Addressing the Rising Burden of Cancer in Brazil: Challenges & Opportunities

An Updated Analysis of Brazil's Health System and Cancer Control Policies

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About this Report

Cancer is the second largest cause of morbidity and mortality in Latin America. The International Agency for Cancer Research estimates that by 2024, the region will experience a 65.6% increase in the incidence of cancer cases (the highest increase among the different regions in the world), registering almost 3 million new cases a year. The future of cancer care requires strong efforts on prevention, screening, diagnosis, treatment and recovery. The wide inequities in access to public health and individual services for cancer and cancer outcomes and the COVID-19 pandemic has further exacerbates the challenge to better response to cancer in Latin America now and in the future. The Health Systems and Cancer Initiative in Latin America (HSCI-LA) led by the Health Systems Innovation Lab (HSIL) at Harvard University aims to foster collaboration among researchers, health professionals, policy makers and civil society organizations to catalyse the development of innovative polices and interventions to improve health system responses to cancer, and to reduce inequities in access and outcomes.

The outcomes from this initiative are presented here as a comprehensive policy study on health systems response to cancer control in Brazil. The report combines extensive analysis of published national data on health systems response to cancer and stakeholder consultations with health care leaders from all key sectors in Brazil. The first part of this report analyzes the cancer context in Brazil and describes a comprehensive Health System Analysis. We present the results for the study performed in the state of São Paulo on identifying the existing level of knowledge and data available to assess the cancer burden and health system responses to cancer prevention, care and control, determine the main challenges in relation to cancer care and control that need addressing in Brazil and a detailed potential interventions to develop an effective response to these challenges on short, medium and long-term. Finally, on the appendix sections we discuss more about the Health System Framework, study methodology, incidence and mortality for cancer in Brazil, and analysis of Brazilian Health System and its performance generally and in relation to cancer.

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GLOSSARY

ASR – Age-Standardized Rate
CVD – Cardiovascular Disease
CNS – Central Nervous System
CONCORD-3 – A program for worldwide surveillance of trends in cancer survival led by the London School of Hygiene and Tropical Medicine. CONCORD-3 is the latest study, published in The Lancet in 2018.
COVID-19 – Coronavirus disease 2019
GDP – Gross Domestic Product
GLOBOCAN – Global Cancer Observatory
HPV – Human Papilloma Virus
LAC – Latin America and the Caribbean
IARC – International Agency for Research on Cancer
HSCI-LA – Health System Control Initiative in Latin America
Intl$ – International dollars
NCD – Non-Communicable Disease OOP – Out-of-Pocket
PAHO – Pan-American Health Organization
PHC – Primary Healthcare
PM2.5 – Particulate Matter 2.5 micrometers and smaller
PPP – Purchasing Power Parity
SARS-CoV-2 – The virus responsible for causing COVID-19
SIM – Mortality Information System
SNSS – National Health Services System
SS – Health Services
SUS – Sistema Único de Saúde
UHC – Universal Health Coverage
WHO – World Health Organization

1. Executive Summary

Objectives

The Health System Cancer Initiative in Latin America (HSCI-LA) Brazil study aims to help improve Brazil's response to the rising burden of cancer, as part of its Constitutional commitment to health as a human right and the international push to achieve universal health coverage. The objectives of this report are to (I) discuss the overall context of the Brazilian health system influencing cancer care and control, (II) present the major health system challenges identified by stakeholders, and (III) identify policy options as suggested by the leading experts involved in the HSCI-LA study.

Methods

The primary methods of inquiry used by the research team included a review of published literature and datasets on the Brazilian health system and cancer burden, an online survey conducted among subject-matter experts to ascertain primary challenges and opportunities within the Brazilian health system around cancer, and a stakeholder workshop which facilitated expert discussion around the topic focusing on Health Systems and Cancer Care in the state of São Paulo.

Findings

According to the Global Cancer Observatory (GLOBOCAN), which includes estimates by the International Agency for Research on Cancer (IARC), a research agency of the World Health Organization (WHO), Brazil had an age-standardized rate (ASR) of 215.4 new cases of cancer per 100,000 people in 2020. Brazil and Argentina have the highest ASR incidence for cancer in Latin America, with more than 200 cases per 100,000 people. Similarly, Brazil has the second highest ASR of mortality among selected Latin American peer countries at 91.2 deaths per 100,000, lower than Argentina but higher than Mexico, Colombia, and Chile.

The primary challenges, identified through a survey of responses from 47 stakeholders and contributions from 32 participants involved in roundtable discussions, were organized into four health system functional areas: 1) Organization and Governance, 2) Financing, 3) Resource Management, and 4) Service Delivery.

A common challenge identified in both stakeholder surveys and virtual workshops was inefficiency in healthcare delivery alongside poor allocation of resources, which can hinder the effectiveness, responsiveness and equity of health services for cancer.

Policy options to address the identified challenges were also categorized by the four health system areas:

1) The Resource Management policy options aimed to (i) improve resources management, planning, priorities, and incentives for enhanced cancer care, (ii) invest in human resources, improve education and training in cancer care and service delivery with an emphasis on promoting a multisectoral approach, (iii) improve coordination – promote actions for federal entities to develop joint actions and enable effective regionalization, and (iv) improve the information system – use population-level data to determine priorities for allocating resources.

2) The Organization and Governance policy options aimed to (i) reinforce the Federal Coordination for cancer care, (ii) invest in digital transformation to improve cancer care and promote better health outcomes, (iii) reinforce multisectoral, comprehensive, and effective cancer care, and (iv) implement initiatives to optimize care pathways.

3) The Financing policy options aimed to i) strengthen budget management – new governance arrangements for cancer care, (ii) increase budget – implement new strategies to expand fiscal space and increase the budget allocated for cancer, (iii) incorporate new technologies – allocate funding to increase the availability and access to innovative technologies, and digital health solutions, and (iv) improve the cancer care pathway – increase the effectiveness, efficiency, and equity of care.

4) The Service Delivery policy options aimed to (i) coordinate the cancer service delivery system to strengthen all levels of care, (ii) establish integrated, comprehensive service delivery for cancer prevention, diagnosis, treatment, rehabilitation, and palliative care, (iii) improve access – promote access at the appropriate time and increase coverage of cancer care in remote areas, and (iv) improve the value of care and prioritize responsiveness.

Recommendations

The study collaborators propose nine overarching recommendations for the Brazilian health system to address the rising burden of cancer and deliver high-value health services[1] for enhanced cancer care.

Highest Priority

1. Promote digital transformation of cancer care, to improve effectiveness, efficiency, equity, and responsiveness of care provided, enabling the delivery of high-value health services for cancer.

[1] High-value health services are produced effectively and efficiently to ensure 'value for money' and delivered equitably and responsively to ensure 'value for many'. High-value health systems produce high-value health services to ensure optimal outcomes are produced at the population level, given political, economic, and social considerations in a nation.

2. Improve cancer care and control coordination and promote connections between the government and civil society.
3. Conduct a comprehensive analysis to identify priorities for cancer care and control and improve resource efficiency and equity and value creation at the system level in relation to cancer.

High Priority

1. Restructure the delivery of cancer services to enable the provision of consistently high-value and equitable cancer services.
2. Harness technologies to expand access to high-value cancer care and scale such technologies in health systems for population benefit.
3. Strengthen multisectoral actions that strengthen primary care and prioritize prevention interventions for cancer.

Medium Priority

1. Restructure the payment model, focusing on creating high-value care and reducing healthcare costs.
2. Improve training of healthcare providers and students for comprehensive cancer care and service delivery.
3. Strengthen multisectoral actions that strengthen primary care and prioritize prevention interventions for cancer.

2. Introduction

The objectives of the Health System Control Initiative in Latin America (HSCI-LA) are to (i) identify and fill the knowledge gaps concerning the burden of cancer and health system responses to cancer prevention, care, and control in selected countries, (ii) determine the main challenges that need addressing in these countries, (iii) detail potential interventions that are needed at country level to develop an effective response, and (iv) build an inclusive coalition of stakeholders to mount a sustained and lasting response to improve health outcomes, enhance financial protection and reduce inequalities. Brazil is the fourth country of focus for HSCI-LA, where separate studies were undertaken in two states, namely in Rio Grande do Sul and São Paulo.

This study used a mixed methods approach, applying a proprietary analytical framework and data collection tools developed by the Health Systems Innovation Lab at Harvard University (Harvard) to ascertain primary challenges and opportunities within the Brazilian health system related to cancer. The main methods of inquiry included: a literature review of published data, a novel online survey conducted among topic experts in Brazil, and a stakeholder workshop with leading health system and cancer experts in the state of São Paulo, Brazil.

The framework for health systems analysis used in the literature review extends earlier approaches (1–5) and emphasizes a systems view (6) when analyzing context and health system performance. The analytical framework has been used in single-country and multi-country analyses (7,8) to explore contextual factors and health system functions that interact to influence the achievement of health system goals, outputs, and objectives. Appendix A provides more details on the framework and each section of the analysis used in this report.

This report is organized in three major sections. The first section presents an analysis of the health system context in the state of São Paulo, Brazil, related to cancer, including the changes in demographic, epidemiological, political, and legal/regulatory environment that influence the trajectory of change in the health system, and which present opportunities and threats in decisively dealing with cancer in Brazil. The second section is a health system analysis that identifies the challenges for the health system related to cancer and presents policy options identified by stakeholders to address these challenges. The third section is focused on a set of recommendations and the proposed next steps to improve the response of the Brazilian health system to address the rising burden of cancer.

3. Methods

To achieve a detailed understanding of the context, health system, and the challenges and opportunities related to the management of cancer in the state of São Paulo, Brazil, the study used a mixed methods approach to research (a detailed explanation of the methods is provided in Appendix B) and three major sources of information:

1. A literature review and analysis of published articles, policies, and datasets;

2. A novel online survey conducted among topic experts, and;

3. A stakeholder workshop.

The Harvard researchers worked with collaborators in Brazil at Fundação Getúlio Vargas (FGV) in São Paulo to establish a core team to undertake the study and develop the report. The data were collected and analyzed between December 2022 and July 2023. During the data collection and analysis process, there was constant guidance and feedback from the Brazilian collaborators and the different working groups involved in the stakeholder workshop.

The first study was implemented in Rio Grande do Sul, and the state of Sao Paulo was chosen to participate in the second study. São Paulo is the most populous state in Brazil, with around 44 million people, equivalent to 22% of the Brazilian population. According to the National Cancer Institute (INCA), the state of São Paulo had an annual projection of 181,340 new cancer cases for 2023 (incidence per 100 thousand inhabitants). Breast and prostate cancers are the most frequent in the state, with an estimated of 20,470 and 16,830 new cases, respectively, while colon and rectal cancer remains the third leading cause, with an estimated 14,980 new cases.

4. Analyzing the Cancer Context in Brazil

This section provides an analysis of the health system in Brazil. We discuss the demographic, epidemiological, political, and regulatory contexts related to cancer, including an overview of Brazil's national cancer control plan and cancer care in the state of São Paulo. In Appendix C, we also provide an additional analysis of demographic and epidemiological transitions; the political, legal, and regulatory environment; and a detailed description of the economic, socio-cultural, and technological factors affecting the Brazilian health system that influence its response to the rising cancer burden.

4.1. Demographic and Epidemiological Transition

The Global Cancer Observatory (GCO) is a web-based platform that displays the global cancer statistics to inform cancer control and cancer research in an interactive platform. All the cancer indicators use data from IARC's Cancer Surveillance IARC's Cancer Surveillance Branch (CSU), including GLOBOCAN; Cancer Incidence in Five Continents (CI5); International Incidence of Childhood Cancer (IICC); and several cancer survival benchmarking projects (SurvCan and SURVMARK).

In the GLOBOCAN analysis of Brazil's cancer burden, incidence is defined as the number of new cases occurring in a geographic area during a specified period (9). Incidence is calculated among only individuals at risk for a specific outcome. Crude incidence figures, while useful in some regard, portray an incomplete contextualization, as they do not account for the differences in population sizes and age structures in and between countries or regions, which are particularly important for comparing the burden of large and highly heterogeneous countries like Brazil to those of less populous countries. Consequently, when the information is available, age-standardized rates (ASR) of incidence per 100,000 people are used to approximate the average risk of developing cancer, and they enable comparisons between countries and regions with different population sizes and age structures.

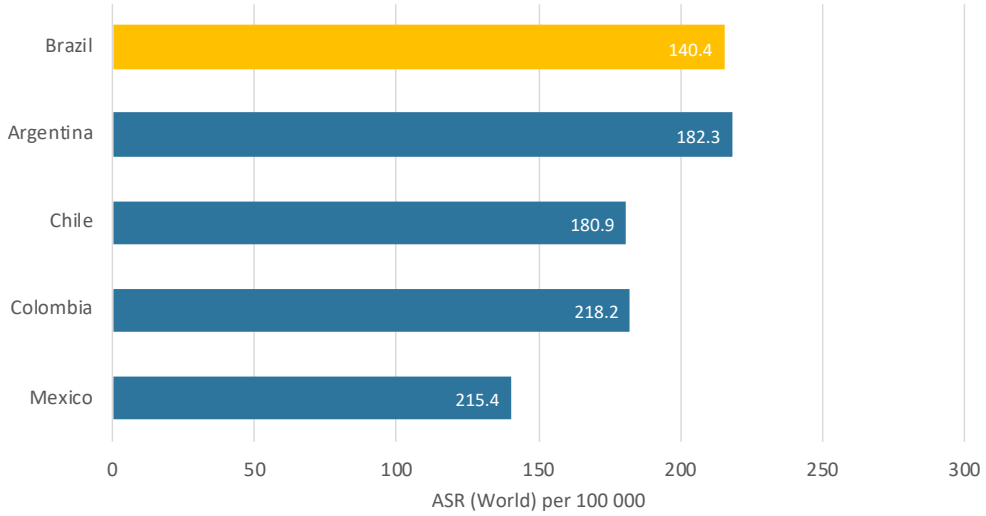
Primary prevention strategies aim to reduce the incidence of cancer. However, increasing age-standardized incidence levels may not necessarily reflect a failure of the health system in scenarios where the expansion of early detection or testing programs and improved data management (for example, through the introduction of population-based registries) more closely approximate the true incidence as more cases are tested, detected, reported, and registered (10). The methodology for reporting mortality in this section mirrors the incidence section, with current mortality estimates denoting 2020 age-standardized rates per 100,000 people.

4.1.1. Cancer Incidence

In 2020, the age-standardized cancer incidence in Brazil was estimated to be 215.4 new cases per 100,000 people. This figure ranked as the second highest among selected Latin American countries—namely,

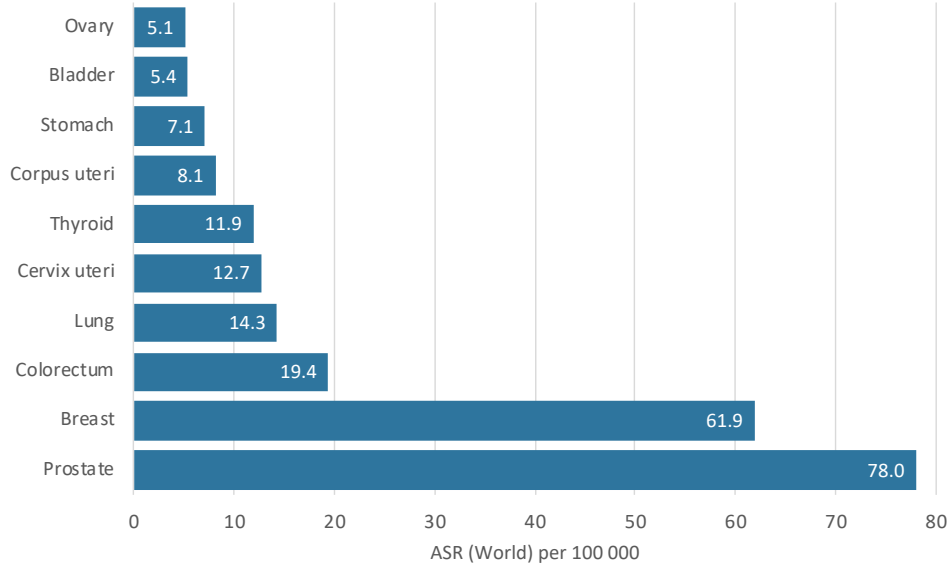
Argentina, Chile, Colombia, and Mexico. The ASR of incidence in Brazil is similar to that in Argentina (218.2 new cases per 100,000) but higher than that in Colombia (182.3), Chile (180.9), and Mexico (140.4).

Figure 1: Estimated age-standardized incidence rate (ASR) of cancer incidence per 100,000 people in 2020, all cancer types (Source: IARC Cancer Today) (9)



Brazil's five most common cancer types in 2020 were prostate cancer (78 new cases per 100,000), breast cancer (61.9), colorectal cancer (19.4), lung cancer (14.3), and cervical cancer (12.7). No other cancer type had a higher rate than 10 new cases per 100,000 (Figure 2).

