

Availability, prices, and affordability of selected essential cancer medicines in a middle-income country – the case of Mexico

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Abstract

Background: More alternatives have become available for the diagnosis and treatment of cancer in low- and middle-income countries. Because of increasing demands, governments are now facing a problem of limited affordability and availability of essential cancer medicines. Yet, precise information about the access to these medicines is limited, and the methodology is not very well developed. **Objective:** To assess the availability and affordability of essential cancer medicines in Mexico, and compare their prices against those in other countries of the region. **Methods:** We surveyed 21 public hospitals and 19 private pharmacies in 8 states of Mexico. Data were collected on the availability and prices of 49 essential cancer medicines. Prices were compared against those in Chile, Peru, Brazil, Colombia and PAHO's Strategic Fund. **Results:** Of the various medicines, mean availability in public and private sector outlets was 61.2% and 67.5%, respectively. In the public sector, medicines covered by the public health insurance "People's Health Insurance" were more available. Only seven (public sector) and five (private sector) out of the 49 medicines were considered affordable. Public sector procurement prices were 41% lower than in other countries of the region. **Conclusions:** The availability of essential cancer medicines, in the public and private sector, falls below World Health Organization's 80% target. The affordability remains suboptimal as well. A national health insurance scheme could serve as a mechanism to improve access to cancer medicines in the public sector. Comprehensive pricing policies are warranted to improve the affordability of cancer medicines in the private sector.

Introduction

Comprehensive cancer care requires a number of interventions, from specialized diagnostics to various treatments including: surgery, radiotherapy, and chemotherapy [1,2]. Low-cost and effective medicines to treat several cancers exist in generic form [3]. However, the prices of many cancer medicines (both generic and originators) make them unaffordable for governments and patients, and contribute to their in health facilities in many low- and middle-income countries (LMIC) [4]. Unavailable and unaffordable essential cancer medicines may lead to substandard and/or interrupted treatment regimens, worse health outcomes, and lower chances of survival [2]. Therefore, equitable access to affordable essential medicines is a crucial component of comprehensive cancer care [3,5–7].

In absolute terms, cancer has become a leading cause of death and disability around the globe. Yet, many patients in LMIC remain untreated [2,3,8,9], and access to cancer care, including medicines, is becoming a priority. Describing the current access to cancer medicines and understanding the barriers that hinder their accessibility [10] are key components to develop responsive national policies, and to measure their impact. In general, comparable information about access to cancer medicines is limited worldwide [10,11]. Direct assessment of the availability and affordability of essential cancer medicines has rarely been conducted in LMICs [11], except in Tanzania [12] and Pakistan [13]. Most studies have been limited to infectious diseases and medicines to treat non-communicable diseases (NCDs) other than cancer [14–17].

In Mexico, cancer accounts for nearly 13% of deaths [18–20]. Cancer care in Mexico is available in the public and private sectors. In the public sector, social health insurance institutions provide comprehensive health services (including cancer treatment) to employees in the formal sector. People who are ineligible for social health insurance can affiliate to the People's Health Insurance (Seguro Popular de Salud - SPS) – a federal government insurance scheme that reimburses health facilities (usually Ministry of Health (MoH) facilities) according to a catalog of services [21,22]. This population can also receive coverage for high-cost services (e.g. all pediatric cancers and eight types of cancers in adults) through the Fund against Catastrophic Expenditures (FPGC) [2,23]. SPS patients receive healthcare and medicines at the point of service with no additional cost. For those diseases not covered by SPS, patients might pay out-of-pocket for some services and medicines according to their level of income. The private sector consists of private pharmacies and health facilities where patients pay additional insurance contributions or out-of-pocket [21]. While several studies have investigated insurance coverage for breast, cervical and children cancer care in the public sector [23–25], there is scant research on the availability and affordability of cancer medicines.

The purpose of this study was to assess and compare the availability and affordability of essential cancer medicines in the public and private sectors in Mexico. We also compared consumer procurement and consumer prices in the two sectors against those in four other middle-income countries in the region (Brazil, Colombia, Chile and Peru).

Methods

The standardized World Health Organization/Health Action International (WHO/HAI) methodology [26] that measures medicine prices, availability and affordability was adapted to study essential medicines for cancer, collecting data from a sample of public hospitals and private pharmacies across the country.

