<td>Stomach</td>
<td>XELOX</td>
<td>840,000</td>
<td>1500.68</td>
</tr>
<tr>
<td></td>
<td>DCF</td>
<td>308,400</td>
<td>550.96</td>
</tr>
<tr>
<td></td>
<td>FLOT</td>
<td>474,000</td>
<td>846.81</td>
</tr>
<tr>
<td>Lung</td>
<td>Carbotaxol</td>
<td>513,600</td>
<td>917.56</td>
</tr>
<tr>
<td></td>
<td>Carbo-etoposide</td>
<td>261,600</td>
<td>467.36</td>
</tr>
<tr>
<td>ENT</td>
<td>Carbo-etoposide</td>
<td>261,600</td>
<td>467.36</td>
</tr>
<tr>
<td>Testicle</td>
<td>BEP</td>
<td>393,000</td>
<td>702.11</td>
</tr>
</tbody>
</table>

\(^6\)55,957 CFA francs = 1 € or 1080 US$. 

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Table 1: (Continued)
The catastrophic health expenditure threshold is reached at 72 days of daily salary, for all types of cancer over a period of six months of treatment. To treat breast cancer, oncologists have used three treatment protocols that are: FAC, FEC, and TAXOTERE. The salary days required for the treatment exceeded two times the catastrophic expenditure threshold for the agricultural worker and a civil servant for the FEC and TAXOTERE protocol (Figure 1).

For cervical cancer, the CARBOTAXOL protocol was applied with salary days needed for treatment exceeding five times the catastrophic expenditure threshold for the agricultural worker and four times for the civil servant. For prostate cancer, the TAXOTERE protocol was applied with salary days required for treatment exceeding times the catastrophic expenditure threshold for the agricultural worker and two times for a civil servant. For colorectal cancer, the FOLFIRI protocol was applied with salary days required for treatment exceeding five times the catastrophic expenditure threshold for the agricultural worker and 10 times for a civil servant (Figure 2).

For cancer of the esophagus, the CARBOTAXOL protocol was applied with salary days needed for treatment exceeding five times the catastrophic expenditure threshold for the agricultural worker and four times for a civil servant. For ovarian cancer, the CARBOTAXOL protocol was applied with salary days needed for treatment exceeding five times the catastrophic expenditure threshold for the agricultural worker and four times for a civil servant. For stomach cancer, the XELOX, DCF, and FLOT protocols were applied. The XELOX protocol had salary days needed for treatment exceeding eight times the catastrophic expenditure threshold for the agricultural worker and seven times for a civil servant. The DCF protocol had salary days required for treatment exceeding times the catastrophic expenditure threshold for the agricultural worker and the civil servant. The FLOT protocol had salary days required for treatment exceeding four times the catastrophic expenditure threshold for the agricultural worker and a civil servant. For lung cancer, CARBOTAXOL and CARBO-ETOPOSIDE protocols have been applied. The CARBOTAXOL protocol had salary days needed for treatment exceeding five times the catastrophic expenditure threshold for the agricultural worker and four times for a civil servant. The CARBO-ETOPOSIDE protocol had salary days required for treatment exceeding two times the catastrophic expenditure threshold for the agricultural worker and the civil servant. For ENT cancers, the CARBO-ETOPOSIDE protocol was applied with salary days required for treatment exceeding two times the catastrophic expenditure threshold for the agricultural worker and three times for the civil servant.

In conclusion, the FAC protocol is the only protocol accessible by the agricultural worker and the public service officer. The rest of the protocols fall under catastrophic health spending.

**DISCUSSION**

**Limitations of the study**

The study was strictly limited to the drugs used in the selected protocols. The costs reported here are therefore well below the costs of cancer care; they only concern drugs, which are largely subsidized by the state. Other aspects directly or indirectly involved in chemotherapy have not been considered: needles and syringes, solvents, palliative chemotherapy, salaries, depreciation, inter-cure check-ups, drugs used against the side effects of chemotherapy (vomiting, anemia, etc.).

In fact, in our study, catastrophic expenditures were largely underestimated because of the method used: (1) Which excluded many direct or indirect expenses and (2) Which fixed 40% as arbitrary threshold of catastrophic expenses of wage income.

A study of the full costs would indeed have considered these various items of expenditure, which are not the least for the patient. In addition, data collection has been hampered by the reluctance of some providers to provide investigators with the required information. Thus, the availability of anticancer drugs could only be assessed.
at National Central Purchasing Office of Essential Drugs and Fann Hospital, while General Hospital of Grand-Yoff and Aristide Le Dantec Hospital were planned. We did not work with Dakar’s Principal Hospital.