Figure 2: Estimated ASR of cancer incidence per 100,000 people, both sexes, all ages, in Brazil in 2020 (Source: IARC Cancer Today) (9)

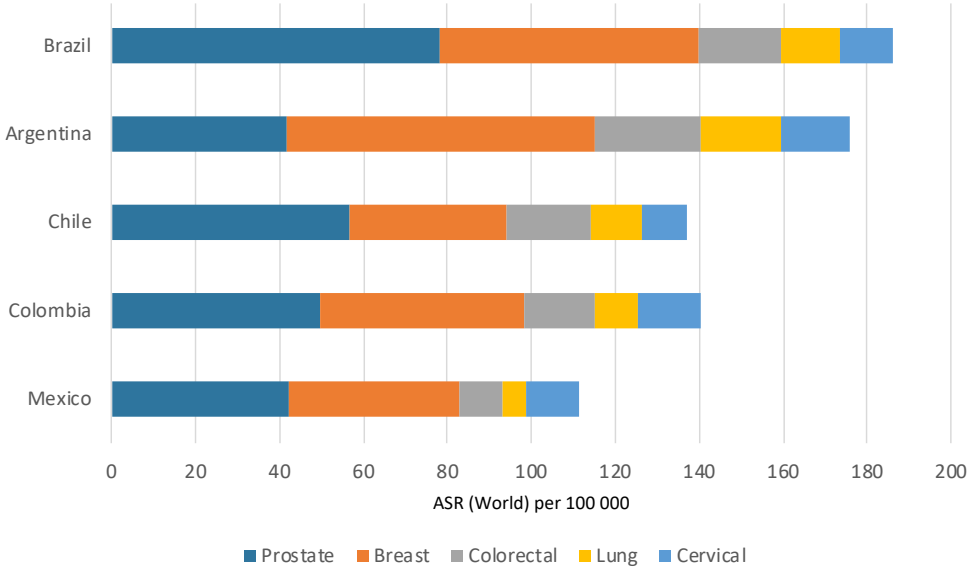


Compared to other large and populous Latin American countries, Brazil has a very high age-standardized incidence for prostate cancer. Brazil's 78 new cases of prostate cancer per 100,000 people in 2020 are much more than those in Argentina (42.0), Chile (56.7), Colombia (49.8), and Mexico (42.2). Breast cancer is also a major problem in Brazil, with 61.9 cases per 100,000, with only Argentina having a higher rate, at 73.1 cases per 100,000. Chile (37.4), Mexico (40.5), and Colombia (48.3) each have lower rates.
Table 1 compares the top 10 cancers by ASR of incidence in Brazil to Chile, Argentina, Colombia, and Mexico. Figure 3 compares the top five cancers by ASR of incidence in Brazil to the same type of cancer in other countries.

Table 1: Estimated ASR of cancer incidence per 100,000 people in 2020 by cancer type (Source: IARC Cancer Today) (9)

	Brazil	**Argentina**	**Chile**	**Colombia**	**Mexico**
Prostate	78.0	42.0	56.7	49.8	42.2
Breast	61.9	73.1	37.4	48.3	40.5
Colorectal	19.4	25.1	19.9	16.9	10.6
Lung	14.3	19.2	12.2	10.5	5.3
Cervical	12.7	16.7	11.1	14.9	12.6
Thyroid	11.9	8.0	4.8	9.1	8.1
Uterine	8.1	7.6	6.5	8.1	7.6
Stomach	7.1	6.3	13.1	12.8	6.2
Bladder	5.40	5.6	4.6	3.0	2.4
Ovary	5.10	7.3	6.0	7.5	6.8
All cancer types	**215.4**	**218.2**	**180.9**	**182.3**	**140.4**

Figure 3: Estimated ASR of cancer incidence per 100,000 people, both sexes, all ages, in 2020, by cancer type for different countries (Source: IARC Cancer Today) (9)



The ranking of age-standardized incidences for cancer differs slightly between countries. Table 2 presents the top five incident cancers by ASR for each Latin American country selected for comparison. There are distinct similarities and differences in ASR in these countries. For example, prostate, breast, and colorectal cancers are the three most common cancer types in the countries studied. Lung cancer and cervical cancer also rank relatively highly in all but Mexico. The age-standardized rate of stomach cancer is disproportionately high for Colombia and Chile, while lung cancer is not in the top five for Colombia or Mexico. In Mexico, thyroid cancer is among the top five but does not appear in the top five in the other countries.

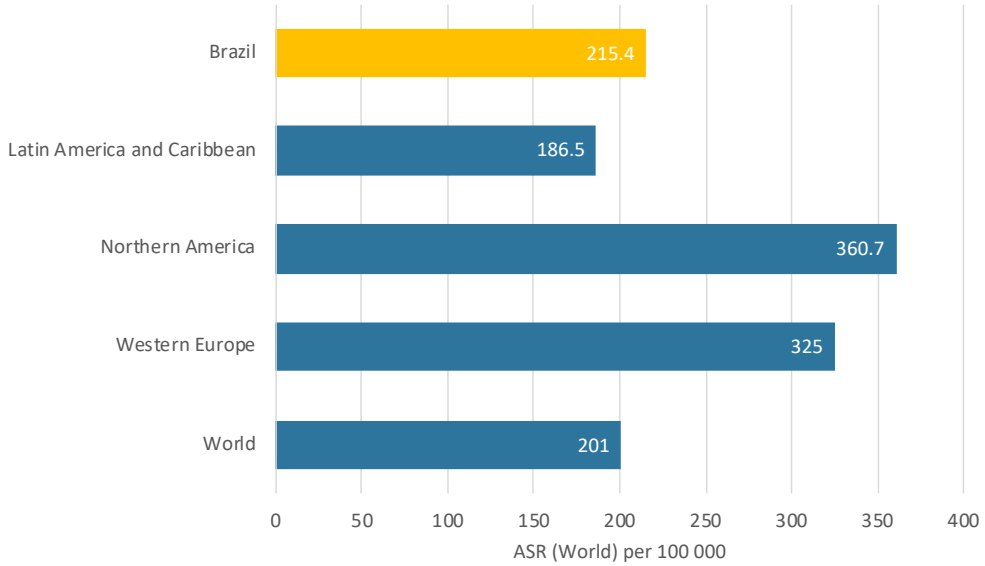
Table 2: The top five ASR cancers with higher incidence per 100,000 people, both sexes, all ages, and selected countries in Latin America (Source: IARC Cancer Today) (9)

Rank	Brazil	Argentina	Chile	Colombia	Mexico
1	Prostate	Breast	Prostate	Prostate	Prostate
2	Breast	Prostate	Breast	Breast	Breast
3	Colorectal	Colorectal	Colorectal	Colorectal	Cervical
4	Lung	Lung	Stomach	Cervical	Colorectal
5	Cervical	Cervical	Lung	Stomach	Thyroid

4.1.2. Incidence Comparisons: Brazil, Latin America, and the World

The average level of ASR of cancer incidence in Brazil is higher than the average global rate (201.0 new cases per 100,000) and that of Latin America and the Caribbean (186.5). However, Brazil has a substantially lower incidence than Northern America (360.7) and Western Europe (325.0) (Figure 4).

Figure 4: Estimated ASR of incidence for all cancers (including non-melanoma skin cancer) per 100,000 people in 2020 (Source: IARC Cancer Today) (9)



The age-standardized incidences of different cancer types in Brazil vary substantially from those in other regions of the world. For example, per 100,000 people, the incidence of lung cancer is 32.6 in Northern America and 32.7 in Western Europe, which is more than double that in Brazil (14.3). Conversely, the incidence of cervical cancer in Brazil (12.7) is nearly double that in Northern America (6.1) and Western Europe (7.0).

Table 3 and Figure 5 provide a breakdown of ASR and incidences for the most common types of cancer in Brazil, world regions, and globally. Table 4 compares the ASR of incidence for the five most common cancer types across various world regions and globally.

Table 3: Estimated number of new cases of cancer per 100,000 (age-standardized) by cancer type in Brazil and world regions for top 10 cancers (Source: IARC Cancer Today) (9)

	Brazil	LAC	NA	WE	World
Prostate	78.0	59.2	73.0	77.6	30.7
Breast	61.9	51.9	89.4	90.7	47.8
Colorectal	19.4	16.6	26.2	28.7	19.5
Lung	14.3	12.0	32.6	32.7	22.4
Cervical	12.7	14.9	6.1	7.0	13.3
Thyroid	11.9	8.6	12.4	9.0	6.6
Uterine	8.1	8.2	21.1	12.9	8.7
Stomach	7.1	8.3	4.2	5.9	11.1
Bladder	5.40	4.0	10.9	13.0	5.6
Ovary	5.10	5.8	8.1	7.1	6.6
All cancer types	**215.4**	**186.5**	**360.7**	**325.0**	**201.0**

LAC = Latin America and Caribbean, NA= Northern America, WE = Western Europe

Figure 5: Estimated ASR of cancer incidence per 100,000 people by cancer type in Brazil and World region in 2020 (Source: IARC Cancer Today) (9)

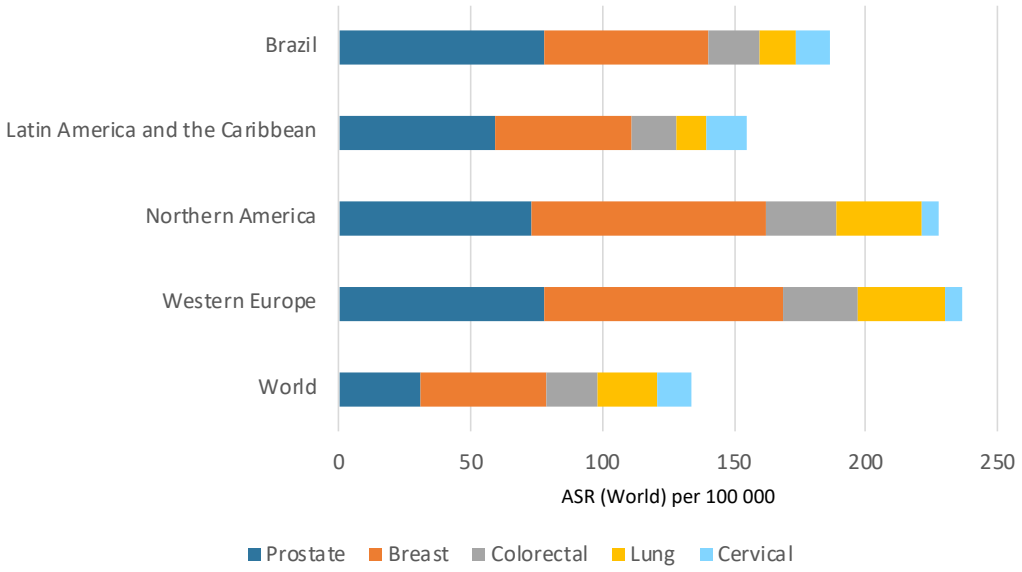


Table 4: The top five ASR of incidence cancers per 100,000 population in Brazil and World regions (Source: IARC Cancer Today) (9)

Rank	Brazil	LAC	NA	WE	World
1	Prostate	Prostate	Breast	Breast	Breast
2	Breast	Breast	Prostate	Prostate	Prostate
3	Colorectal	Colorectal	Lung	Lung	Lung
4	Lung	Cervical	Colorectal	Colorectal	Colorectal
5	Cervical	Lung	Uterine	Skin melanoma	Cervical

LAC = Latin America and Caribbean, NA= Northern America, WE = Western Europe

4.1.3. Incidence of cancer in the State of São Paulo

The National Cancer Institute (Instituto Nacional de Cancer - INCA) has published cancer estimates since 1995. The methodology adopted is similar to that used by the International Agency for Research on Cancer (IARC) of the World Health Organization (WHO) for global estimates. Its primary sources of information are cancer registries and the Mortality Information System (Sistema de Informação de Mortalidade - SIM). The projected estimates presented herein are currently triennial and will be valid from 2023 to 2025. The estimate for the triennium from 2023 to 2025 indicates that 704,000 new cancer cases will occur, 483,000 if the cases of non-melanoma skin cancer are excluded. However, INCA provides a distribution of the incidence by geographic region and shows the variation in the magnitude and types of cancer among the different regions of Brazil. For instance, the south and southeast regions account for about 70% of the total incidence, with half of the cases in the southeast region (11).

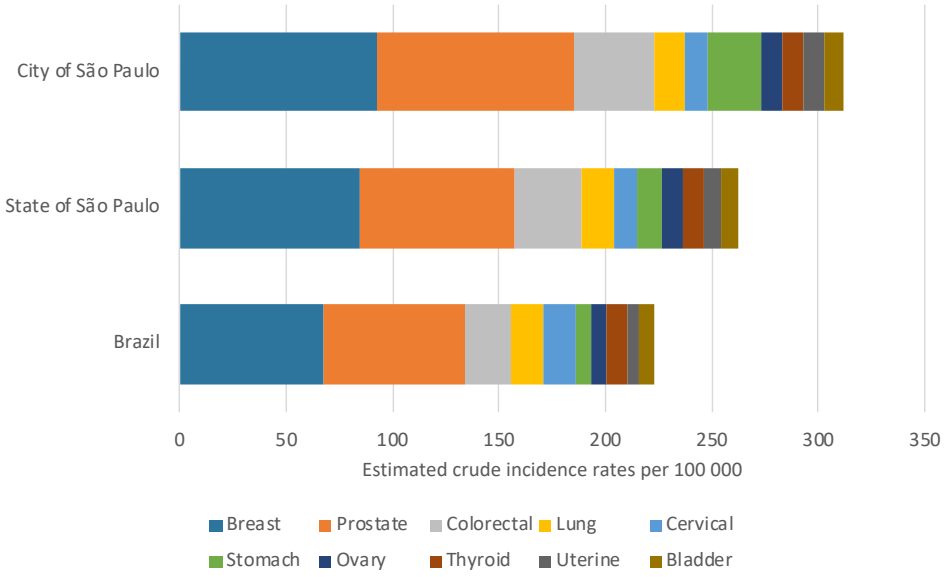
Table 5 and Figure 6 present the crude incidence estimates for the state and city of São Paulo in 2023, compared to Brazil, by the top 10 cancers in incidence presented in Table 3.

Table 5: Estimated crude incidence rates per 100,000 population, both sexes, for 2023 by cancer type (primary location) in Brazil and the state and capital of São Paulo (Source: INCA) (11)

	Brazil	State of São Paulo	City of São Paulo
Breast	67.86	84.43	92.72

Prostate	66.54	72.89	92.06
Colorectal	21.10	31.65	38.14
Lung	15.06	15.33	14.26
Cervical	15.38	10.52	11.23
Stomach	7.68	11.70	24.95
Ovary	7.08	10.18	9.86
Thyroid	9.94	9.91	10.03
Uterine	5.25	7.69	9.44
Bladder	6.62	8.11	9.14
All cancer types	**223.59**	**264.51**	**312.41**

Figure 6: Estimated crude incidence rates per 100,000 population, both sexes, for 2023 by cancer type (primary location) in Brazil, state, and city of São Paulo (Source: INCA) (11)



The crude incidence rates for the state of São Paulo and the city of São Paulo are similar for almost all the top five cancers in Brazil. The crude incidences for breast, prostate, colorectal, bladder, uterus, and thyroid are far greater in the city of São Paulo than at the state or national level. This difference may be explained by a higher concentration of the population and hospitals that provide access to diagnosis and care. It is particularly high for stomach cancer, with a crude incidence of 24.95 in the city of São Paulo, and less than

half for the state and national levels, respectively 11.70 and 7.68, which may be due to more access to endoscopy and screening in general. The incidence of lung and cervical cancer in the municipality is lower than at the national level. The difference is more substantial for cervical cancer (15.38 at the national level and 11.23 in the city of São Paulo). This difference may be explained by a higher vaccination coverage against human papillomavirus (HPV), more regular screening for cervical cancer (12) through Pap tests or HPV screening tests to identify precancerous lesions before they turn into cancer, or less risky behaviors, such as smoking, early age of sexual debut, and number of sexual partners.
Table 6 presents the top 5 cancers crude incidence for Brazil, the state, and the city of São Paulo in 2023.

Table 6: The top five cancers ranked by crude incidence rates per 100,000 population in Brazil, and the state and city of São Paulo for the year 2023 (Source: INCA) (11)

Rank	Brazil	State of São Paulo	City of São Paulo
1	Breast	Breast	Breast
2	Prostate	Prostate	Prostate
3	Colorectal	Colorectal	Colorectal
4	Cervical	Lung	Stomach
5	Lung	Cervical	Lung

4.1.4. Cancer Mortality

The types of cancers with the highest incidence levels differ from those ranked by mortality rate (Table 7).