Sample

We selected 49 cancer medicines (each strength and dose-form specific) from the national formulary. According to the national clinical guidelines, the SPS protocols and the National Institute of Cancerology's (INCAN) guidelines, these medicines are required for the treatment of breast cancer, colorectal cancer, leukemia and renal cancer. Of these, the SPS reimburses 40 medicines (for more information on the medicines of study see Additional file 1).

Data were collected in Mexican states where cancer care is provided. A total of 26 specialized and tertiary hospitals in the public sector were selected from eight of 32 states of the country, with differing levels of marginalization [27,28], Organization for Economic Co-operation and Development (OECD) health well-being levels [29], and with at least one MoH hospital specialized in cancer care (Table 1). In this way, our sample captured the variability and characteristics of the health system. We surveyed all MoH hospitals providing cancer care in the selected states except in Chihuahua, Oaxaca and Veracruz. We did not survey five hospitals in these three states due to logistical issues and hospital's refusal to participate.

Table 1. Characteristics of selected states and number of facilities surveyed

State	Level of Marginalization	OECD Health well-being indicator	No. Public Hospitals surveyed	No. Private Pharmacies surveyed
Campeche	High	Low	1	1
Oaxaca	High	Low	2	2
Veracruz	High	Low	3	2
Chihuahua	Medium	Low	2	2
Guanajuato	Medium	Medium	3	3
Yucatan	Medium	Medium	2	3
Jalisco	Low	High	4	3
Mexico	Low	High	4	3
City				

*OECD - Organization for Economic Co-operation and Development

Cancer medicines are not always continuously stocked in private pharmacies. Instead, pharmacies that dispense these medicines usually do so from a fixed inventory list, with next-day delivery. We selected 1 to 3 pharmacies that market specialty medicines (e.g. cancer medicines) in each of the eight states, resulting in a total of 19 pharmacies.

Data collection

The survey was conducted from March to June 2017. From the public sector hospital pharmacies, we recorded whether the medicine was in stock at the time of the visit (yes/no), and the price paid by the hospital and by the patient (if applicable). We did not distinguish between originator brands or generics, because the Mexican public sector regularly procures generic versions of multisource medicines and only provides originator (patented) medicines when no generics are available.

In the private sector pharmacies, we recorded whether the medicine was included in the pharmacy's inventory and could be ordered for next-day delivery (yes/no), the price paid by patients of the lowest-priced generic available and the price of the patented medicines.

Data analysis

We conducted the data analysis using the WHO/HAI methodology workbook [26] as described in the following sections.

Availability

We assessed availability in each sector by calculating the percentage of facilities where each medicine was available, and the mean across a collection of medicines. In the public sector, we also compared availability per disease, since breast cancer and colorectal cancer are covered by SPS for adults and children, while leukemia and renal cancer are covered for children only.

Affordability

We assessed affordability from the patient's perspective when paying out-of-pocket. For each medicine, we compared the defined daily dose values [30] and the median unit price with the minimum daily wage in 2017 [26,31]. Based on affordability assessments by Khatib et. Al [32] and Sarwar et al. [13], we considered a medicine as affordable if 20% or less of the daily wage was needed to pay for one day of medicine [13,32]. In public hospitals, affordability was only assessed in the three hospitals where patients pay out-of-pocket for cancer medicines. We were not able to include data from the other hospitals, as these reported that patients did not pay out-of-pocket for their medicines or only paid a co-payment (for all healthcare services) according to their level of income when they do not have SPS coverage.

Prices and international price comparison

The WHO/HAI methodology expresses prices as a ratio (Median Price Ratio (MPR)) to international reference prices, which are the median supplier prices reported by Management Sciences for Health (MSH) [33]. As MSH reported prices for a limited number of the study medicines, prices from publicly accessible websites of comparable countries in the region were also used as external benchmark, namely Brazil, Colombia, Chile (recently considered a high-income country) and Peru [34–37]. To calculate MPRs, MSH international reference prices, the Pan-American Health Organization (PAHO) Strategic Fund procurement prices and 2017 median public sector procurement prices in the comparator countries were compared with Mexican public procurement prices. For patient prices, comparisons were made with median patient prices of patented and lowest priced generic medicines in the comparator countries.