Financial accessibility and catastrophic health expenses

A study in India estimated that catastrophic spending threshold was reached when households spent 40% of their purchasing power on health expenditures. The impoverishment linked to health expenditure was considered in the situation, when these were subtracted from consumption expenditure, they led to per capita expenditures below the poverty line for the country [10].

The same study reveals a growing increase in household-level health expenditures between 1995 and 2004, rising from 31.6% to 47.3%. These expenditures were mainly from savings and household income (between 40% and 60%), while 30% to 35% came from loans outside the household. The share of catastrophic expenditures attributable to cancer was 170% higher than catastrophic expenditures related to the management of communicable diseases. This proportion was 22% for cardiovascular diseases and injuries [10].

This situation illustrates what is happening in developing countries. Although no comprehensive study has been done about it, it can be accepted that expenditure attributable to cancer and other NCD impoverished families in similar or even greater proportions.

The situation is different in Europe, where a study conducted in European countries shows that cardiovascular diseases are more associated with catastrophic expenditures than cancer [11].

Direct payments, a source of financial instability

In general, the portion of payment that the patient is responsible for is made through direct payments (out of pocket). For most public hospital clients, this is even the only alternative, not including state health services subsidies.

These payments are usually unexpected and unforeseen, and are sources of financial instability for households. In addition to the catastrophic amount of expenditure, they contribute to lasting impoverishment of households [11]. They also relate to all the other items of direct expenditure (consultations, drugs, laboratory analyzes) or indirect expenses (transport, special nutrition) [12].

In a study conducted in China on patients with rectal colorectal cancer, it was observed that direct payment in the first year after their diagnosis accounted for up to 60% of their household income calculated over the previous year [13].

Direct payments result in a rate of waiver of treatment that can be very high. A study carried out in Mexico showed that the lack of health insurance coverage led to early hospital exits in patients with breast cancer (which is the leading cause of cancer mortality in women), with a subsequent increase in mortality among them, compared to the group of women receiving health insurance [14].

In a longitudinal study conducted in Southeast Asia in cancer patients [15], the costs were considered catastrophic when direct payment of treatment was 30% of annual household income. One year after their diagnosis, 29% of those monitored had died, 48% lived in financial disaster, only 23% remained alive without catastrophic expenses. Here again, patients not covered by a health insurance system were more likely to experience catastrophic expenses (RR = 1.27).

Household socioeconomic status changes as a result of catastrophic expenditures

Low-income and households not covered by social security may therefore be at greater risk of poverty and misery because of the cost of care and direct payment, but also because of the loss of income caused by the disease and its consequences on their quality of life in general. When the head of the household suffers from cancer, this leads in the medium term to a significant change in the socioeconomic status of the household [16].

Survival rates for most cancers are low and quality of life is greatly impaired, with significant consequences for household socioeconomic status [17]. In addition, this disease is a burden for individuals and their households, especially the poor and the uninsured, because of the lasting impact on the socioeconomic status of the household [16].

Due to their extent and their medical care costs, colorectal cancers are probably among the most consequential for the household; worldwide, colorectal cancer (CRC) is the third most commonly diagnosed cancer in men and the fourth most common in women [18]. In 2012, there were an estimated 159,100 new male cases and 142,200 new female cases in China [19]. The patients and their families suffer both financially and emotionally from this burden, which cause intangible costs [11]. This causes a decrease in the well-being of the patient or his relatives caused by pain, suffering, or emotional impact of the disease or treatment [20].

Cancer has socioeconomic and financial consequences that go beyond catastrophic spending. In fact, the patient becomes unable to work because of the burden of his symptoms, treatment, or side effects [4].

CONCLUSION

Expenditure related to the purchase of drugs for cancer chemotherapy is well beyond the means of Senegalese people, despite a large subsidy from the Ministry of Health. Almost all treatment protocols fall
within the scope of catastrophic health expenditure. The consequences of this situation can be all the more serious as they generally result from direct payment by patients or their families, who are ultimately reduced to sacrificing all their assets for treatment whose outcome remains uncertain.

Our results, which only considered the cost of drugs, confirm other studies in developing countries, particularly in Asia, which show how cancer depletes households by diverting savings to care, and leading them to debt. In the long run, studies have also shown that the lack of access to treatment is a key factor in foregoing treatment and subsequent mortality.

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Ahmadou Dem – Conception of the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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Conflict of Interest
Authors declare no conflict of interest.

Data Availability
All relevant data are within the paper and its Supporting Information files.

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