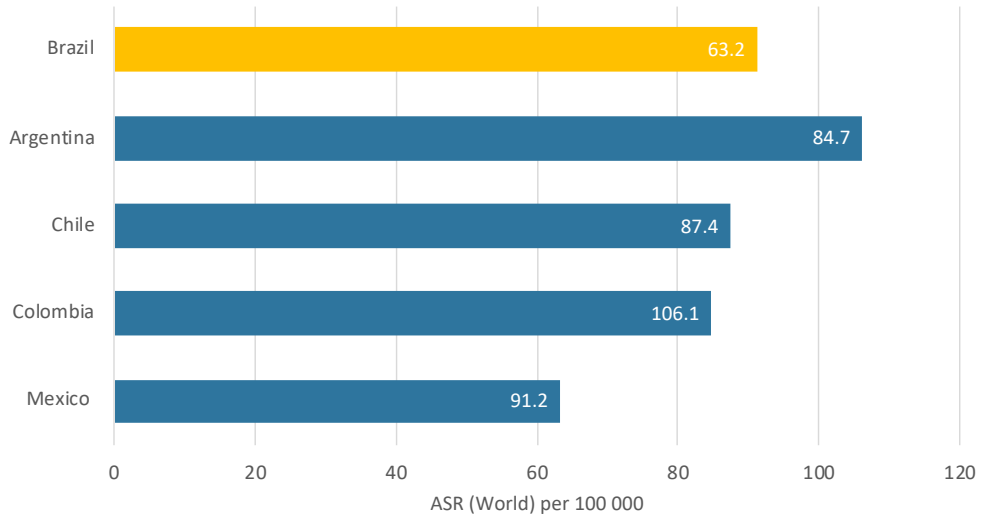
Table 7: Most common 10 ASR cancer types in Brazil per 100,000 population, all ages, both sexes (Source: IARC Cancer Today 2020) (9)

Incidence		Mortality	
Prostate	78.0	Breast	13.8
Breast	61.9	Prostate	13.7
Colorectal	19.4	Lung	12.3
Lung	14.3	Colorectal	9.0
Cervical	12.7	Cervical	6.3
Thyroid	11.9	Stomach	5.5

Uterine	8.1	Pancreas	4.4
Stomach	7.1	Liver	4.3
Bladder	5.40	Brain, CNS	4.2
Ovary	5.10	Esophagus	3.5
All cancer types	215.4	**All cancer types**	91.2

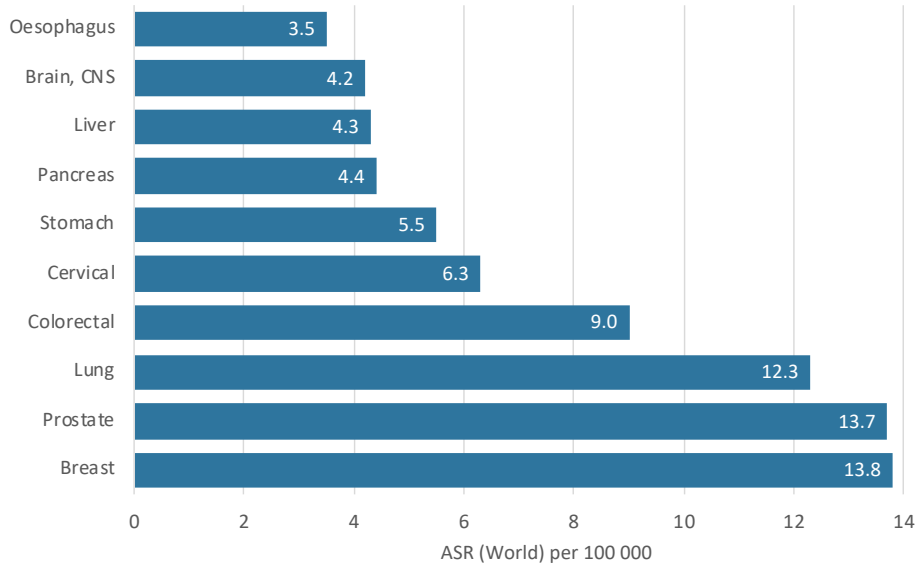
In 2020, the age-standardized mortality rate for all cancers in Brazil was 91.2 deaths per 100,000 people—the third highest among the selected Latin American countries. The level in Brazil is similar to that in Argentina (106.1 deaths per 100,000) and Chile (87.4) but higher than that in Colombia (84.7) and Mexico (63.2) (Figure 7).

Figure 7: Estimated age-standardized mortality rate for all cancer types per 100,000 people, all ages, both sexes, 2020, in Brazil and selected Latin American countries (Source: IARC Cancer Today) (9)



The top 10 cancers by ASR of mortality in Brazil are breast (13.8 deaths per 100,000), prostate (13.7), lung (12.3), colorectal (9.0), cervical (6.3), stomach (5.5), pancreatic (4.4), liver (4.3), brain and central nervous system (CNS; 4.2), and esophagus (3.5). The top six cancers in Brazil have an age-standardized rate above five deaths per 100,000 people (Figure 8).

Figure 8: Estimated age-standardized mortality rate for cancer per 100,000 people, all ages, both sexes, in Brazil in 2020 (Source: IARC Cancer Today) (9)



For common cancers, the estimated age-standardized cancer mortality rates in Brazil are similar to those in other countries in Latin America and the Caribbean (Figure 9). For instance, Brazil's highest ASR of mortality is breast cancer, at 13.8 deaths per 100,000 people, which ranks second highest among the selected large Latin American countries, behind Argentina (18.9 deaths per 100,000), but is similar to the estimates for Colombia (13.1). Similarly, prostate cancer has the second highest ASR of mortality in Brazil, at 13.7 deaths per 100,000. This rate is similar to that in Chile (14 deaths per 100,000) but higher than those in Argentina (12.2), Colombia (11.9), and Mexico (10.6; Table 9).

Figure 9: Age-standardized mortality rate for cancer per 100,000 population for prostate, lung, stomach, breast and colorectal cancers, all ages, both sexes in 2020 (Source: IARC Cancer Today) (9)

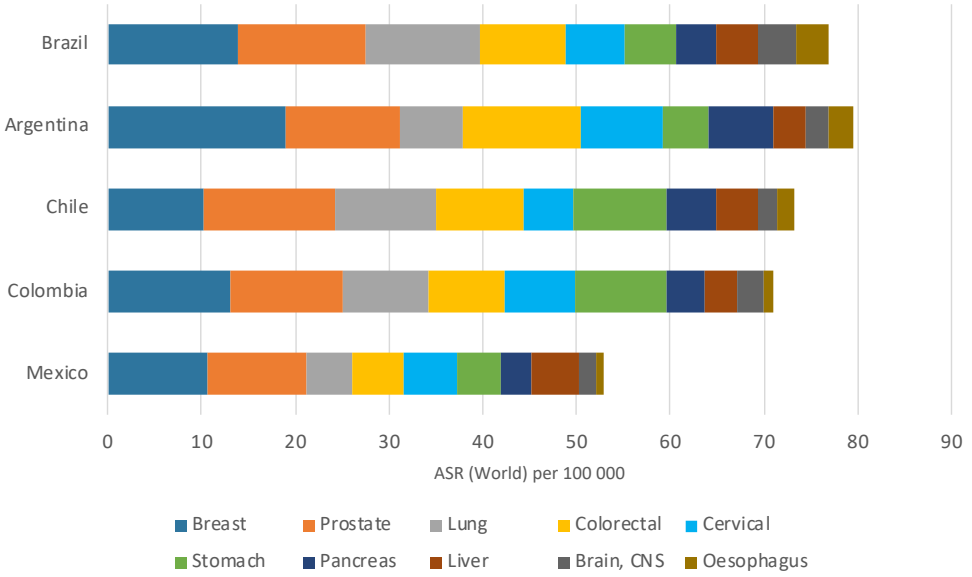


Table 8 shows the age-standardized Mortality Rates for Cancer per 100,000 population for the top 10 cancer types in Brazil compared with the rates observed in comparator countries.

Table 8: Age-standardized mortality rates per 100,000 population, all ages, both sexes, for the top 10 cancers in selected Latin American countries in 2020 (Source: IARC Cancer Today) (9)

	Brazil	**Argentina**	**Chile**	**Colombia**	**Mexico**
Breast	13.8	18.9	10.2	13.1	10.6
Prostate	13.7	12.2	14.0	11.9	10.6
Lung	12.3	6.8	10.8	9.2	4.9
Colorectal	9.0	12.6	9.4	8.2	5.4
Cervical	6.3	8.7	5.2	7.4	5.7
Stomach	5.5	4.9	10.0	9.9	4.7
Pancreas	4.4	7.0	5.3	4.0	3.3
Liver	4.3	3.3	4.5	3.4	5.0
Brain, CNS	4.2	2.6	2.1	2.8	1.9
Esophagus	3.5	2.6	1.7	1.2	0.87
All cancer types	**91.2**	**106.1**	**87.4**	**84.7**	**63.2**

Table 9: Top five cancer types ranked by age-standardized mortality rates per 100,000 population, all ages, both sexes in selected Latin American countries in 2020 (Source: IARC Cancer Today 2020) (9)

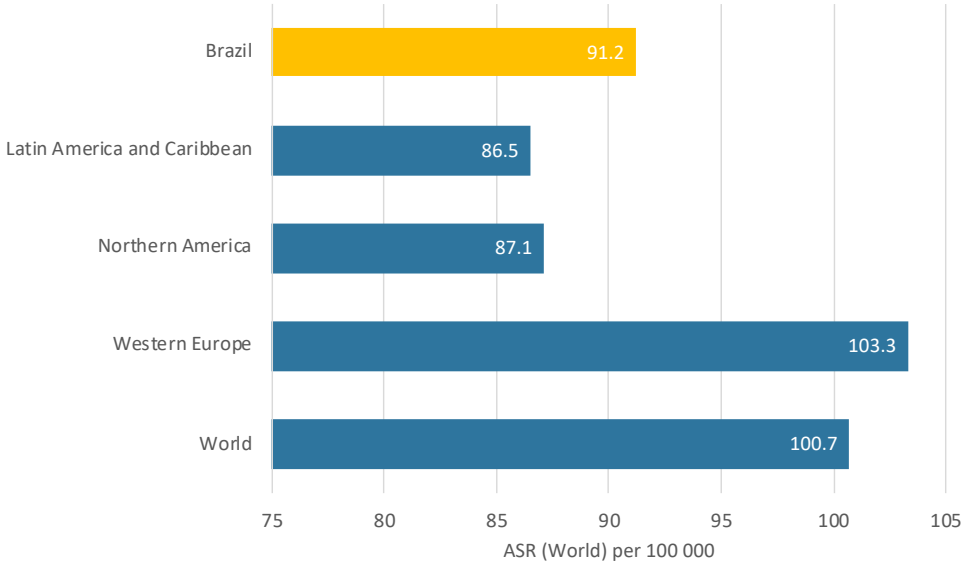
Rank	Brazil	Argentina	Chile	Colombia	Mexico
1	Breast	Breast	Prostate	Breast	Breast
2	Prostate	Lung	Lung	Prostate	Prostate
3	Lung	Colorectal	Breast	Stomach	Cervical
4	Colorectal	Prostate	Stomach	Lung	Colorectal
5	Cervical	Cervical	Colorectal	Colorectal	Liver

Breast, prostate, lung, colorectal, and cervical cancers rank in the top five for all countries except Mexico, where liver cancer appears in the top five, while in Chile and Colombia, stomach cancer is ranked in the top five (Table 9).

4.1.5. Comparison Mortality Rates: Brazil, Latin America, and the World

The average age-standardized mortality rate for cancer in Brazil (91.2 per 100,000 population) is similar to that in Northern America (87.1), greater than that in Latin America and the Caribbean (86.5), and lower than that in Western Europe (103.3) and the world (101.7). While Northern America and Western Europe have much higher age-standardized incidence rates for cancer than Brazil, both regions have comparable mortality rates to Brazil (Figure 8).

Figure 10: Estimated number of deaths from cancer per 100,000 population (ASR), both sexes, all ages, in Brazil and selected World regions (Source: IARC Cancer Today 2020) (9)



The age-standardized mortality rates for different cancer types vary across other world regions, and the world at large (Figure 9 and Table 11). The pattern in Brazil is similar to that in Latin America and the Caribbean. The mortality rate for stomach cancer in Brazil (5.5 per 100,000 in 2020) is far higher than that in Northern America (1.8) and Western Europe (3.3) but lower than the world average (7.7).

Figure 11: Estimated age-standardized mortality rate from cancer per 100,000 population (ASR), all ages, both sexes by cancer type (Source: IARC Cancer Today 2020) (9)

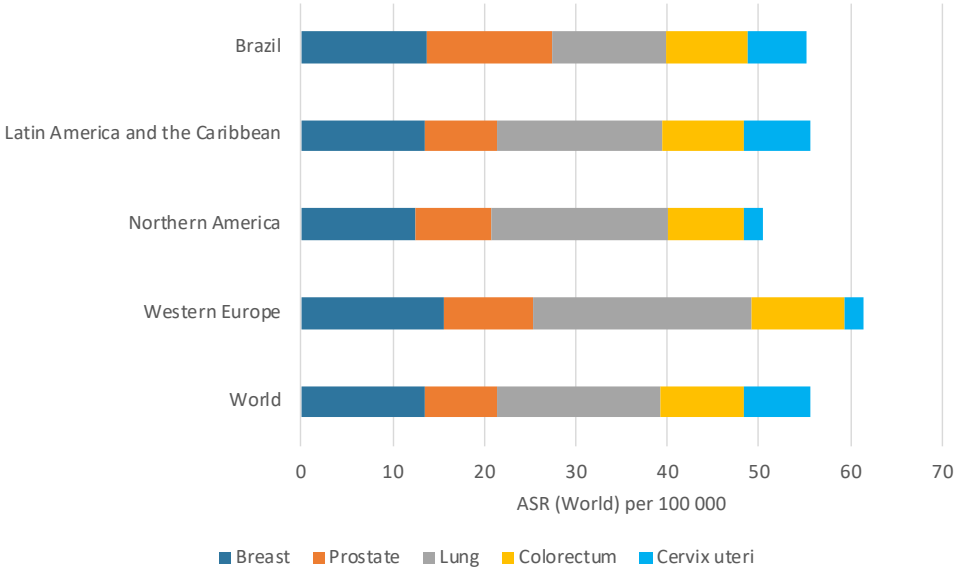


Table 10: Estimated number of deaths from cancer per 100,000 (ASR), all ages, both sexes by cancer type (Source: IARC Cancer Today 2020) (9)

	Brazil	LAC	NA	WE	World
Breast	13.8	13.5	12.5	15.6	13.6
Prostate	13.7	14.2	8.3	9.8	7.7
Lung	12.3	10.5	19.3	23.8	18.0
Colorectal	9.0	8.2	8.2	10.2	9.0
Cervical	6.3	7.6	2.1	2.0	7.3
Stomach	5.5	6.4	1.8	3.3	7.7
Pancreas	4.4	4.3	6.5	7.8	4.5
Liver	4.3	4.6	4.7	4.5	8.7
Brain, CNS	4.2	2.9	3.3	3.9	2.8
Esophagus	3.5	2.2	2.4	3.0	5.6
All cancer types	**91.2**	**86.5**	**87.1**	**103.3**	**100.7**

LAC = Latin America and Caribbean, NA= Northern America, WE = Western Europe

A comparison of the top five cancers by age-standardized mortality rate in Brazil with selected world regions reveals similarities and differences (Table 11). For example, in Brazil and each of the selected world regions, breast, prostate, lung, colorectal, and cervical cancers are among the top five cancer types by age-standardized mortality. In contrast, breast cancer appears in second place among the top five cancer types in Latin America, and stomach and liver cancer occur in the top five cancer types worldwide.

Table 11: Top 5 cancer types in Brazil and selected world regions ranked by age-standardized mortality rates per 100,000 population (ASR), all ages, both sexes (Source: IARC Cancer Today 2020) (9)

Rank	Brazil	LAC	NA	WE	World
1	Breast	Prostate	Lung	Lung	Lung
2	Prostate	Breast	Breast	Breast	Breast
3	Lung	Lung	Prostate	Colorectal	Colorectal
4	Colorectal	Colorectal	Colorectal	Prostate	Liver
5	Cervical	Cervical	Pancreas	Pancreas	Stomach

LAC = Latin America and Caribbean, NA= Northern America, WE = Western Europe

4.1.6. Cancer Mortality in São Paulo

INCA provides the Atlas of Cancer Mortality to assist public health professionals in determining the priorities needed for cancer prevention and control. Mortality information obtained through the systematic collection of information present in death certificates is the simplest and most accessible approach for examining the causes of death within a population. The source of information on cancer deaths is the Ministry of Health's Mortality Information System (SIM), which draws information from death certificates, among other sources (13).

Table 12 provides the mortality rates for Brazil, the state of São Paulo, and the capital of São Paulo for the 10 cancers with the highest mortality rate. The state and its capital city follow the same trends as the national level and are globally higher, with a mortality rate of 118.53 per 100,000 people for the state, 113.41 for the capital, and 106.65 at the national level. The rates for São Paulo state are also substantially higher for breast, colorectal, and pancreatic cancers but lower for prostate and cervical cancers compared to the national level.

Table 12: Crude mortality rates per 100,000 for all cancers, both sexes, all ages, in 2020, according to primary tumor location in Brazil, the state and city of São Paulo (Source: SIM) (13)

Cancer	Brazil	São Paulo (State)	São Paulo (City)
Breast	8.52	9.79	10.35
Prostate	7.48	6.80	5.58
Lung	13.47	14.85	14.39
Colorectal	8.83	12.18	12.93
Cervical	3.13	2.22	2.31
Stomach	6.54	7.08	6.65
Pancreas	5.62	7.25	8.62
Liver	5.08	5.44	4.62
CNS	4.42	4.83	4.26
Esophagus	3.92	3.62	2.99
All cancer types*	106.65	118.53	113.41

*Including non-melanoma skin cancer

4.1.7. 5-Year Net Survival for Brazil's Most Common Types of Cancer

Although cancer incidence and mortality rates are valuable metrics to consider when examining a country's cancer burden and health system performance, mortality levels are influenced by incidence levels—in addition to health system performance. Typically, as the incidence declines, so does the mortality rate. Hence, an alternative metric should be considered to reflect better health-system performance concerning cancer management across the care continuum. The five-year net survival for cancer patients provides important insight into the effectiveness, equity, efficiency, and responsiveness of the care individuals receive for cancer.

We used the five-year net survival figures from the CONCORD-3 study as a measure of the Brazilian health system's performance in managing cancer. CONCORD-3 provides five-year net survival from 2000 to 2014 for most cancers by world region and country. To model estimates in Brazil, the CONCORD-3 study used data from six population-based registries, which collectively cover around 7.7% of the total population in Brazil (14). This figure is slightly less than but comparable to those observed in Argentina (9.2%), Chile (13.8%), and Colombia (9%). Brazil's level of population coverage represents an improvement from the previous iteration of the study, CONCORD-2, in which 5.7% of the population was covered. However, this level remains well below countries like the US, whose registries used in the study cover 85.6% of the population (14).

Table 13 uses CONCORD-3 data to compare survival for the top 5 cancers in Brazil with the highest mortality rates in 2018—namely, prostate, breast, lung, colon, and stomach cancers. A difference in methodology exists between the CONCORD-3 study and IARC's GLOBOCAN study. The data from IARC groups all colorectal cancers together—specifically, cancers of the bowel, colon, and rectum (9). However, the CONCORD-3 study disaggregates this group of gastrointestinal cancers into colon and rectal cancers. Hence, Table 13 presents data for colon cancer and not colorectal cancer. Further, the asterisks in Table 13 denote data points considered less reliable than others because 15% or more of patients were either:

1. Lost to follow-up or censored alive within 5 years of diagnosis or, if diagnosed in 2010 or later, before Dec 31, 2014.