Results

Availability and affordability of medicines in the public and private sectors

Table 2 shows the availability and affordability of cancer medicines in the public hospitals and private pharmacies we surveyed. In the public sector, the overall mean availability was 61.2%, with 70.2% availability of the SPS medicines. Mean availability of medicines was: for breast cancer 81.8%, for leukemia 69.2%, for colorectal cancer 62.9%, and renal cancer 57.3%. Overall availability in the private sector was 67.4%. Generic medicines (60.6%) were more available than patented medicines (54.0%). The availability of patented medicines was below 50% in the public and private sectors for most medicines

except bevacizumab 400mg, L-asparaginase, mercaptopurine, rituximab 100mg and 500mg, and trastuzumab.

In the public sector, the median affordability (n=49 medicines) was 1.45 days' wages required to purchase one day's supply. Seven medicine products were considered affordable, that is, one day of medicine supply costs 20% or less of the daily wage: etoposide, fluorouracil, letrozole, methotrexate (2.5mg tablet (tab), 500mg injectable (inj) and 50mg inj) and tamoxifen. In the private sector, five medicine products were considered affordable: fluorouracil, methotrexate 500mg inj and 50mg inj, tamoxifen, and methotrexate 2.5mg tab. The median price of overall medicines in the private sector was 5.50 days' wages needed to buy one day of one medicine's supply. The median affordability of patented medicines was 30.17 days' wages needed to buy one day of one medicine's supply. For the generic medicines, it was 0.78 days' wages.

Table 2. Availability and affordability of 49 selected cancer medicines in public hospitals and private pharmacies

No.	Medicine	Availability		Affordability*	
		Public Sector (n= 21)	Private Sector (n= 19)	Public Sector (n= 21)	Private Sector** (n= 19)
1	Anastrozole 1mg tab	76.19%	89.47%	0.24	0.59
2	Bevacizumab 100mg inj	42.86%	73.68%	30.12	57.68
3	Bevacizumab 400mg inj	66.67%	68.42%	29.42	51.99
4	Capecitabine 500mg tab	76.19%	78.95%	1.88	5.50
5	Carboplatin 150mg inj	85.71%	68.42%	0.44	0.83
6	Cetuximab 5mg/ml inj	38.10%	36.84%	35.74	62.88
7	Cyclophosphamide 200mg inj	80.95%	84.21%	0.48	0.67
8	Cyclophosphamide 500mg inj	95.24%	73.68%	0.53	0.64
9	Cytarabine 500mg inj	95.24%	84.21%		
10	Dasatinib 50mg tab	4.76%	31.58%	17.20	33.95
11	Daunorubicin 20mg inj	66.67%	63.16%		
12	Docetaxel 20mg/1ml inj	66.67%	78.95%	5.26	8.00
13	Docetaxel 80mg/4ml inj	71.43%	84.21%	3.78	6.59
14	Doxorubicin 10mg inj	85.71%	73.68%	0.61	1.09
15	Doxorubicin 50mg inj	85.71%	84.21%	0.45	0.57
16	Epirubicin 10mg/5ml inj	42.86%	63.16%		3.00
17	Epirubicin 50mg/25ml inj	61.90%	84.21%	0.57	1.86
18	Etoposide 20mg/ml inj	95.24%	78.95%	0.16	0.33
19	Everolimus 10mg tab	14.29%	42.11%	21.26	30.17
20	Everolimus 5mg tab	9.52%	42.11%		30.17
21	Exemestane 25mg tab	85.71%	78.95%	1.02	0.73
22	Fluorouracil 250mg inj	80.95%	52.63%	0.10	0.16
23	Folinic Acid 50mg/4ml inj	95.24%	63.16%		
24	Folinic Acid 15mg tab	42.86%	57.89%		
25	Gemcitabine 1g inj	76.19%	78.95%	1.09	4.86
26	Ifosfamide 1g inj	85.71%	73.68%	3.15	5.50
27	Imatinib 100mg tab	33.33%	63.16%	3.58	17.59
28	Imatinib 400mg tab	38.10%	47.37%	3.43	18.63