2. Registered only from a death certificate or at autopsy.

3. Registered with unknown vital status or incomplete dates, such as unknown year of birth, unknown month or year of diagnosis, or unknown year of last known vital status.

Table 13: 5-Year net survival for adults, percentage of all diagnosed cancer cases for prostate, breast, lung, colon and stomach cancers in Brazil, Argentina, Chile and Colombia (Source: CONCORD-3 Study) (14)**.**

	Brazil	Argentina	Chile	Colombia
Prostate				
2000-2004	90%	83.5%	82.6%	83.6%
2005-2009	92.5%	83.6%	84.4%	87.8%
2010-2014	91.6%	87.6%	82%*	80.3%*
Breast				
2000-2004	68.7%*	82.3%	74.6%	72.3%
2005-2009	76.9%*	82%	73.5%	79.1%
2010-2014	75.2%*	84.4%	75.5%*	72.1%*
Lung				
2000-2004	10.7%	19.5%*	7.1%*	9.4%
2005-2009	7.8%	12.4%*	6.3%*	10.5%
2010-2014	8.5%	13.1%*	4.6%*	8.7%*
Colon				
2000-2004	44.5%*	54.2%*	35.5%	45%
2005-2009	50.6%*	51.2%*	47.1%	41.3%
2010-2014	48.3%*	54.4%*	43.9%*	34.5%*
Stomach				
2000-2004	19.1%*	21.7%*	14.5%	18.4%
2005-2009	24.7%*	19.3%*	16.3%	17.7%
2010-2014	20.6%*	21.5%*	16.7%	17.1%*

In Brazil, from 2010 to 2014, the cancers with the highest five-year net survival were prostate and breast cancers, which have the highest mortality rate of any cancer type. The cancers with the lowest five-year survival were lung cancer and stomach cancer, at 8.5% and 20.6% respectively. Similar survival level and ranking were found in other Latin American countries such as Argentina, Chile, and Colombia. Argentina presented higher survival between 2010-14 for breast, lung, colon, and stomach compared to Brazil. Chile presented the lowest survival for the cancers with highest mortality, stomach, and lung.

To further contextualize Brazil's performance, Table 14 compares the country with the highest survival for the top five cancers in Brazil with countries globally that have achieved the highest survival levels. These figures indicate that for the top five cancer types by mortality, the five-year net survival levels in Brazil considerably lag behind those achieved by the best-performing countries, indicating considerable room for improvement in Brazil.

Table 14: Countries with the highest 5-year net survival for cancer from 2000 to 2014 and that for Brazil for selected cancer types (Source: CONCORD-3 Study) (14)**.**

5-Year Survival from Cancer in 2010-2014			
Type of Cancer	Country with the Highest Level of 5-Year Net Survival	5-Year Net Survival (%)	5-Year Net Survival in Brazil (%)
Prostate	Puerto Rico	98.4%	91.6%
Breast	USA	90.2%	75.2%
Lung	Japan	32.9%	8.5%
Colon	South Korea	71.8%	48.3%
Stomach	South Korea	68.9%	20.6%

4.1.8. Childhood Cancer in Brazil

In 2019, a study published in Lancet Oncology by members of the Health System Innovation Lab at Harvard estimated five-year net cancer survival for children in Latin America and the rest of the world. The survival estimates varied for all childhood cancer types, ranging from 8.1% in Eastern Africa to 83.0% in North America, with an overall global average of 37.4% (15). These estimates informed the Lancet Oncology Commission on Sustainable Care for Children with Cancer which was published subsequently by the Lancet Oncology (16).

In September 2020, the WHO Global Initiative for Childhood Cancer set a target of 60% five-year survival by 2030 for childhood cancers. However, the authors of the Lancet Oncology Commission on Sustainable Care for Children with Cancer argued that this target is unlikely to be achieved at the current levels of coverage and rates of scale-up, particularly for cancer types like retinoblastoma, Burkitt's lymphoma, and nephroblastoma, for which current survival levels are about 25% (16). For example, in South America, the average five-year net survival for childhood cancer is 60.2%, but for many cancers, survival levels are well below the WHO's target of 60%, including acute myeloid leukemia (57.1%), astrocytomas (49.3%), CNS embryonal tumors (41.0%), and osteosarcomas (53.5%; Table 15)) (17).

Table 15: Estimated 5-year net survival for the top 10 childhood cancer types in Brazil by incidence (Source: Harvard Dataverse) (17)

Cancer Group	Cancer Type	5-year Net Survival			
		Argentina	Brazil	Chile	Colombia
Leukemia	Lymphoid	75.6%	69.4%	74.5%	74.5%
Leukemia	Acute Myeloid	63.0%	54.8%	57.1%	58.4%
CNS Neoplasms	Astrocytoma	70.7%	37.8%	49.3%	49.9%
Lymphoma & Related	Non-Hodgkin except Burkitt	80.4%	69.8%	72.0%	74.3%
Lymphoma & Related	Hodgkin	89.0%	71.4%	76.7%	79.6%
Renal Tumors	Nephroblastoma	81.6%	61.2%	69.3%	71.3%
CNS Neoplasms	CNS Embryonal	56.9%	28.8%	41.0%	41.5%
Neuroblastoma	Ganglioneuroblastoma	73.9%	56.0%	63.0%	64.7%
Retinoblastoma	Retinoblastoma	83.8%	60.8%	72.3%	71.1%
Bone Tumors	Osteosarcoma	62.2%	49.9%	53.5%	55.0%

Analysis of the projected incidence levels for childhood cancers in Latin American countries and estimates of what proportion of these are likely to be diagnosed suggest that on average 70.3% of the new cases in Brazil are likely to be diagnosed, compared with 68.9% in Argentina, 68.8% in Chile, and 70.9% in Colombia (Table 16) (17). The proportion of childhood cancers likely to be diagnosed in Latin American countries is well below those likely to be achieved in Western Europe (97.2%) and North America (97.3%) (17).

Table 16: Projected number of new cases of childhood cancer in 2030 and estimates of proportions that will be diagnosed (Source: Harvard Dataverse) (17)

Country	Projected incidence of childhood cancer in 2030 (95% Confidence Interval)	Estimated number of childhood cancer cases diagnosed (95% Confidence Interval)	Proportion likely to be diagnosed
Argentina	2089 (1578-2760)	1439 (1160-1729)	68.9%
Brazil	7934 (5588-10472)	5579 (4361-6826)	70.3%
Chile	648 (452-863)	446 (337-551)	68.9%
Colombia	2004 (1369-2690)	1421 (1102-1753)	70.9%

4.2. Political, Legal and Regulatory Environment

Since the 1920s, Brazil has introduced several major policies and laws to expand coverage and access to cancer screening, treatment, care, and control (Table 17). The published literature indicates that one of the first government proposals to fight cancer in Brazil took place in 1920, which introduced compulsory notification of cancer cases and the registration of cancer as a cause of death (18).

Public entities, in collaboration with philanthropic institutions, established healthcare centers specialized in treating cancer patients and promoting preventive care (19). For example, in 1937, a new regulation enabled the creation of the Cancer Center in Rio de Janeiro. In 1941, the National Cancer Service (Serviço Nacional de Câncer (SNC)) was created. In 1957, the National Institute of Cancer José Alencar Gomes da Silva (INCA), an integrated cancer institute and hospital, was inaugurated. INCA became the headquarters of the SNC.

In the 1970s, during the military dictatorship, there was a lack of new cancer control policies. In the 1980s, the Oncology Program (Pro-Onco) was launched, with the main goal of promoting cancer control (20), but there was no effective cancer control.

Article 196 of the Brazilian Federal Constitution of 1988 defines "health" as a right for all and a duty of the state. From the 1990s onward, with the transition to democratic rule and the establishment of the Unified Health System (SUS), there was a renewed emphasis on cancer control with an acceleration in the development of new policies and regulations for cancer. Following the establishment of SUS in 1990, INCA assumed its role as the lead and responsible agency for cancer control policies in Brazil. The establishment of the SUS coincided with the implementation of several health policies designed to develop and improve health services for cancer patients (21).

In this study, we undertook a comprehensive literature review and analysis to explore the evolution of major policies and regulations related to cancer prevention, treatment, care, and control in Brazil since the establishment of SUS. We categorized the content of the legal norms according to the historical period (definition; organization; expansion; integration) and purpose (structuring rules; qualification/accreditation; financing; protocols/technology). The major policies leading to structural changes in cancer care and control are summarized in Table 17.

Table 17: Timeline of Key Cancer Policies in Brazil (20–27)

1941	Creation National Service of Cancer (*Serviço Nacional de Câncer* - SNC)
1957	Inauguration of The National Institute of Cancer José Alencar Gomes da Silva (INCA)
1972	INCA is reinstated to the Ministry of Health.
1988	Federal Constitution – "Health is a right for all and a duty of the State"
1990	Unified Health System (Sistema Único de Saúde - SUS) established

1993	Cancer care units are separated as *Centros de Referencia* (CR) I (patient with any type of neoplasm) and CR II (patients main types of neoplasms). Standardization of Specialized Centers of Radiotherapy and Chemotherapy
1998	New criteria for registering centers of high complexity care in oncology. Stablish strategies for comprehensive service to patients with cancer and hierarchical network, focusing on care pathways and referrals. Also new cancer care center were open according to epidemiological data
1998	CR are substituted by Center for High Complexity in Oncology (Cacon) and the inclusion of its clinics in the System of SUS Outpatient Information (SIA/SUS)
1998	The National Cervical Cancer Control Program (Viva Mulher) established
1999	Law No. 9,797/99 - Obligatory plastic surgery to repair the breast by SUS, in cases of mutilation resulting of cancer treatment
1999	Creation of Assistance Programs and Regulation of Oncology Centers
2000	First initiatives for the control of breast cancer emerge, consolidation of protocols to guide treatment and standardize care
2000	Definition of Technical Criterias for Bone Marrow Transplantation
2001	Implementation of National Prostate Cancer Control Program
2002	Setting parameters for eligibility of care coverage, including oncology health services
2002	Implementation of the National Program for Pain Assistance and Palliative Care
2003	Inclusion of health indicators cervicovaginal cytopathologic exams and mortality rates of women for cervical and breast cancers
2005	National Oncology Care Policy (Política Nacional de Atenção Oncológica - PNAO) passed structuring the patient care pathway. Established programs to promote health, prevent cancer and organize the health system to provide an appropriate therapeutic treatment
2005	Organization Oncology Networks (Redes de Atenção Oncológica - RAO), promoting a reconfiguration of criteria for enabling high complexity oncology units
2006	Pact for Health (Pacto pela Saúde) set institutional reforms within the SUS, which were agreed upon between the three entities of governance (Federal, State and Municipality) with the objective of promoting innovation in management processes and instruments, aiming to achieve greater efficiency and quality in the responses of the SUS, including cancer care
2006	Technical regulation of the services radiotherapy
2008	The mammography law (Law 11,664) which guarantee a mammography from 40 years old
2009	Update of the technical regulation of stem cell transplantation hematopoietic, including the minimum requirements for performing this therapy and strengthening all Brazilian Registry of Voluntary Marrow Donors Bone

2009	Development of the Information System of Breast Cancer Control (Sismama), by INCA and Data SUS, a tool for proper detection actions management early breast cancer
2011	Creation of the National Cancer Clinical Research Network (RNPCC)
2012	Expansion plan of radiotherapy
2012	Publication of the Law No. 12.732/12 - obligation to start cancer treatment within a maximum of 60 days after the diagnosis
2013	The National Policy for Prevention and Control of Cancer (Política Nacional para Prevenção e Controle do Câncer - PNPCC) replaced PNAO providing greater emphasis on comprehensiveness of care and health information
2013	Implementation of the Cancer Information System (Sistema de Informação de Câncer - SISCAN) within the scope of the SUS. This is a web platform version that integrates the Cervical Cancer Information Systems (SISCOLO) and Breast Cancer Information Systems (SISMAMA)
2013	Law No. 12.880 – inclusion of oral medications for the treatment of breast cancer in the list of procedures of the National Health Agency (ANS)
2014	Creation of Referral Services for Diagnosis and Treatment of Precursor Colon Cancer Lesions of the Uterus (SRC) and Breast Cancer (SDM)
2018	Compulsory Registration Law No. 13.685 notification of cancer cases in public and private health networks mandatory
2019	Amends Law No. 12.732/12, so that exams related to the diagnosis of malignant neoplasm are carried out within 30 (thirty) days
2021	Law 14.238 creates the bill of rights of the person with cancer
2022	Directive SAES 2 includes the field “Reported Antineoplastic Drugs” in the screen of complementary data of chemotherapy in the Authorization of Outpatient Procedures (APAC) to select antineoplastic drugs utilized in the treatment of patients with cancer
2022	Law No. 14.308 creates the National Policy of Attention to Pediatric Oncology

Two of the major policies and regulations are especially salient, considering their relevance and major influence on structural changes in the health system concerning the delivery of health services for cancer. The first, the National Oncology Care Policy (Política Nacional de Atenção Oncológica (PNAO)), developed in 2005 by the Health Ministry (28), was designed to organize the Oncology Care Network in the Brazilian States to overcome fragmentation related to cancer care and ensure greater effectiveness and efficiency in cancer care and control. The policy focused on actions for developing comprehensive cancer care, including promotion, prevention, diagnosis, treatment, rehabilitation, and palliative care, to be implemented in all states of Brazil, considering the three spheres of governance (federal, state, and municipal) involved in healthcare planning, financing, and delivery. Moreover, the policy included actions to expand coverage for cancer care with appropriate resourcing, according to the principles of universality, integrality, and citizenship (20).

The second, Law 12.732, dated November 22, 2012, guarantees that patients with malignant neoplasms "receive, free of charge, in the Unified Health System (SUS), all necessary treatments and establishes a period of up to 60 days from the day on which the diagnosis is confirmed in the report to undergo the first treatment in SUS with surgical therapy or radiotherapy or chemotherapy, according to the therapeutic need that the case requires" (29). In 2019, there was an amendment to this Law to ensure that "exams related to the diagnosis of malignant neoplasm are carried out within 30 (thirty) days" (23).

More recently, new laws were enacted between November 2021 and March 2022 to redirect and reinforce control initiatives (24). For example, the Law 14.238, dated November 19, 2021, created the bill of rights of the person with cancer and appears to fill an important gap in the national regulatory backbone, as, besides being an additional tool to ensure the constitutional right to health, it is a strategic for social control (25). The directive from the Secretary of Specialized Care (SAES) dated January 3, 2022, is another important regulation that includes the field "Reported Antineoplastic Drugs." These drugs purchased by hospitals are now specified in the Authorization of Outpatient Procedures (APAC). This information was included to register the entire APAC so the health service receives funds to cover comprehensive care for the patient (26). Finally, Law 14.308, dated March 8, 2022, created the National Policy of Attention to Pediatric Oncology. Law 14.308 aims to implement mechanisms to broaden early access to diagnosis and treatment for improved prognosis for children and adolescents with cancer (25).

4.2.1. Brazil's National Cancer Control Plan

The National Oncology Care Policy (Política Nacional de Atenção Oncológica - PNAO) of 2005 was replaced in 2013 during the presidency of Dilma Rousseff by the National Policy for Prevention and Control of Cancer (Política Nacional para Prevenção e Controle do Câncer - PNPCC) (30).

This policy was created to emphasize the comprehensiveness of cancer care and the development of health information systems regarding cancer. It aimed to reduce mortality and disability caused by cancer, decrease the incidence of some types of cancer, and improve the quality of life of individuals with cancer through promotion, prevention, early detection, timely treatment, and palliative care (30).

Brazil's National Policy for the Prevention and Control of Cancer was introduced in May 2013. The policy identified several principles and guidelines related to cancer. Specifically, in Chapter II of Ordinance No. 874 of the policy, the Ministry of Health identified major principles for the health promotion, prevention, care, and control of cancer, as well as education, use of new technologies, surveillance, monitoring, evaluation, and communication (Table 18; Appendix).

Table 18: Principles and Guidelines of Brazil's National Cancer Policy, 2013 (Source: Brazilian Virtual Library of Health) (30)

Section I: The General Principles of the National Policy for the Prevention and Control of Cancer	
1.	Recognition of cancer as a preventable chronic disease and the need to offer comprehensive care
2.	Organization of regionalized and decentralized care networks
3.	Training of professionals and promotion of permanent education
4.	Intersectorial articulation and guarantee of broad participation and social control; and
5.	The incorporation and use of technologies aimed at the prevention and control of cancer
Section II: Principles and Guidelines Related to Health Promotion	
1.	Strengthening of public policies that aim to develop to the maximum the potential health of each citizen
2.	Carrying out intersectorial actions, seeking partnerships that favor the development of health promotion actions
3.	Promotion of healthy eating habits
4.	Promotion of bodily practices and physical activities
5.	Coping with the impacts of pesticides on human health and the environment, through health promotion practices with a preventive and sustainable nature
6.	Development of actions and public policies to combat smoking, alcohol consumption, overweight, obesity and inadequate food consumption, considering risk factors related to cancer
7.	Promotion of activities and practices related to health promotion
8.	Advances in actions to implement the Framework Convention on Control of Tobacco Use
9.	Fostering the preparation of normative documents aimed at regulating the production and consumption of unhealthy products and foods (saturated or trans fats, sugar and salt)
10.	Encouraging the expansion restrictive measures to the marketing of unhealthy foods and beverages
Section III: Principles and Guidelines Related to Cancer Prevention	
1.	Encouragement to eliminate or reduce exposure to carcinogens related to work and the environment
2.	Prevention of smoking initiation and alcohol use and consumption of unhealthy foods

3.	Implementation of cancer early detection actions, through screening and early diagnosis
4.	Guarantee of timely diagnostic confirmation of suspected cancer cases
5.	Structuring of monitoring and quality control actions for screening exams
Section IV: Principles and Guidelines Related to Surveillance, Monitoring and Evaluation	
1.	Monitoring of risk factors for cancer to plan actions capable of preventing the disease
2.	Use, in an integrated manner, of data and epidemiological and care information available for the planning, monitoring, and evaluation of actions and services for the prevention and control
3.	Implementation and permanent improvement of the production and dissemination of information
Section V: Principles and Guidelines Related to Comprehensive Care	
1.	Timely and safe treatment of patients diagnosed with cancer
2.	Multidisciplinary care to all users with cancer
3.	Carrying out treatment of rare or very rare cases that require a high level of specialization and greater technological capacity
4.	Offer of rehabilitation and palliative care for cases that require it
Section VI: Principles and Guidelines Related to Science and Technology	
1.	Establishment of methods and mechanisms for analyzing the economic-sanitary feasibility of public undertakings in the Health Industrial Complex, aimed at preventing and controlling cancer
2.	Implementation of the research network for the prevention and control of cancer
3.	Implementation of scientific opinion and elaboration of practices
Section VII: Principles and Guidelines Related to Education	
1.	Fostering the training and specialization of human resources for the qualification of professional practices
2.	Implementation, in the State Commissions for Teaching-Service Integration (CIES), of educational projects aimed at the prevention and control of cancer
Section VIII: Principles and Guidelines Related to Health Communication	
1.	Establishment of communication strategies with the population, with Health professionals and with other social actors
2.	Encouragement of actions to strengthen individual and collective capacity for communication in health, promoting changes in favor of health promotion, prevention, and cancer control

4.3. Cancer Care Network in the State of São Paulo

São Paulo state has a population exceeding 44 million people (31) and faces a substantial challenge concerning cancer care. In 2022, more than 143,000 cases were reported (32), and the numbers are projected to rise even further in 2023, with an estimated crude incidence rate of 383.11 cancer cases per 100,000 inhabitants (33). By 2025, around 540,000 new cases are expected to be diagnosed in the state (34).

To meet the growing demand for cancer care in the state's health system, a comprehensive cancer care network has been established based on the framework of Regional Health Care Networks (Redes Regionais de Atenção à Saúde - RRAS). Each RRAS comprises one or more Health Regions, which consist of neighboring cities sharing economic, cultural, and structural similarities. These Regional Health Care Networks effectively coordinate and integrate health services, ensuring comprehensive care across various “Thematic Networks”, including oncology.

The Brazilian Unified Health System (SUS) operates on the principles of universality, equity, and integrality. Universality ensures that health is a civil right for all residents, regardless of gender, race, occupation, or social status. Equity guarantees proportional treatment based on individual needs, while integrality provides a range of services, from health promotion and prevention to treatment and rehabilitation.

Among the organizational principles, the most prominent are regionalization, hierarchy, decentralization, and public participation. Regionalization reduces territorial and social inequities by identifying health regions and guaranteeing articulation between existing health services. Health services are classified in complexity levels through hierarchy, ensuring each case access to its required complexity service within the available resources in the region. Decentralization redistributes the responsibilities of health services among government levels, providing conditions for the county to act as the administrative and financial manager of its health system Community public participation is ensured by health councils and conferences aiming to evaluate, control and build strategies on health politics.

The Regional Health Care Networks are designed according to the principle of regionalization and decentralization. They aim to provide primary care, medium complexity services, and a portion of high complexity services, enabling residents to have universal and comprehensive access to health services for cancer diagnosis and management near their homes.

SUS governance is accomplished through representative bodies of county managers on a state level (COSEMS) and a national level (CONASEMS) and representative bodies of state managers on a state level (CONASS). The management of RRAS involves shared responsibilities among municipal, state, and federal governments through inter-manager commissions, which can be organized as bipartite (comprising municipal and state managers) or tripartite (including municipal, state, and federal managers). Each Health Region has a Regional Interagency Commission (Comissão Intergestores Regional - CIR) composed of municipal managers representing the cities within that region and state managers. The CIR is

responsible for planning and organizing the priorities of a region and also for the implementation of regulatory mechanisms.

It was initially planned that RRAS, with multiple Health Regions, would have a Managing Committee of the Regional Health Care Network (CGRede). This committee, which was envisioned to comprise of members representing participating municipalities, state management representatives, and representatives of the RRAS epidemiological surveillance group, would be responsible for various tasks such as developing and updating the diagnosis of RRAS's capacity, defining patient referral systems, establishing thematic networks, and instituting mechanisms for healthcare regulation.

Consequently, it was challenging to acheive a consensus regarding the inter-regional management on CIRs in the state of São Paulo. The acting appeal body constitutes the Bipartite Interagency Commission (Comissão Intergestores Bipartite - CIB), which is equally comprised by representatives of the state management and state-level municipal secretaries (COSEMS). Issues are also taken into consideration by the Tripartite Interagency Commission (Comissão Intergestores Tripartite - CIT), which the Health Ministry, CONASS, and CONASEMS equally constitute.

The State of São Paulo encompasses 17 RRAS, each serving a population of 1,000,000 to 3,500,000 residents. Each RRAS delivers primary and secondary health services, and 15 also provide tertiary services. São Paulo boasts 82 high-complexity oncology centers, with the majority located in the city of São Paulo (RRAS 06). These high-complexity services are further categorized into High Complexity Care Centers (Centros de Assistência de Alta Complexidade, CACON) and High-Complexity Oncology Units (Unidades de Alta Complexidade em Oncologia, UNACON). CACONs generally serve the region but may extend their services to the entire state, while UNACONs have a regional scope.

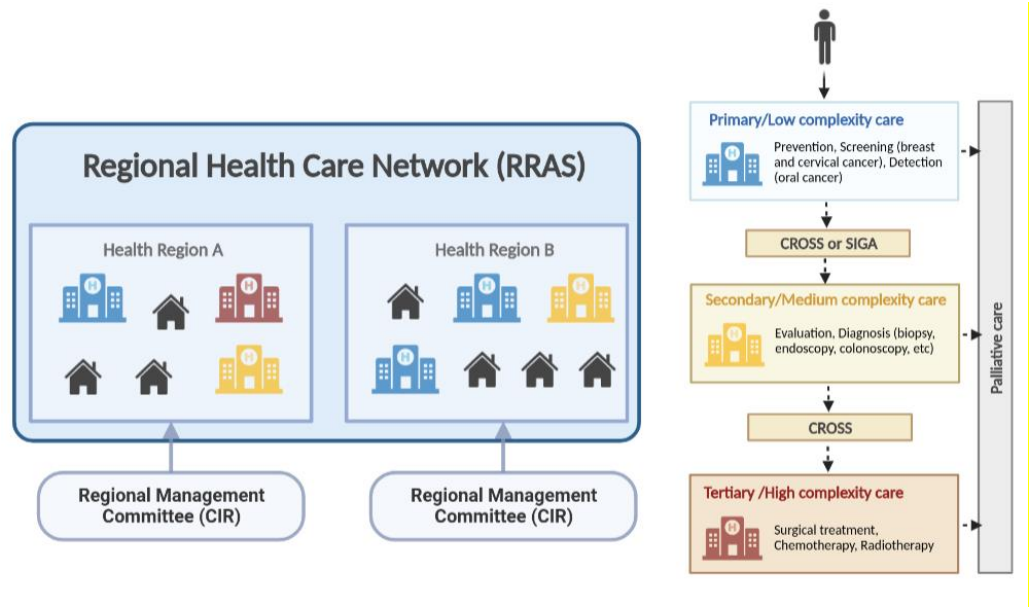
The journey of a cancer patient typically begins within their RRAS of residence, where primary healthcare units play a crucial role. Primary care organizes health promotion, prevention initiatives (such as HPV vaccination), and screenings for breast and cervical cancer. Oral cancer detection and the follow-up of the treatment of all cancer types are also commonly performed in primary care. Moreover, in 2022, the Government of the State of São Paulo designated specific specialty medical outpatient clinics (Ambulatório Médico de Especialidades - AME) within the primary healthcare network to contribute to all the stages of cancer care. These clinics offer various health services for cancer, including screening and diagnostic tests, consultations, minor surgeries, and chemotherapy, primarily focusing on skin and bowel cancers.

In secondary care, patients undergo diagnostic procedures such as biopsies, colonoscopies, and endoscopies. Cancer treatments are provided in high-complexity health centers such as CACONs and UNACONs, where surgeries, chemotherapy, and radiotherapy are available. Access to treatment is regulated through the Centre for the Regulation of Health Services Offers (Central de Regulação de Ofertas de Serviços de Saúde, CROSS), which regulates access to state health services and ensures that individuals diagnosed with malignant neoplasms receive prompt, appropriate, and locally accessible treatment. The Integrated Health Care Management System (Sistema Integrado de Gestão de Assistência à Saúde, SIGA)

regulates access to municipal health services, organizing access to secondary care, with palliative care integrated into all levels of care. (Figure 12)

Despite experiencing a chronic shortage of public financing over the years, SUS and the cancer care network of the state are still recognized as exemplary cases compared to other states in Brazil. For example, the Cancer Institute of the State of São Paulo (Instituto do Câncer do Estado de São Paulo - Icesp), a CACON, was ranked in 2022 as the 4th best public hospital in the country (35,36). Due to this recognition of high standards of care, even individuals with private healthcare coverage frequently receive oncological treatment through the publicly funded and provided healthcare system. The National Supplementary Health Agency (Agência Nacional de Saúde Suplementar - ANS) states that there were 10,290 consultations in the SUS for beneficiaries of private health plans in 2022 in the state of São Paulo alone (37). Moreover, patients from other states frequently relocate to São Paulo to access specialized treatment in oncology.

Figure 12. Schematic representation of a Regional Health Care Network (RRAS) comprising two health regions. Each RRAS is equipped with primary and secondary care services and may also include highly specialized tertiary centers. The patient's journey through various levels of care is depicted on the right side, showcasing the oncology services available at each level within the state of São Paulo (38)



In addition to providing hospital services, São Paulo's institutes and universities actively engage in various types of cancer research, exploring potential applications in the public health system. The Brazilian National Cancer Institute (INCA) supports the development and coordination of integrated actions in the prevention and control of cancer in all states in Brazil.

It is vital to address the inequity in the distribution of healthcare providers of different complexity levels among health regions in the state of São Paulo. As not every RRAS can include all levels of complexity, because of lack of funding or regional resources, patients are redirected to other regions, which cause

over-burdening in certain RRAS and under-capacity in others, making it difficult to achieve the integrality principle. This increases the physical and psychological burden faced by the patient in often vulnerable moments of seeking care and increases the chances of non-adherence to treatment. Additionally, the underfunding experienced by the healthcare services provided by SUS often leads to a lack of materials, damaged infrastructure, and long waiting lines, which may result in a poor reputation for SUS among users.

While the existing structure of decentralization and distribution of actions across the three levels of care is essential, there is a need for better integration and distribution of services throughout the health regions. Improved coordination among the responsible managers is crucial to ensure improved effectiveness, efficiency, equity, and responsiveness of cancer care in the state of São Paulo.

5. The COVID-19 Pandemic and Implications for Cancer Care and Control in Brazil

The first confirmed COVID-19 case in Brazil was reported on 26 February 2020 and the first death on 12 March 2020. By February 2023, there were 697,000 deaths from COVID-19 (the second highest in the world after the United States) and almost 37 million reported cases. As of 20 January 2023, a total of 500,059,803 vaccine doses have been administered (39). Brazil ranked fifth among Latin American countries, with the largest COVID-19 vaccination doses per 100 population (225 doses), representing a vaccination rate of 81.50% (fully vaccinated). The pandemic occurred in two main waves: The first wave corresponds to the period from 25 February 2020 to 5 November 2020. The second wave corresponds to the period from 6 November 2020 to 30 April 2021. The second wave, which coincided with the spread of the Gamma variant, was more severe than the first wave (40,41).

Brazil has extensive experience dealing with disease outbreaks, a well-established immunization program, and a Unified Health System. However, early in the pandemic, the federal government's response to control the COVID-19 pandemic was disastrous, with a disorganized and confused national response that was not evidence based (42). As a result, the governors of each state implemented different measures. Some states decided to follow the recommendations of national and international experts to fight COVID-19, while others ignored best practice guidelines. In the first year of the pandemic, three health ministers were appointed and then resigned after brief tenures. The Brazilian government has also been criticized for its delayed vaccination policy, which could have saved more lives (43).

The social inequalities in Brazil contributed to the high number of infections during the COVID-19 pandemic is the social inequalities in Brazil. Disparities in healthcare access and health outcomes were widespread due to the austerity measures introduced by the government following the economic crisis that began in 2015 (44). There are exceptionally high mortality rates from COVID-19 in the north region, in the Pardo (mixed ethnicity) and Black populations, and among men with low socioeconomic status (45). In addition, various sociodemographic indicators reflected different mortality patterns from COVID-19 in urban areas. In São Paulo, the mortality risk was higher among men, in the Black and Pardo population groups, and in those with lower socioeconomic status, such as those with less education, those living in crowded households, and those with lower income (46).

Studies examining SARS-CoV-2 antibody prevalence in cities showed a rapid escalation of the epidemic in Brazil's north and northeast regions, with a higher prevalence of COVID-19 in low-income and indigenous groups (47). Despite the restrictive and sanitary measures adopted by states and municipalities, socioeconomic inequalities and socioeconomic vulnerability, rather than age and health status, played a critical role in the number of cases and deaths from COVID-19 (48).

The long-term impact of Brazil's response to address the intersection of COVID-19 and cancer has yet to be seen, especially as cancer is a long-term disease, and it will take several years to observe changes in patterns. A decline of almost 10% in expected mortality from cancer and cardiovascular disease (CVD), compared to 2019, has been identified and can be explained by the action of COVID-19 as a competitive cause of death, resulting in migration of the underlying cause of death. An increase of 82.1% in mortality from cancer as a comorbidity was observed (49). In Brazil, during the pandemic, patients with cancer delayed exams and treatments due to fear of exposure to COVID-19 (50). There have been reports of delays in medical appointments and elective procedures for cancer (51) due to COVID-19, a major risk for patients with cancer who are receiving systemic treatment (52). A substantial decrease in cancer-related hospital admissions during the COVID-19 pandemic, with marked differences across regions, was also noticed (53). The delays in cancer diagnosis and care have led to increased mortality and years of life lost due to cancer (54).

Since the beginning of the COVID-19 pandemic, the number of cancer cases diagnosed in Brazil has declined sharply in all regions. Between 2019 (pre-COVID-19 year) and 2020 (pandemic year), there was a reduction in cancer screening (around 45%), diagnosis (35%), and treatment (approximately 15% for cancer surgeries) (55). Specifically, regarding the number of cases diagnosed, there was a drop of 24.3% in the north, and in the northeast 42.7% (56). Some studies have shown the impact of decreased diagnosis and screening during this period, especially for breast and lung cancer, the most common cancers in Brazil (46,57). The Brazilian Society of Pathology and Surgical Oncology estimated that 70% fewer biopsies were performed compared to 2019. Moreover, a Brazilian Radiotherapy Society (SBRT) survey reported a more than 50% reduction in the number of patients undergoing radiotherapy in some radiotherapy centers (58). Because of the need to reorganize hospital flow to meet the demands of the COVID-19 pandemic, the number of oncological surgeries in Brazil in 2021 was the lowest in the past six years (2015–21). Although the number of surgical procedures for patients with cancer started to decline in 2020, the change was more pronounced in the following year, as changes in hospital procedures were made throughout 2020 due to the sudden emergence of the pandemic. Once again, the discrepancy in the numbers between the various regions of the country, especially the northern and southern regions, also highlights disparities in the organizational capacity of the public system in each region in 2020 and 2021 (59).

The sharp fall in the number of cancer cases diagnosed and treated will have negative consequences for individuals with cancer in the coming months and years, as the health system in Brazil lacks the resources and capacity to manage the substantial backlog of cases. The sudden and substantial reduction in the number of patients treated during this period might result in a national health system overloaded with patients with advanced stages of cancer. Multisectoral action is needed to develop an appropriate response for comprehensive care, incorporate innovative actions to provide cancer care for all those in need, and ensure patients have access to the correct information and feel safe to seek care.

6. Health System Analysis

The purpose of this section is to present areas for improvement for the Brazilian health system in relation to cancer. We present an analysis based on data from two sources: (i) a qualitative online survey conducted with stakeholders in Brazil, specifically in São Paulo, and (ii) an analysis of discussions and feedback received during a workshop with key stakeholders in Brazil, specifically those from São Paulo. The survey and the workshops asked stakeholders to identify the major challenges related to cancer care in Brazil and to suggest policy options to address the challenges identified effectively.

This section reports the challenges identified in the survey and the workshops. We present policy options, identified by the stakeholders participating in the survey and the workshop, which could enable the Brazilian health system to address the rising cancer burden in ways that are more effective, efficient, equitable, and responsive.

6.1. Health System Challenges Related to Cancer

A total of 47 stakeholders responded to the online survey. The survey respondents were from various backgrounds, including the public sector or government (53%), academia (15%), private sector (11%), healthcare provider (9%), civil society (4%), and other not specified (8%).

The challenges were identified in relation to health system functions of Organization and Governance, Financing, Resource Management, and health system outputs, namely, Service Delivery for public health and individual health services. These challenges were coded and organized thematically into groups. Respondents identified financing as the top challenge (47%), followed by Organization and Governance (32%), Service Delivery (15%), and Resource Management (6%). Table 19 provides a synthesis of the top 10 challenges identified by the survey respondents for each of the four categories.