29	Irinotecan 20mg/ml inj	76.19%	68.42%	3.18	7.25
30	L-Asparaginase 10000IU inj	76.19%	84.21%	13,15	17.03
31	Letrozole 2.5mg tab	66.67%	84.21%	0.20	0.44
32	Mercaptopurine 50mg tab	52.38%	84.21%	1.45	2.38
33	Methotrexate 2.5mg tab	71.43%	84.21%	0.02	0.07
34	Methotrexate 500mg inj	80.95%	78.95%	0.02	0.02
35	Methotrexate 50mg inj	95.24%	68.42%	0.06	0.11
36	Nilotinib 200mg tab	23.81%	36.84%		21.72
37	Oxaliplatin 100mg/20ml inj	61.90%	84.21%	0.89	2.36
38	Oxaliplatin 50mg/10ml inj	57.14%	73.68%	1.25	2.40
39	Paclitaxel 6mg/ml inj	80.95%	78.95%	0.45	1.63
40	Panitimumab 20mg/ml inj	28.57%	42.11%	31.72	58.93
41	Pazopanib 200mg tab	9.52%	26.32%		14.89
42	Pazopanib 400mg tab	4.76%	52.63%	8.49	14.89
43	Rituximab 100mg/10ml inj	61.90%	68.42%	6.65	30.97
44	Rituximab 500mg/50ml inj	71.43%	68.42%	4.65	30.96
45	Sorafenib 200mg tab	19.05%	57.89%	19.59	31.13
46	Sunitinib 12.5mg tab	14.29%	47.37%	11.89	25.10
47	Tamoxifen 20mg tab	90.48%	78.95%	0.02	0.06
48	Trastuzumab 440mg inj	71.40%	57.89%	13.77	23.63
49	Vincristine 1mg inj	85.71%	78.95%	0.35	0.45
Mean availability/		61.20%	67.45%	1.45	5.50
Median affordability					
Mean availability/Median affordability:					
	Breast cancer medicines	74.8%	78.1%	0.57	1.36
	Leukemia medicines	59.3%	66.4%	3.50	17.72
	Colorectal cancer medicines	55.6%	58.3%	2.53	6.37
	Renal cancer medicines	52.0%	61.9%	1.09	17.72

tab= tablet; inj= injectable; mg= milligrams; ml= milliliters; IU= international unit; n= number of facilities surveyed and included in the analysis

* Affordability is expressed as number of days needed to purchase one day of treatment based in minimum daily wage

**Affordability in the private sector: we present only the affordability of the lowest priced generic medicines. For medicines with no generic alternatives, we present the affordability of the patented/originator medicine

Procurement and patient prices

Table 3 shows median public sector procurement prices and median patient prices in the private sector, both in local currency (Mexican peso (Mex\$)) and as ratios to median prices in the four comparator countries and international reference prices. In the public sector, the overall median procurement price in Mexico was 0.59 times (41% below) the median comparator country price and 0.80 times (20% below) the MSH international reference prices. However, the prices of a few individual medicines were over twice the median comparator country price, e.g. MPR of anastrozole (2.12x), docetaxel 80mg (5.56x) and 20mg inj (3.40x). The prices of docetaxel 20 mg/ml (12.42x) and 80mg/ml (12.08x), folinic acid 50mg/ml (3.88x) and irinotecan (6.16x) were over three times the MSH international reference prices. For patient prices in the private sector, overall medicines had median MPRs of 0.65 (35% below the reference prices). Cancer medicines ranged from an MPR of 0.13 for oxaliplatin 50mg inj to 2.48 for docetaxel 80mg inj. Most medicine prices were 2 to 6 times higher in the other Latin American (LATAM) countries compared to Mexico. On the other hand, six medicines were cheaper in Peru. Only the price of docetaxel was consistently higher in Mexico (Figure 1).

Table 3. Median public procurement prices and median patient prices, in local currency and as price ratios to comparator countries

No.	Medicine Name	Public Sector Procurement			Private Sector Patient	
		Price (Mex\$)	MPR (LATAMc)	MPR (MSH)	Price* (Mex\$)	MPR (LATAMc)
1	Anastrozole 1mg tab	24.29	2.12	2.35	47.36	1.27
2	Bevacizumab 100mg inj	53.58	0.58		102.59	0.82
3	Bevacizumab 400mg inj	48.67	0.66		92.48	0.84
4	Capecitabine 500mg tab	22.07	0.59	0.67	73.33	0.89
5	Carboplatin 150mg inj	1.27	0.31	0.65	2.67	0.21
6	Cetuximab 5mg/ml inj	40.81	0.61		77.43	1.01
7	Cyclophosphamide 200mg inj	0.15	0.41	0.36	0.21	0.35
8	Cyclophosphamide 500mg inj	0.14	0.37	0.45	0.20	0.42
9	Cytarabine 500mg inj	0.30	1.08	1.66	0.60	0.58
10	Dasatinib 50mg tab	573.78	0.57		1132.27	1.46
11	Daunorubicin 20mg inj	5.90	0.25	0.31	12.99	0.31
12	Docetaxel 20mg/1ml inj	62.93	3.40	12.42	99.53	0.54
13	Docetaxel 80mg/4ml inj	51.83	5.56	12.08	82.00	2.48
14	Doxorubicin 10mg inj	7.45	1.23	1.79	17.53	0.42
15	Doxorubicin 50mg inj	3.92	0.86	1.38	9.20	0.49
16	Epirubicin 10mg/5ml inj	12.84	0.36	1.20	34.35	0.59
17	Epirubicin 50mg/25ml inj	6.20	0.41	0.73	21.28	0.38
18	Etoposide 20mg/ml inj	0.49	0.64	1.30	1.06	2.01
19	Everolimus 10mg tab	1702.00	0.83		2414.97	0.65
20	Everolimus 5mg tab	425.50	0.44		1207.48	0.65
21	Exemestane 25mg tab	69.18	1.08	1.69	58.50	0.66
22	Fluorouracil 250mg inj	0.08	0.49	0.38	0.13	0.63
23	Folinic Acid 50mg/4ml inj	3.56	0.76	3.88	4.60	1.14