Table 19: Challenges for the Brazilian health system in relation to cancer in São Paulo is organized by category and priority identified in the stakeholder survey

Frequency	Top Priority Category	Second Priority Category	Third Priority Category	Fourth Priority Category
	Financing	Organization and Governance	Service Delivery	Resource Management
1	Lack of resources for providing comprehensive cancer care and control	Poor coordination and policy planning	Poor access (delay, inequalities)	Poor management of available resources (planning, waste)
2	Poor budget management	Ineffective management of services	Lack of human resources	Lack of qualified human resources for cancer services
3	Inefficient incorporation of new technologies into service delivery	Inadequate access to comprehensive cancer care (delay or lack of access)	Fragmentation of services	Lack of accountability for management resources
4	Ineffective payment models	Lack reinforcement of government agreement	Poor information systems	Lack of resources for comprehensive cancer care
5	Increasing cost of services and rising demand for services	Poor information systems	Lack of comprehensive care	Poor decentralization
6	Lack of accountability	Fragmentation of services	Lack of resources for comprehensive cancer care	Poor standardized contracts
7	Lack of priorities for allocation	Weak primary care	Lack of scientific evidence (protocols)	Poor information systems

8	Outdates healthcare procedures costs	Lack of qualified human resources	Poor coordination (government)	Poor coordination
9	Lack reinforcement of government agreement	Poor accountability	Increasing demand	Increasing costs (due to judicialization)
10	Lack of evidence or data on health economics	Lack of priorities (or "lack of priority setting" or "lack of clarity on priorities")	Ineffective incentives for all level of care	Lack of care pathways (care protocols)

The major challenges identified by the respondents are similar to those that emerged from the discussions at the stakeholder workshop, which included 32 participants (Table 20). The inclusive and interactive roundtable format of the stakeholder workshop allowed the participants to discuss the specific details of each challenge extensively. The workshop participants identified specific root causes for the challenges identified and some of the consequences of these challenges faced by SUS. They are presented in Table 20.

Table 20. Challenges for the Brazilian health system in relation to cancer organized by health system area, as identified at the roundtable meetings of stakeholders

Opportunity area	Challenge identified	Specific reasons and root causes for the challenge identified
Financial	Poor management of available funds	• Resource are not accompanied by performance/clinical outcomes or payment models that prioritize value for patients; • Investments are focused on the final stages of the natural history of the disease, when such cost-effective interventions exist for health promotion and prevention of specific types of cancer; • Lack of individualized data and interoperability between different data systems to visualize the patient's care continuum, experience and journey; • Absence of instruments and tools to identify service gaps for cancer and to stimulate the implementation of health services to address these gaps;

		• Lack of organization of priorities to comprehensively address cancer care needs.
	Poor coordination	• Lack of systematic data throughout the financing value chain in relation to delivery of health services for cancer, with only aggregated expenditures available; • Lack of intersectoral collaborative activities between different ministries, extending beyond the Ministry of Health; • No framework to inform tripartite funding in specialized cancer care, with no definition of municipal and state contributions; • Unclear sustainability plan for philanthropic hospitals in the current funding model.
	Poor primary care	• Public not aware of actions that that can promote health and prevent cancer and thus promote efficiency in health system (i.e., preventive care); • Cost-effective strategies and service quality not adequately emphasized in planning and priority setting; • Misaligned incentives, resulting in suboptimal care outcomes and a lack of prioritization of provision of health services that focus promotion and prevention.
Organization and Governance	Fragmentation	• Lack of clear priorities to inform policy design and programs for comprehensive cancer care; • Inadequate functional integration between levels of care; • Decentralization of decision-making across regions, with inadequate sharing of knowledge and variable capability to implement programs; • Lack of a multidisciplinary team approach for cancer care at the facility level; • Poor reinforcement of government agreement.
	Inconsistent enforcement of regulations	• Inadequate planning and coordination to implement existing regulations in relation to cancer care; • Diagnoses delayed; delays created by problems with the health system's administration;

		• Lack of tools to properly enforce laws and regulations that are often ignored in the current health system; • Lack of enforcement mechanisms for implementation of policies related to access to services and patient care that affect patient outcomes, leading to reduced effectiveness; • Poor legislation for cancer care and policies developed without evidence.
	Difficulty implementing digital innovations	• The flow of patients in the system is limited by poor integration of the information system; • Poor integration of an information system to guide logistics and a lack of control; • Weak mechanisms for ensuring effective inclusion of stakeholders in the decision-making process when developing regulations; • Lack of integrated information systems; differences at institutional level and among states in how information and data are processed/shared.
Resource Management	Lack of planning	• Inefficient use of available resources; • Inadequate incorporation of cost-efficient technologies in the system for enhanced cancer care; • Inadequate budget and its application in care pathways. The effective cost of the system may not be the same for services, thus making the efficient management of resources difficult in practice; • Lack of protocols developed and implemented in a standardized manner across facilities to help reduce resources waste; • Inefficient collection of data and challenges accessing high quality data to inform cancer care, policies and programs.
	Patient flow in the network	• Gaps in the patient journey in the network. Issues that need attention based on the level of need and urgency not adequately prioritized by healthcare managers; • Inefficient use of health system assets and resources

		exacerbated by the lack of integration within and across health system levels. Presentation of patients to the health system at advanced stages of the disease due to late diagnosis as a result of poor management in the network; • Poor information system with different network components and the lack of integration between the public and private sectors.
	Poor training and education	• Gaps in care, in terms of resources and professionals; deficiency in the regulation and training of specialists, with a concentration of these professionals in large urban areas; • No mechanism to ensure that the deployment and provision of healthcare professionals and interdisciplinary teams that are needed to provide comprehensive care for cancer considers demographic density of each locality, to enable a more equitable services in line with need; • Lack of incentives and enabling working conditions to attract and retain healthcare workers; • Guidelines for healthcare workers are outdated and updates are required to provide more autonomy in decisions related to patient care and enable rapid adoption of best practices to achieve improved patient outcomes for cancer.
Service Delivery	Patient care pathway	• Priorities not reflected in funding and resource allocation, leading to a mismatch between demand and supply, with numerous health service gaps for the major cancers causing excess disability and mortality; • Difficulty monitoring patient journey throughout the health system, between functional levels, providers, and sectors; • Poor information system integration; • Networks not properly integrated, especially between primary and secondary levels of care.
	Poor access (delay and coverage)	• Major geographic and socioeconomic barriers to accessing health services for cancer;

		• Early detection of cancer hampered by lack of focus on screening; • Lack of timely access to diagnosis and treatment; • Expansion of access according to contextual, health system and epidemiological factors; • Health promotion, disease prevention, and primary care attention for cancer care not prioritized in policies and funding.
	Quality of care	• Lack of understanding of patients' needs and expectations in relation to cancer care and alignment with existing priorities; • Lack of human resources and specialized services in certain geographic areas; • Inadequately trained and distributed health professionals; • Inadequate use of protocols and scientific evidence for guiding prevention, diagnosis and treatment.

6.2. Policy Options to Address the Challenges Identified

In the online survey, respondents provided policy options to address the health system challenges they identified within the four health system areas. The proposed policy options are summarized in Table 21 and presented in the order in which the top opportunities were identified for each health system area: Organization and Governance (36%), Financing (36%), Service Delivery (23%), and Resource Management (5%).

Table 21: Policy opportunities for the Brazilian health system in relation to cancer care and control in São Paulo identified in the survey, organized by health system functional area.

Policy Option	Specific Policy Actions
Policy Area: Governance and Organization	
1. Reinforce the Federal Coordination for cancer care – policies that reinforce multisectoral, comprehensive, and effective cancer care	• Focus on a National Political Plan for Cancer Care, including a policy framework review, while reviewing the roles of collaborating entities involved in care and control; • Ensure cancer policies adopt a multisectoral approach and identify direct and clear responsibilities for institutions beyond those in the health sector;

	• Improve the management of cancer care, building a structured plan for distributing resources for cancer care at all levels of the health system and between public and private sectors.
2. Invest in digital transformation to improve cancer care and promote better health outcomes	• Implement the use of CPF (*Cadastro de Pessoa Física*) as a unified identification tool for patients in the system, promoting interoperability between information systems; • Improve the use of existing health data using existing data science tools and capabilities to produce reliable and useful reports to inform evidenced-based decision-making; • Accelerate the implementation of the national population-based cancer registry to establish a system with reporting of standardized data and centralized collection and management of cancer data.
3. Reinforce multisectoral, comprehensive, and effective cancer care	• Define comprehensive cancer management to include screening, diagnosis, treatment, and palliative care, with an emphasis on the provision of equitable, efficient, and effective services; • Consider users' opinions regarding actions that adversely impact health and install mechanisms for rapid and effective corrective measures; • Decrease judicialization, improving communication between the legislature and the executive branches with participation of clinicals and experts.
4. Implement initiatives to optimize care pathways	• Strengthen communication in the media about cancer awareness and improve cancer prevention and promotion to address inequalities; • Optimize referral and counter-referral mechanisms to ensure appropriate treatment time and accessible care follow-up; • Involve communities, civil society, and other stakeholders in cancer awareness initiatives and in the improvement of cancer care; • Provide continuing education to healthcare professionals to improve the value of care and optimize cancer care.

Priority Policy Area: Financing	
1. Budget management – New governance for cancer care	• Political and inter-federative agreements to establish a national plan for combating cancer; • Promote connections between the government and civil society to exchange experiences, data, and strategic analyses; • Guarantee allocation of resources according to the national plan; • Reallocate priorities based on evidence of cost-effectiveness and consider waste reduction; • Implement regulations and mechanisms for inspection, surveillance, and control of national and regional health budgets.
2. Increase budget – Implement new strategies to expand fiscal space and increase the budget allocated for cancer	• Adopt bundled care payments instead of only procedure-based payments; • Implement value-based procurement measures; • Transition from the fee-for-service payment model and pursue novel payment approaches; • Encouraging the implementation of digital solutions through bonuses suggested as an initial step in this transition; • Implement cost and outcome measurement systems that will underpin and enable novel payment mechanisms that prioritize value in cancer care; • Update payment rates for health services/APAC "*Autorização de Procedimento Ambulatorial*".
3. Incorporation of technologies – Allocate funding to increase the availability and access to innovative technologies, and digital solutions for health	• Create a unified information system with individual-level data to enable tracking of the patient's journey; • Invest in digital innovation infrastructure, capabilities, and robust entrepreneurial ecosystem; • Incorporate mechanisms that promote the national development of technologies and cost-effectiveness evaluation of these technologies in the Brazilian health system, assigned to government agencies; • Improve the quality, comprehensiveness integration, and analysis of data from registries and medical records to provide precise information for efficient and equitable allocation of

	resources for cancer care.
4. Improve the cancer care pathway – Increase the effectiveness, efficiency, and equity of care	• Prioritize interventions that improve responsiveness; • Monitor patient survival rates in different post-treatment periods, an important indicator for assessing local performance and identifying potential improvements; • Improve planning and resource allocation for cancer care by considering the costs of treatment, funding for health promotion, prevention, and early detection activities, especially for high-risk populations; • Create common guidelines for all territorial health plans to implement minimum care and treatment standards for cancer with quality indicators.
Policy Area: Service Delivery	
1. Improve the coordination of the cancer service delivery system to strengthen all levels of care	• Create a Cancer Care Coordination Plan, including guidelines for improved network for service delivery. • Strengthen the monitoring of the cancer care services provided at all levels to improve the cost-effectiveness of services and outcomes. • Implement integrated care pathways to achieve rapid referrals and reduce fragmentation of care management across the care continuum, while measuring "value" throughout the system through cost and outcome measurement systems.
2. Establish integrated comprehensive service delivery for cancer prevention, diagnosis, treatment, rehabilitation, and palliative care	• Create incentives for healthcare provider institutions that provide high- value cancer care treatment and services at all levels (primary, secondary, and tertiary). • Use digital tools to communicate with patients and monitor their care pathways, follow-up exams, diagnostics, and treatment. • Promote the development of integrated cancer centers that can provide comprehensive cancer care equitably, effectively, and efficiently.
3. Improve access – Promote access at the appropriate time and increase coverage of cancer care in remote areas	• Develop accountability and enforcement mechanisms to ensure all actors comply with laws and regulations related to cancer care services. • Ensure regular audits of insurers and healthcare service providers to monitor the cancer care services provided. • Collect qualitative and quantitative data with pooling, analysis and reporting to establish priorities for

	healthcare services and ensure the budget is allocated according to need. ● Provide alternative modes of delivering healthcare in remote areas, for example, by using telemedicine to improve access and care.
4. Improve the value of care and prioritize responsiveness	● Create guidelines, protocols, and training for national and regional government officials on the cancer burden and strategies for managing cancer. ● Coordinate actions to promote education in cancer care and incentivize continuous education and professional development. ● Train healthcare professionals better to increase responsiveness at all levels of care according to patients' needs. ● Use digital tools and social platforms with trusted champions to promote health education for patients and families regarding comprehensive and effective cancer care.
Policy Area: Resource Management	
1. Improve resources management –Planning, priorities, and incentives for cancer care	● Collect data and promote transparency in how resources are generated, deployed and managed to deliver health services for cancer. ● Implement outcome-based contracts. ● Define the value of treatment based on achieved results. ● Benchmark performance of provider institutions that deliver cancer care services, with rewards for best performers and reporting to identify reasons for variations across institutions. ● Incentivize every component of the system to take responsibility for outcomes from the beginning of care. ● Evaluate population-level outcomes for cancer. ● Encourage a more comprehensive cancer care and patient-centered approach. ● Create incentives for healthcare provider institutions that provide high- value cancer care treatment and services at all levels (primary, secondary, and tertiary).
2. Invest in human resources – Improve education and training in	● Establish laws that determine the types of professionals needed for the health system, together with training

cancer care and service delivery with an emphasis on a multisectoral approach	competencies for different types and levels of professionals. ● Professional Scope Clarification: Enhance the regulation of professional roles, establishing clearer and more secure scopes for each area of expertise. This clarification streamlines human resource management. ● Do not rely solely on the services providing the training. ● Ensure a standardized and aligned approach to human resource training, distribution, retention and continued development based on the system's actual needs and national cancer policy. ● Support educational and training institutions to promote continued education and training at all levels for healthcare students, professionals, and managers.
3. Improve coordination – Promote actions for federal entities to develop common actions and enable effective regionalization	● Utilize consortia and agencies to promote and facilitate the organization and coordination of resources and services. (Consortia are instruments that allow two or more federal entities to develop common actions, at the regional level, for the provision of public services. Collaborate in the provision of oncology services). ● Strengthen regional governance and management. regional- and state-level health networks through enhanced data, reporting and audits, cross learning platforms, transparent benchmarking, and incentives. ● Promote equitable and accessible distribution of services. ● Enhance the value and effectiveness of patient care. ● Integrate regional planning and joint management.
4. Improve the information system – Use population-level data to determine priorities for allocating resources	● Prioritize the implementation of the cancer registry to enable collection and pooling of cost and outcome data. ● Establish effective mechanisms for information sharing and platforms to analyze data, benchmark performance in the system and report results. ● Reduce waste and gain a clear understanding of patient experience accessing care by collecting qualitative and quantitate information along the integrated care pathway

	across all levels of the system. ● Invest in the development of interoperable information technologies that allow different data systems to access data at the patient level to inform management. ● Improve care coordination among different healthcare providers. Using digital tools to guide priorities, inform implementation and continuously improve efficiency and effectiveness.

7. Recommendations and Next Steps

In this section, we provide recommendations for a set of actions that could be implemented to address the rising cancer burden in Brazil by consistently delivering high-value health services for cancer care and control. These recommendations are based on the synthesis of the responses elicited in the survey and the roundtable discussions during the study. They are organized according to their priority for the health system (highest, high, or medium). For each policy recommendation, we estimate the potential financial cost of implementation (high, medium, or low) and the length of time needed for their implementation (short-, medium-, or long-term) (Table 22).

Table 22: Summary of policy recommendations with priority, cost, and timeline assessment.

Recommendation	Priority	Estimated Cost	Estimated Timeline
Promote digital transformation of cancer care, to improve the effectiveness, efficiency, equity, and responsiveness of care provided, leading to high-value health services for cancer	Highest	Medium Cost	Medium term
Improve coordination of cancer care and control and promote connections between the government and civil society	Highest	Medium cost	Medium term
Conduct a comprehensive analysis to identify priorities for cancer care and control and to improve the efficiency and equity of resource allocation	Highest	Medium cost	Short term
Restructure the delivery of cancer services to enable the provision of consistently high-value and equitable cancer services	High	Higher cost	Medium term
Incorporate technologies to increase the availability of and access to improve cancer care	High	Medium cost	Medium term
Strengthen multisectoral actions that strengthen primary care and prioritize prevention interventions for cancer	High	Lower cost	Medium term
Restructure payment models, focusing on the value of care and reducing healthcare costs	Medium	Medium cost	Medium to Long term
Improve the training of healthcare providers and students in comprehensive cancer care and service delivery	Medium	Lower cost	Medium term
Implement initiatives for optimizing care pathways and monitoring and guiding patients in the system	Medium	Medium cost	Short term

*Short term: 1-5 years; Medium-term 3-5 years; Long-term 6-10 years

Highest Priority

1. Promote digital transformation of cancer care to improve the effectiveness, efficiency, equity, and responsiveness of care provided, leading to high-value health services for cancer

    - Improve the value, comprehensiveness integration, and analysis of data from registries and medical records to provide precise information for efficient and equitable allocation of resources for cancer care.
    - Implement CPF (*Cadastro de Pessoa Física*) as a unified identification for patients in the system, promoting interoperability across disparate data systems.
    - Implement a framework to audit provider institutions delivering cancer care, benchmark their performance periodically and report on variations in value and results achieved.
    - Invest in digital technologies to facilitate the design and implementation of digital data registries and data linkage of data to medical databases and health records. Generate new evidence to understand better the cancer burden in the country and use this evidence to inform resource allocation and management based on need.
    - Implement a digital information system that integrates cost and outcome data for services delivered at different levels in the health system across the care continuum (prevention, promotion, treatment, and rehabilitation).
    - Improve data quality and validity of data in the information systems for cancer by conducting audits of the public system to establish which population groups are affected by cancer and allocate budgets and resources according to need to overcome inequities between and within states.

2. Improve cancer care and control coordination and promote connections between the government and civil society.

    - Improve coordination among government, healthcare professionals, and civil society to reinforce and collectively advance, with accountability, the policies of Prevention and Control of Cancer.
    - Develop regional cancer programs to build a Cancer Care Coordination Plan that includes guidelines for an improved network for service delivery across regions.
    - Optimize the referral and counter-referral mechanisms to ensure appropriate treatment times and accessible care follow-up, with clear guidelines and standards of care.
    - Create performance incentives for different levels of cancer care and address the disparities in healthcare access across regions.
    - Monitor patient survival rates in different post-treatment periods as an crucial indicator for assessing local performance and identifying potential improvements

3. Conduct a comprehensive analysis to identify priorities for cancer care and control and improve resource efficiency and equity.

- Reallocate priorities based on the evidence of cost-effectiveness, which reduces waste.
- Reorganize existing resources and reinforce existing national cancer policies to promote effective governance of public systems and institutions involved in cancer care and control.
- Monitor the performance of healthcare institutions that provide cancer care.
- Implement regulations and mechanisms for inspection, surveillance, and control of national and regional health budgets.
- Reinforce mandatory collection of cancer-related data at the national, regional, and local levels.

High Priority

1. Restructure the delivery of cancer services to enable the provision of consistently high-value and equitable cancer services

    - Improve the organization and coordination of resources and services, strengthen regional governance and management, and promote equitable distribution and accessible services.
    - Strengthen monitoring of cancer services provided at all levels to improve the cost-effectiveness of services and promote the achievement of outcomes that align with national cancer policy.
    - Implement integrated care pathways to achieve rapid referral and reduce fragmentation of care management across the care continuum, improving the value of care for patients, providers and payers.
    - Provide incentives for multidisciplinary research collaborations involving national and international institutions to investigate the introduction of cost-effective, innovative interventions for enhanced cancer care and control.

2. Harness technologies to expand access to high-value cancer care and scale such technologies in health systems for population benefit

    - Allocate funding to increase the availability and access to innovative technologies and digital health solutions.
    - Incorporate mechanisms that promote the national development of technologies and cost-effectiveness evaluation of these technologies in the Brazilian health system, assigned to government agencies.
    - Improve the quality, comprehensiveness, integration, and analysis of data from registries and medical records to provide precise information for efficient and equitable allocation of resources for cancer care.
    - Implement cost-effective digital solutions to enable more efficient use of available cancer care and control resources.

3. Strengthen multisectoral actions that strengthen primary care and prioritize prevention interventions for cancer.

- Strengthen communication in the media and social media using trusted champions to promote cancer awareness and improve cancer prevention and promotion to address inequalities.
- Conduct community-based studies to test the effectiveness and population-based impacts of different cancer prevention and control strategies.
- Provide continuing education opportunities for healthcare professionals to improve the value of care and optimize cancer care and provide better patient care.
- Implement cost-effective solutions to enable more efficient use of available cancer care and control resources.

Medium Priority

1. Restructure the payment model, focusing on creating high-value care and reducing healthcare costs

- The government should consider changing the payment model to improve the efficiency, effectiveness, equity, and responsiveness of cancer care.
- Review the existing scientific evidence to adopt different types of payment models to help guide the change to a new payment model.
- Performance and outcome-based financing: Transition from the fee-for-service payment model to novel financing approaches prioritizing measurable results and value. Encouraging the implementation of digital solutions that enable performance-based bonuses for providers is suggested as the first step in this transition.
- Update payment rates for health services /APAC “Autorização de Procedimento Ambulatorial.”
- Invest in research to generate the evidence based for new financing models appropriate for the Brazilian health system.
- Explore options to introduce value-based procurement in select provider institutions providing health services for cancer care before expanding in scale and scope to other institutions and health services.

2. Improve training of healthcare providers and students for comprehensive cancer care and service delivery

- All government levels should reinforce academic training and continuing education for healthcare providers regarding cancer prevention, diagnosis, and treatment.
- Use digital tools to provide continuous up-to-date training and professional development on cancer for healthcare professionals, providers, and government officials.
- Increase the quality of training required for certification of licensed specialists to provide cancer treatment.
- Strengthen training on cancer in undergraduate courses and training of general physicians, nurses, physical therapists, nutritionists, and other healthcare professionals.
- Integrate palliative care into continuous professional development of all physicians involved in the care of patients with cancer.

3. Strengthen multisectoral actions that strengthen primary care and prioritize prevention interventions for cancer

   - Optimize referral and counter-referral mechanisms to ensure appropriate treatment time and accessible care follow-up.
   - Involve communities, civil society, and other stakeholders in cancer awareness initiatives and the improvement of cancer care.
   - Provide continuing education for healthcare professionals to improve the quality of care and optimize cancer care.

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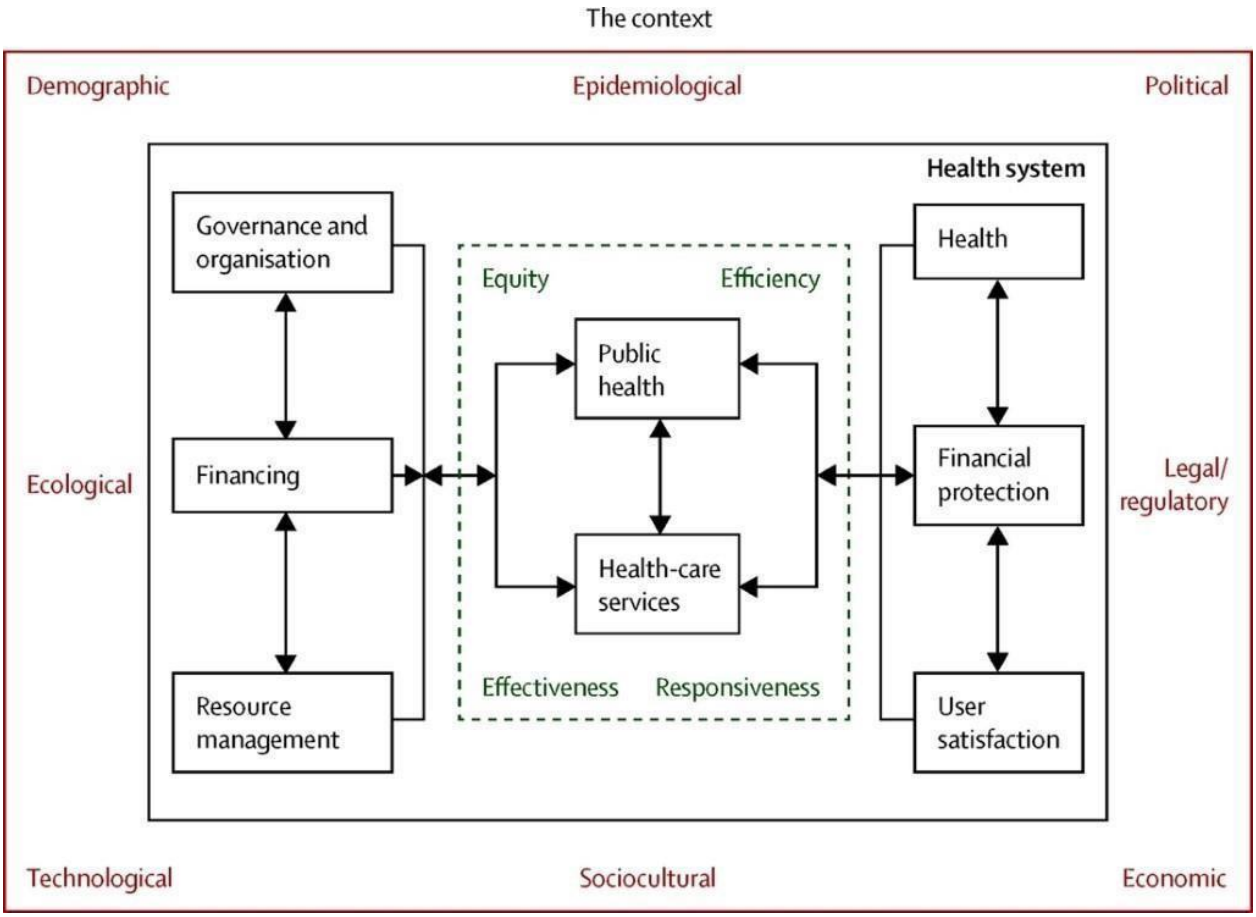
9. Appendix A: Health System Framework

Analytical Framework

The framework for health systems analysis (Appendix Figure 1) builds on earlier approaches (1–4,60) and emphasizes a systems view (6) in the analysis of context and health system performance. The analytical framework has been used in single- and multi-country analyses (7,8) and can be used to explore contextual factors and health system functions that interact to influence system performance and achievement of health system goals and objectives.

Appendix Figure 1: Analytical framework (Atun R et al. Lancet 2013, Atun and Moore, Oxford University Press, 2021) (61,62)



PART I: Context

The context refers to the interplay of the demographic, epidemiological, political, economic, legal/regulatory, ecological, socio-cultural, and technological changes, which individually and through their interactions influence the trajectory of change in health systems. These changes create 'opportunities' or ' threats' for health systems in the short- or long-run.
While historical antecedents, political systems, and socio-cultural norms shape the direction of health system reform, critical events, such as government change, economic crises (or growth), and natural or human-led catastrophes, create external shocks on health systems and provide opportunities for change and reform.

Analysis of context aims to answer five questions:

1. What are the contextual changes?
2. How are these changes affecting the health system?
3. What is the likely magnitude of the impact of these changes on the health system?
4. How and when will these changes impact the health system?
5. How certain is the likely impact?

In relation to "opportunities," analysis should identify contextual changes conducive to attaining desired health system goals and objectives in line with the values embraced by stakeholders. Concerning "threats," analysis should identify contextual changes that may hinder the attainment of desired health outcomes or worsen health system performance.

Elements of context

- **Demographic transition:** How are the general population dynamics changing in the country of analysis (life expectancy, mortality rate, birth rate, population growth, population structure, urban and rural differences, emigration, and immigration)? What are the implications of the demographic transition?
- **Epidemiological transition:** How is the epidemiological profile changing (infant mortality, maternal mortality, morbidity and mortality levels by different disease groups and population segments)? Which conditions are rising or falling (incidence, prevalence for key non-communicable and communicable diseases)? How is the prevalence of risk factors (smoking and obesity for example) and social determinants of health changing?
- **Political environment:** What are the prevailing values of the government that shape broad policy objectives, especially those related to social sectors; political stability; and political economy.
- **Legal and regulatory environment:** What international treaties or important laws of the country are likely to affect the health system.

- **Economic changes:** What is the economic outlook, such as: Gross Domestic Product (GDP) growth trends, government debt levels, current account balance, inflation level, unemployment levels, income distribution, and what is the likely impact of the economic environment on the government fiscal space for allocations to public sector health budget, or private sector investment.
- **Socio-cultural dynamics:** R elates to values and expectations of citizens; lifestyles, behavioral choices (for example, smoking, diet, and physical activity), and risk perceptions, which might affect the health system.
- **Ecological changes:** Relates to the physical and ecological environment affecting health.
- **Technological changes:** Technological developments – for example communication and information technologies, analytic capability, and geographic information systems – that can be harnessed to enhance the provision of services.

PART II: Health Systems Analysis

Health systems analysis should explore performance in relation to goals and objectives and analyze how health system design might affect performance.

Health System Outcomes (Goals)

1. **Population health:** concerned with both the level and distribution of health (for example, as measured by life expectancy at birth or age 30 or 60 years), mortality (mortality levels), or burden of disease (as measured by disability-adjusted life years), as well as specific population health outcomes of interest – such as infant or under-five mortality rate, maternal mortality ratio, standardized mortality rate for key diseases, or premature mortality from key diseases.
2. **Financial risk protection:** relates to fairness in health financing (distribution of health expenditures) and extent of financial risk protection for the general population and specific population segments (levels of out-of-pocket expenditures as a percentage of total health spending, and impoverishing health expenditures by income quintiles).
3. **User satisfaction:** examines citizens' satisfaction with the health system.

Health System Objectives in Relation to the System Outputs Produced

1. **Equity** relates to fairness in the allocation of resources or services among different individuals or groups, health service coverage, access to health services by population segments, and subsequent health outcomes; it considers equality and differential ability of various groups in accessing care and treatment and assesses whether those in equal need are treated equally, irrespective of other characteristics.

2. **Efficiency** relates to (a) Macroeconomic efficiency – level of health expenditure as a fraction of the GDP and (b) Micro-economic efficiency – 'allocative efficiency' (producing right outputs to achieve goals, i.e. what is produced for available resources in terms of a mix of services to maximize a combination of health outcomes and user satisfaction) and 'technical efficiency' (producing outputs at minimum costs, i.e. how the services are produced – inputs or costs should be minimized for target output).
3. **Effectiveness** is related to the extent to which a desired outcome is achieved when a cost-effective intervention is applied to a population and includes an assessment of the technical quality of clinical care and the extent to which evidence-based interventions are used.
4. **Responsiveness** relates to the ability of the health system to meet legitimate expectations of citizens in relation to perceived service quality and experience as patients.

Health System Outputs

1. **Service Delivery**; Analysis should discuss the organization of public health and personal healthcare services and assess whether the health system can meet current needs effectively: i.e., whether the system offers a comprehensive set of services, provides continuity of care, and achieves effective coordination of patients' journey in the health system along the care continuum through effective referral- and counter-referral-systems. The analysis should also discuss the public-private mix of services and the balance of hospital services with those provided in primary health care and the community.

Health System Functions

The framework identifies four health system functions, which policymakers can modify to achieve health system goals and objectives:

1. **Governance and organization**; (a) institutional relationships, in particular the role of the Ministry of Health in relation to other actors in the health system; (b) extent of decentralization, (c) extent of regulation and competition, and (d) organizational design – extent of public and private sector involvement.
2. **Financing**; the analysis should briefly discuss sources of financing, how finances are pooled, how they are allocated to agencies or intermediary organizations (such as local authorities), and financial coverage provided for population groups. The analysis should also briefly explore which provider payment methods are used to remunerate healthcare service providers and the pros and cons of the methods used.
3. **Resource Management**; The analysis should explore how and where financial, physical, human and intellectual resources are allocated and whether resource shortages or distributional imbalances exist.

10. Appendix B: Methods

Brazil is one of the countries selected to carry out the study. To achieve a complete approach and understanding of the context of the country, its health system and the challenges and opportunities related to the approach of cancer in the country, we used four major sources of information:

1. A literature review of published articles, policies, and datasets;
2. A novel online survey conducted among experts, clinicians, policymakers and key informants from civil society,
3. Pre-workshop planning meetings, and
4. An in-person workshop.

The Harvard research team worked with collaborators in Brazil to establish a core team to undertake the study. The data was collected and analyzed between November 2022 and May 2023. During the data collection and analysis, there was constant guidance and feedback from the different working groups, including the stakeholder workshop.

10.1. Literature Review

A literature review was conducted by three researchers from Harvard University to quantify the burden of cancer in Brazil and compare this burden within other large Latin American countries like Colombia, Chile, Argentina, and Mexico, as well as selected high-income countries like France (metropolitan) and the United Kingdom which have well established national cancer care and control programs.
To analyze cancer incidence and mortality figures in Brazil and selected countries and to ensure comparability, we used data from the International Agency for Research on Cancer (IARC) Cancer Today and Cancer Tomorrow (9,63), data visualization tools inclusive of 36 cancer types in 185 countries or territories of the world in 2020 as part of the GLOBOCAN project (10). Supporting data was obtained from the CONCORD 3 study (14), which tracks global cancer survival data for 18 cancer types in 71 countries based on population-based cancer registries.

The team performed a critical analysis of the available literature concerning the different aspects of the Brazilian health system. Sources of information were divided into three components:

- **Context:** First, we analyzed major factors influencing health and cancer context in Brazil using published journal articles and reports by international organizations, such as the International Monetary Fund (64), the World Bank Place (65), Inter-American Development Bank (66), the Pan American Health Organization (67), Latin American agencies, as well as official government bulletins, mainly from the Ministry of Health and official websites of national and regional

governments, which provide information the political, social, economic, ecological and technological context within which the Brazilian health system operates (68).

Another main source of information was non-peer reviewed articles published in the last five years related to the different aspects of the health system and the cancer in Brazil. Most of these articles were published in international newspapers (The Economist) (69) and Brazilian newspapers with national circulation (O Globo and Folha do São Paulo) (70,71), as well as local news agencies (O Globo) (72).

- **Health System:** Using available data, we analyzed the performance of the Brazilian health system in achieving health system goals (improved level and distribution of health, financial protection and user satisfaction) and objectives (equity, efficiency, effectiveness and responsiveness). We also analyzed the organization, governance, financing and resource management in the Brazilian health system and the personal health service and public health service outputs it produces to achieve health system objectives and goals. Data were gathered from published surveys, routine health administration data, and disease registries, and national and international reports, which evaluate the different aspects of the health system and compared Brazil with other Latin American countries.

  Our primary sources of information were the Ministry of Health (68) and the National Cancer Institute (INCA) (73), an agency under the Brazilian Ministry of Health, which has bibliography and reports at the national level and from each of the country's states. INCA has published the last report on Cancer Incidence in Brazil for 2023 (11). It also has related publications on some aspects of the health system in general, such as health determinants, health system resources, and epidemiological and vital profiles in the country (68).

  Other data sources related to the burden of cancer in Brazil included state secretaries of health (74,75), Agência Nacional de Vigilância Sanitária (ANVISA) (76) and studies by health think tanks, such as the Fundação Oswaldo Cruz (77).