24	Folinic Acid 15mg tab	15.84	0.71	0.62	23.33	0.80
25	Gemcitabine 1g inj	0.44	0.32	0.89	1.95	0.37
26	Ifosfamide 1g inj	0.27	0.75	1.30	0.63	0.83
27	Imatinib 100mg tab	57.32	0.54	4.22	281.58	0.52
28	Imatinib 400mg tab	219.48	0.77	0.44	1192.74	0.66
29	Irinotecan 20mg/ml inj	6.97	1.20	6.16	19.34	0.35
30	L-Asparaginase 10000IU inj	0.11	0.49	1.06	0.14	0.92
31	Letrozole 2.5mg tab	2.62	0.04	0.28	35.00	1.03
32	Mercaptopurine 50mg tab	33.24	0.59	0.76	54.48	1.25
33	Methotrexate 2.5mg tab	1.20	0.36	0.39	5.81	1.73
34	Methotrexate 500mg inj	0.45	1.13	1.35	0.79	0.61
35	Methotrexate 50mg inj	1.22	0.59	0.59	3.44	1.05
36	Nilotinib 200mg tab	279.07	0.56	11.92	579.59	0.84
37	Oxaliplatin 100mg/20ml inj	6.36	0.78	0.43	17.15	0.18
38	Oxaliplatin 50mg/10ml inj	8.52	1.11	0.75	17.45	0.13
39	Paclitaxel 6mg/ml inj	2.78	0.76		8.72	0.58
40	Panitimumab 20mg/ml inj	76.99	0.84		157.23	1.18
41	Pazopanib 200mg tab	170.44	0.56		297.90	0.59
42	Pazopanib 400mg tab	339.86	0.57		595.85	0.45
43	Rituximab 100mg/10ml inj	13.09	0.45	0.49	77.46	0.85
44	Rituximab 500mg/50ml inj	10.82	0.21	0.31	77.44	1.26
45	Sorafenib 200mg tab	404.04	0.73		622.82	0.67
46	Sunitinib 12.5mg tab	326.01	0.43		717.58	0.53
47	Tamoxifen 20mg tab	1.46	0.68	0.66	4.90	0.41
48	Trastuzumab 440mg inj	49.29	0.68		94.56	0.97

49 Vincristine 1 mg inj	53.66	0.36	0.84	101.00	0.53
Median	12.84	0.59	0.80	41.18	0.65

OB = originator brand; LPG = Lowest Price Generic; tab= tablet; inj= injectable; mg= milligrams; ml= milliliters; IU= international unit; n= number of facilities surveyed and included in the analysis; LATAMc=Latin American countries MPR=Median Price Ratio; Mex\$ = Mexican Peso; MSH = Management Sciences for Health

*Median prices and MPR in the private sector: we present only the median prices and the MPR of the lowest priced generic medicines. For medicines with no generic alternatives, we present the median prices and the MPR of the patented/originator medicine

Discussion

In Mexico, the overall availability of cancer essential medicines in the public sector was slightly lower than in the private sector. In general, prices in Mexico were lower than international reference prices and lower than other LATAM countries. Only few medicines were considered affordable in both the public and private sectors; affordability of medicines in the public sector (14% of medicines) was slightly better than in the private sector (10% of medicines).

Availability of cancer medicines

The average availability of cancer medicines was lower in the public sector (61.2%) than in the private sector (67.45%), with high variability across individual medicines. The availability of SPS medicines was slightly higher (70.2%), especially for those for breast cancer and leukemia. Greater availability reflects an increased government investment in these two types of cancer treatments. Access to colorectal cancer medicines was lower than breast cancer and leukemia medicines; barriers to access essential medicines for colorectal cancer have been reported [22], despite the fact that colorectal cancer is covered by SPS. Renal cancer medicines for adult patients had the lowest availability of all, likely because they are not covered by SPS and therefore deprioritized [38,39].

Overall, the availability of cancer medicines falls below the World Health Organization's (WHO) target of 80% for essential medicines to treat major NCDs (which includes cancer) [40–42]. Thus, mechanisms to improve the availability of cancer medicines in Mexico are warranted. Low availability in the private sector could be explained by the fact that specialized medicines are marketed in selected pharmacy chains only. Therefore, patients have a limited choice of pharmacies, restricted to some states and mostly in urban areas.

The availability of cancer medicines in Mexico's public sector is higher than other LMIC countries from which data were available. For example, studies in Tanzania and Pakistan [12,13] reported 50% availability of cancer medicines in the public sector. In Pakistan, the availability of cancer medicines in the private sector was higher than in the public sector, which is a common trend in LMIC [13]. However,

private pharmacies in Pakistan focus more on stocking originator brand cancer medicines, while in Mexico private pharmacies have a better availability of generic cancer medicines [13].

Affordability of cancer medicines

Most cancer medicines are unaffordable for patients, in the private and in three public hospitals where patients paid for cancer medicines. Based on our own definition, only 7 out of 49 cancer medicines were affordable [13,32]. In addition, most cancer treatment regimens require more than one medicine, making the treatment as a whole even less affordable, often leading to catastrophic expenditures and poverty [6,43,44]. The studies from Tanzania and Pakistan also reported that cancer medicines required more than one working day to pay for one day of treatment, therefore considered unaffordable to most patients [12,13]. These results, including Mexico, confirm the LMIC's general picture of unaffordability of essential cancer medicines. Therefore, more aggressive pricing policies are needed to disrupt this ongoing problem.

We also found that 18 out of 21 of the public hospitals we surveyed reported no additional charges for patients without SPS coverage, as a mechanism to guarantee access to treatment without incurring in health expenditure. For those hospitals that do charge uninsured patients for treatment, these patients must make out-of-pocket payments for (mostly) unaffordable medicines and/or turn to charity organizations [23,45].

Procurement prices and international price comparison

We found that, in general, prices of cancer medicines in the public sector in Mexico were lower than other LATAM countries and international reference prices. The Mexican government has contained procurement prices better in the public sector than other countries in the region, through pooled procurement, price negotiations and using reference pricing for SPS medicines [46–49]. For SPS medicines, most public procurement prices were under the SPS reference prices [47,50], and overall about 20% lower than (MSH) international reference prices. Still, additional efforts are needed to further reduce and monitor prices; in particular for those that are more than twice the reference prices (e.g. docetaxel).

Overall, medicine prices in Mexico's private sector were lower than retail prices in the regional countries. Yet, current prices, especially for patented medicines, remain unaffordable, warranting the development of comprehensive price regulations schemes, which has not been properly introduced in the country yet [46,51]. High prices of patented cancer medicines seem common in the region, as other LATAM countries, such as Argentina, Chile, Uruguay, Paraguay and Brazil have reported unaffordable prices as well [52]. Such high prices in the private sector usually lead to catastrophic expenditure, in particular for low-income patients who were unable to get their medicines in the public sector [6]. Besides wider national health insurance coverage for public sector medicines, additional pricing policies are necessary to improve access to more affordable cancer medicines in the private sector.

Strengths and Limitations

To our knowledge, this is the first study on the availability, prices, and affordability of cancer medicines using an adapted form of the WHO/HAI methodology. This study collected data from a representative sample of public hospitals and private pharmacies in eight states. Future research should also consider assessing the availability, affordability, and prices of cancer medicines in other insurance schemes (social health insurance institutions) and other geographic regions of Mexico.

This study has some limitations. At the time of data collection, some medicines were reported as “just became out-of-stock”. Thus, our availability data may underestimate the actual availability of cancer medicines on a regular basis [26]. At one surveyed hospital, some medicine prices were restricted, as this information pertained to the state’s MoH database. In addition, our calculations of patient affordability account for single medicine for one day of treatment, which may underestimate the affordability of the treatment as a whole. Furthermore, our affordability assessment in the public sector is limited to the only 3 hospitals that reported patient prices for cancer medicines, which may understate our results on medicine’s affordability in the public sector. However, the current results show that medicines are still unaffordable to patients that receive care at those institutions and pay out of pocket for medicines without coverage.

We only surveyed pharmacies in the private sector because we did not obtain approval from private hospitals to conduct our research. Private hospitals providing cancer care provide chemotherapy at their facilities and care for approximately 19% of cancer cases [53]. Hence, our results do not fully represent the availability, prices, and affordability of cancer medicines in the private sector as a whole. However, the private sector hospitals and clinics represent approximately 2% [54] of the pharmaceutical market. Thus, omitting these data is not likely to have resulted in significant bias in our observations. Additional research is necessary to describe the availability and affordability of cancer medicines in this private subsector.

Practical implications

Medicines in the public sector covered by SPS were the most available, especially for breast cancer and leukemia. These results reflect the additional investment by the government to improve health care access to priority diseases. We recommend periodically revising and updating the SPS’s protocols for “resource appropriate strategies” [2] that guarantee the best level of care with the most efficacious and cost-effective medicines, including innovative medicines. We also recommend the expansion of SPS coverage to improve access to treatment to all types of cancer.

Overall, the Mexican government has kept prices of cancer medicines in the public sector below prices from other LATAM countries. Yet, most medicines remain unaffordable for patients – particularly for innovative medicines under patent. A comprehensive assessment of the government’s budget allocations and the complete calculation of costs of cancer care (i.e. pharmaceutical and non-pharmaceutical) are required.

The high prices and low affordability of cancer medicines in the private sector reflect a lack of pricing policies and pharmaceutical market regulation. Price monitoring, prices transparency for single-source products, and compulsory licensing when all other measures fail to yield affordable medicines, should be implemented to increase affordability for payers (patients and the health system). Mexico should also consider the full range of pricing policies [55] for medicines in the public and private sectors to assure the provision of affordable medicines for all patients.

Further research is needed to assess the affordability of medicines and comprehensive cancer treatments, both from the patient's and the health system's perspective. Continuous monitoring of prices and availability of cancer medicines is necessary to monitor their impact on health expenditure and access to cancer care.

Conclusions

The availability of cancer medicines in public hospitals and private pharmacies in Mexico need to improve in order to reach WHO's target of 80% availability. The SPS should be used as a public mechanism to ensure appropriate and timely access to cancer medicines. Although prices in the public sector were lower than in other countries of the region, most cancer medicines continue to be unaffordable to patients in Mexico. Comprehensive pricing policies are needed to improve the affordability of cancer medicines in the public and private sectors.

List Of Abbreviations

CG	Clinical Guidelines
FPGC	Fund against Catastrophic Expenditures
INCAN	National Institute of Cancerology (Instituto Nacional de Cancerología)
inj	injectable
INSP	National Institute of Public Health (Instituto Nacional de Salud Pública)
IU	International Unit
LATAM	Latin America
LMIC	Low- and Middle-Income Countries
LPG	Lowest Price Generic
Mex\$	Mexican Peso
mg	milligram
Middle-Income Country	MIC
ml	milliliter
MoH	Ministry of Health
MPR	Median Price Ratio
MSH	Management Sciences for Health
NCD	Non-communicable diseases
NCG	National Clinical Guidelines
OB	Originator Brand
OECD	Organization for Economic Co-operation and Development
PAHO	Pan-American Health Organization
SPS	People's Health Insurance (Seguro Popular de Salud)
tab	tablet
WHO	World Health Organization

Declarations

Ethics approval and consent to participate

The Ethics Committee of the National Institute of Public Health (INSP) in Mexico approved this study prior to data collection (CI-1406). No consent to participate was necessary for this study.

Consent for publication

Not applicable

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

DMH carried out the planning and design of the study, the data collection, data analysis and discussion and interpretation of the results. She carried out the writing of the manuscript. ME and HVH contributed to the planning and design of the methodology and the study, carried out revisions of the data analysis, and revisions and editing of the manuscript. AD, SBA and RSS contributed to the planning of the study, carried out revisions and editing of the manuscript. JPvD and SAR carried out revisions and editing of the manuscript. All authors read and approved the final manuscript.

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Additional File

File name: AvailabAffordab_Additional file 1

File format: Microsoft Word (.doc)

Title of data: Medicines of study and their characteristics

Description of data: Characteristics of selected medicines of study following inclusion criteria

Figures

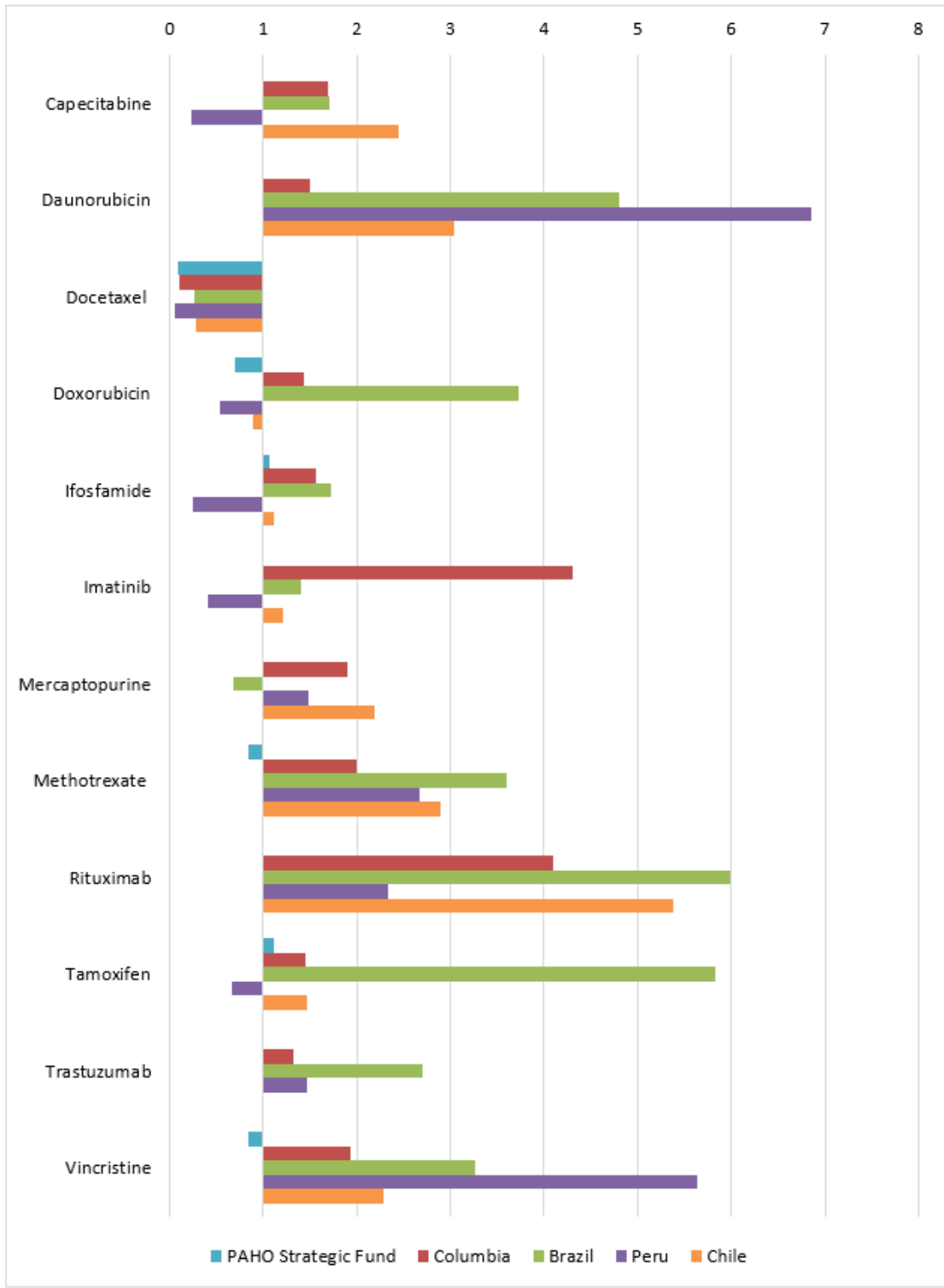


Figure 1

Price differences between public procurement prices in Mexico (=1) and other LATAM countries and PAHO's Strategic Fund * Price data from PAHO's Strategic Fund was only available for docetaxel, ifosfamide, methotrexate, tamoxifen and vincristine * Trastuzumab price comparison with Chile was not possible because Chile uses another presentation: trastuzumab-emtansine

Supplementary Files

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