  We also used data from PAHO/WHO (67), which shows the official data of the country, and enables comparison of the Brazilian health system with other countries in Latin America.

- **Cancer:** A primary source of information was the reports from the Instituto Nacional de Câncer (INCA), which plays a role in multiple areas of cancer prevention and control including prevention, epidemiological surveillance, treatment, information, education, and research (73). As part of the Ministry of Health, INCA delivers cancer care within the Integrated Public Health System (Sistema Unico de Saúde, SUS), formulates and coordinates public policies, develops research activities, and disseminates practices on medical oncology. Another valuable source of information was the Strategic Action Plan to Tackle Noncommunicable Diseases (NCD) in Brazil 2011-2022, which lists and sets priorities for the measures and investments required prepare the country for rising NCD incidence over a 10-year period (78). Cancer represented one of the four major groups of NCDs

addressed in the Plan with cost-effective policy recommendations to reduce the NCD burden. The report largely focused on improving risk factors like physical activity and diet but also included specific objectives related to cancer like strengthening measures of early diagnosis and treatment of cervical and breast cancers.

We conducted an analysis of the available online data to quantify the burden of cancer in Brazil and compare this burden within other large and populous Latin American countries like Argentina, Chile, Colombia, and Mexico, as well as high-income countries like France (metropolitan)and the United Kingdom which have well established national cancer programs.

To analyze cancer incidence and mortality in Brazil and selected countries, we used data from the International Agency for Research on Cancer (IARC) Cancer Today and Cancer Tomorrow data visualization tools, which include data on 36 cancer types in 185 countries or territories of the world in 2020 as part of the GLOBOCAN project (9,10,63).

When determining estimates of cancer incidence, the GLOBOCAN study used the best available data sources of cancer incidence and mortality in a given country. Hence, the validity of national estimates largely depends on the degree of representativeness and quality of data in a particular country (10). The Brazilian cancer registries used in incidence and mortality estimates and projections were the Cancer Registry of Aracaju, Barretos Cancer Registry, Cancer Registry of Curitiba, Espirito Santo Cancer Registry, Florianopolis Cancer Registry, Cancer Registry of Goiânia, Jau Cancer Registry, Cancer Registry of João Pessoa, Poços de Caldas Cancer Registry, Recife Cancer Registry, Roraima Cancer Registry, and Cancer Registry of São Paulo City (79). Further details of the methodology used in the GLOBOCAN study, its estimates, and projections can be found in Sung et. al, 2020 (10).

In the GLOBOCAN analysis, incidence is defined as the number of new cases occurring in a specified period and geographic area conveyed either as an absolute number of annual cases or as a rate per 100,000 people per year. It is important to note that incidence is calculated only among individuals at risk for a specific outcome. Incidence rates approximate the average risk of developing cancer and allow comparisons between countries or regions with different population sizes which nominal metrics may obscure. Age-standardized rates (ASR) per 100,000 person-years enhance such comparisons across geographies by accounting for differences in population age structures. Primary prevention strategies aim to reduce measures of incidence. However,increasing incidence rates do not necessarily reflect failure within the health system in cases where the expansion of early detection, testing, or other programs result in a transient rise in incidence rates as more cases are tested and therefore discovered (10).

Mortality is defined as the number of deaths occurring in a specified region or period, with the mortality rate defined as the number of deaths per 100,000 people per year. With mortality as a product of the incidence and the proportion of patients who die, mortality rates measure the average risk of death in the population from a specific cancer. Similar to incidence, the degree of detail and quality of mortality data varies considerably between countries, with only 1 in 5 countries reporting high-quality death registrations (10).

For survival, we used the CONCORD-3 study, which presents an analysis of global cancer survival for 18 cancer types in 71 countries based on population-based cancer registries (14). These two sources provided comparable age-standardized incidence and mortality rates for cancer in Brazil, other countries in Latin America, and other world regions (10).

The CONCORD-3 study, published in the Lancet in 2018, analyzed the trends in cancer survival worldwide between 2000 and 2014. CONCORD-3 included individual records for 37. 5 million patients diagnosed with cancer during the 15-year period 2000–14. Data were provided by 322 population-based cancer registries in 71 countries and territories, 47 of which provided data with 100% population coverage. The study included 18 cancers or groups of cancers: esophagus, stomach, colon, rectum, liver, pancreas, lung, breast (women), cervix, ovary, prostate, and melanoma of the skin in adults, and brain tumors, leukemias, and lymphomas in both adults and children (14).

Five-year net survival provides a useful measure of health system performance in managing cancer (14). In total, the population covered by the four participating registries in Brazil was 7.7%, a figure slightly below Latin American peers like Argentina (9.2%) and Chile (13.8%). This figure represents an improvement from the previous iteration of the CONCORD study (CONCORD-2), where only 5.7% of the population was covered by participating cancer registries, yet a far cry from countries like the US where coverage levels are 85.6% (14). Some of Brazil's survival estimates are considered less reliable than certain countries because 15% or more of patients were either:

1. Lost to follow-up or censored alive within five years of diagnosis or, if diagnosed in 2010 or later, before Dec 31, 2014.
2. Registered only from a death certificate or at autopsy.
3. Registered with unknown vital status or incomplete dates like unknown year of birth, unknown month or year of diagnosis, or unknown year of last known vital status.

The team's analysis of CONCORD-3 data selected Brazil's five cancers with the highest mortality rates per 100,000 people in 2018, namely prostate, breast, lung, colon, and stomach cancers. The analysis was expanded to compare Brazil's 5-year net survival percentage with Latin American counterparts (Argentina, Chile, Colombia, and Mexico) and the countries with the highest reported survival for these cancers (13).

10.1.1. Literature review updates

In 2022, a new team of researchers updated the previous report with a particular focus on the cancer burden in the State of São Paulo in compared with the rest of Brazil, as well as the impacts of the pandemic on cancer care. Indeed, as cancer is a long-term disease, the evolution of its burden on Brazil has changed little in two years. It is important to note the shock of COVID-19 crisis, which will undoubtedly have a major impact on this burden but whose effects are still difficult to analyze.

We conducted an update of the available online data from the GLOBOCAN project; from the International Agency for Research on Cancer (IARC) Cancer Today and Cancer Tomorrow. We added to this analysis the projected incidence data from INCA and death registries of the Brazil Mortality Information System (SIM) for Brazil and São Paulo (9,11,13,14,63). Data from IARC Cancer Today is reported by ASR, while in IARC Cancer Tomorrow, crude rates are reported, due to a lack of ASR data.

For the incidence in the state and capital of São Paulo we used crude rates provided by the National Cancer Institute (INCA) (11). The report was published in February 2023 and presents the estimate of new cancer cases for 2023 with a global analysis of the magnitude and distribution of the main types of cancer by sex, for Brazil, geographic regions, states, capitals, and the Federal District.

For the mortality in the state and the municipality of São Paulo, the crude numbers of deaths come from the SIM registries (13). The SIM is the oldest health information system in the country. It was instituted by the Ministry of Health in 1975 and has had nationally consolidated data since 1979 (80).

While some of the databases presented in this report separate colon, rectum and anal cancers, this report presents data related to colorectal cancer as the sum of all three pathologies, to account for the data where all these pathologies are grouped. Depending on the database, it is specified whether or not the rates take into account non-melanoma skin cancer. Because every dataset has a slightly different methodology, the differences are specified along the text or on the legends where appropriate.

10.2. Online Stakeholder Survey

An electronic survey was conducted with stakeholders via the online survey program Qualtrics CoreXM™ (81,82). The purpose of the survey was to gather opinions from important stakeholders before the in-person stakeholder workshop. The survey asked participants to identify major challenges for the Brazilian health system related to cancer, suggest policy options to solve those challenges and rank the identified challenges and policies in order of importance to address. Respondents were also asked to suggest challenges and policy suggestions under four main categories of opportunity for health system reform: (1) organization and governance, (2) financing, (3) resource management, and (4) service delivery. All responses were open-ended.

Challenges and opportunities for the health system in relation to cancer were analyzed using qualitative thematic analysis. Coders categorized free-text responses using pre-defined themes based on hypotheses (deductive codes) by two researchers. If there was a discordance, both researchers would discuss the code to achieve a consensus. Qualitative analysis of health system challenges around cancer included two stages:

1. **Deductive coding:** First, deductive codes were used to organize all open-ended responses by the four opportunity categories for which respondents were asked to identify challenges: (1) organization and governance, (2) financing, (3) resource management, and (4) service delivery.

2. **Frequency coding:** Then, using the software NVIVO a word cloud was generated based on frequency and percentage of codes. The word cloud is generated on the basis of keywords being represented as per the frequency in the codes in the study.

Lastly, opportunities were described by the authors in the order of most important classified by participants in the online survey. Also, the authors ranked the opportunities for the health system to enact (highest, high, or medium), the potential financial cost to implement (highest, high, or medium), and the length of time required to implement (short, medium, or long-term).

10.3. Brazil Stakeholder Workshop

HSCI-LA organized in-person workshops on cancer control policies in Brazil attended by 32 stakeholders from leading public and private organizations involved in cancer control. The workshop helped to elucidate first-hand the main challenges related to cancer and potential solutions to address the rising burden of cancer in Brazil and the challenges identified.

The stakeholders were invited to participate in a facilitated roundtable discussion focused on four main areas of cancer policy: (1) organization and governance, (2) financing, (3) resource generation and management, and (4) service delivery. Each roundtable was moderated by a senior policy maker with a good knowledge of the Brazilian health system and cancer control, and a good knowledge of the institutions and stakeholders therein. The moderators were also responsible for organizing and inviting a multi-stakeholder group of participants based on background and expertise for each of the roundtables which they facilitated.

The themes emerging from the roundtables were collated and categorized for analysis and comparison with the responses for the survey and to explore in more depth some of the issues identified in the survey. The roundtables enabled the participants to discuss and explore not only the challenges related health system functions and outputs (public health/personal services), but also, and importantly, potential solutions that could be developed to address the identified challenges.

The solutions were categorized and prioritized in discussion with the participants to develop a set of proposed policies and actions that were appropriately sequenced to improve health system performance to achieve equity, efficiency, effectiveness, and responsiveness objectives for cancer and to improve cancer outcomes in terms better health (survival for example), financial protection and user satisfaction.

11. Appendix C: Analysis of Context in Brazil

11.1. Demographic and Epidemiological Transition

Brazil has undergone a significant shift in demographics within the last 70 years. In the mid-1950s, the country began a decline in population growth rates, typical in nations with significantly advanced demographic transition. In 1960, fertility rates were at 6.3 children per woman, but by 2020, fertility rates had decreased to 1.6 children per woman, below the replacement rate of 2.1 (83). Concurrently, infant mortality rates have significantly decreased, allowing for a bulge in the working-age population of Brazil (84). According to Anderson and Shneider, now is the time Brazil may take advantage of the demographic dividend. However, the window of opportunity is set to begin reversal in 2025, when population aging will accelerate (85). Indeed, population aging and increased longevity, especially for women, will impact the costs of health plans, with greater intensity for individual / family members (86).

Like its middle-income peers, Brazil is experiencing a double burden of non-communicable disease and infectious diseases. Though mortality due to cardiovascular disease and cancer appear to have decreased in recent years, they remain the top health challenges in Brazil. Among infectious diseases, Zika, dengue, HIV, and cholera remain endemic while other diseases like malaria, leprosy, and leishmaniasis have intensified in recent years. States in the northeastern portion of the country also must contend with the burden of increased homicide rates within the last decade, adding another layer to the complex public health situation in Brazil (84).

11.2. Political, Legal, and Regulatory Environment

The Federative Republic of Brazil is the fifth-most populous nation in the world and accounts for one-third of the population of Latin America. Brazil is administratively subdivided into 26 states and the Federal District, which contains the capital city of Brasília. Its most recent constitution, enacted in 1988, established its current democratic government after emerging from two decades of military dictatorship running from 1964-1985 (87).

The 1988 Constitution set limits on presidential power and government censorship. In Brazil, legislative ability lies with the bicameral National Congress, comprising the Chamber of Deputies and the Federal Senate. Executive power lies with the President, elected once every four years. Judicial power is separated among a few institutions, with the Federal Supreme Court in charge of ruling on constitutional concerns as well as those pertaining to federal civil servants of the country. The Higher Court of Justice hears non-constitutional cases and those pertaining to state governors. The judicial system is also subdivided into ordinary and special branch courts, the former consisting of state and federal courts, and the latter comprising labor, electoral, and military courts ((87).

After a decade of democratic rule, with high economic inequality, high inflation, and accusations of corruption comprising the first half of the 1990s followed by a period of strong economic growth in the latter half, Luiz Inacio Lula da Silva ("Lula") was elected in 2002 as the country's first democratically elected successor in over 40 years. During his administration, employment, wages, and several social reforms were prioritized. Investment in Brazil rose during this period, and the agricultural and mining sectors grew (87).

In 2010, Dilma Rousseff was the first woman to preside over Brazil elected. In 2014, she was re-elected for a new term. Brazil sustained a period of robust expansion until around 2011 when the economy started to suffer the impact of the deteriorating global economy and a contraction in the Brazilian industrial sector. Also, after an annual readjustment of the public transport tariff in the city of São Paulo in 2013, a series of protests began, which ended gaining strength and putting pressure on all spheres of government. The newly re-elected government of Dilma Rousseff began to face intense popular pressure, economic contractions in the industrial sector, as well as other demands from citizens. The Petrobras scandal, the economic recession, accusations of electoral corruption, and pressure from opposition political groups led to the impeachment of President Dilma Rousseff and her removal from office in 2016.

The Interim Temer administration introduced austerity measures to manage the economic crisis but was unsuccessful. In combination with Lula's conviction in 2017 and incarceration in 2018, public opinion swayed toward far-right populist Jair Bolsonaro. In 2021, the Supreme Court overturned all convictions in Lula's court case. Bolsonaro administration, which assumed power in the 2020s, approached the COVID-19 pandemic with passive response of the federal government rather than implementing evidence-based, public-health policies with disastrous consequences for Brazil (88).

On Jan 1, 2023, Luiz Inácio Lula da Silva was sworn in as president after a turbulent period, succeeding Jair Bolsonaro, who was accused of having downplayed the COVID-19 pandemic and to whom building a strong Sistema Único de Saúde (SUS) was not on the agenda (88). The new Government is expected to set new priorities for the SUS. Indeed, it will have to face the fallout from the COVID-19 pandemic and, notably the drop-in disease diagnosis (including cancer diagnoses), screening tests, surgeries, and other healthcare procedures that will lead to a higher demand for patients who may have developed advanced disease. A major issue the new Government will have to deal with will be the budget for the public health system. If it does not undergo review, the public health system will suffer a substantial cut of almost R$23 billion (around £3·6 billion), reducing the budget to the lowest level in the last 10 years (89). The health expenditure in Brazil with the public health system represents only 3·8–3·9% of the country's GDP, significantly lower than the average spent by OECD countries (90). But even more than the budget, the challenge lies in its allocation strategy, all the more so given the rising cost of oncology treatments. This is a social issue of major importance, as Brazil is already a country of many inequalities (91), and access to high-quality health care is a challenge the newly elected Government promises to address (92).

11.3. Economic Environment

Finance and Cancer Survival

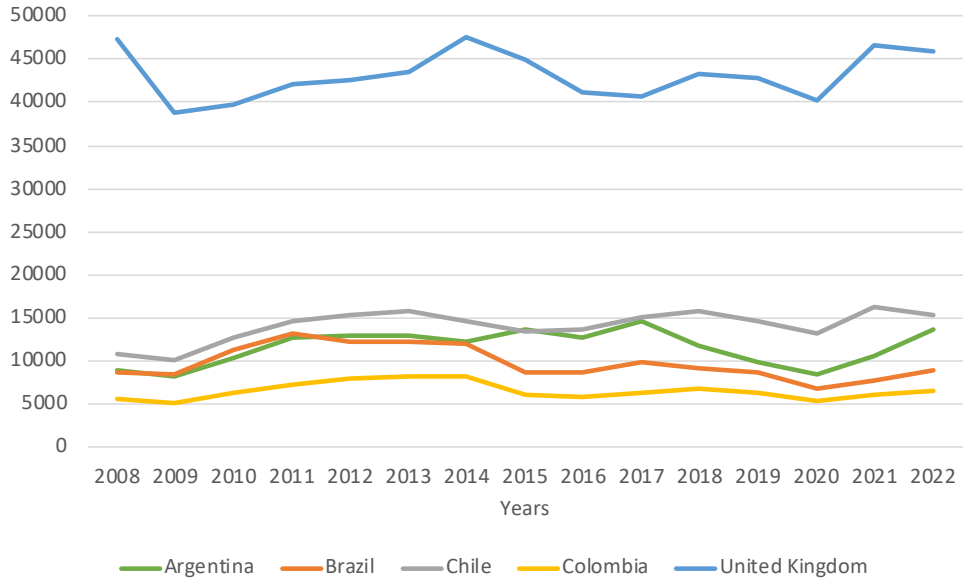
Continuing the analysis of cancer survival estimates, the team plotted five-year survival against financial metrics like Gross Domestic Product (GDP) per capita and health expenditure per capita. GDP per capita is calculated by dividing a country's annual GDP by its midyear population, with the original figure reported in current US Dollars (USD). Healthcare expenditure pertains to the estimated expenditure on healthcare goods and services consumed each year, also nominally reported in current USD. However, these nominal figures fail to account for the differences in the prices of goods and services in different countries and regions. Hence, purchasing power parity (PPP) is an additional adjustment to the per capita metrics that facilitates a more precise comparison between countries. The PPP metrics analyzed are reported in International Dollars (Intl$), which has the same purchasing power as the US dollar has in the United States. The following analysis uses GDP per capita and health expenditure per capita, both nominal and PPP, from 2000 to 2014 in Argentina, Chile, Colombia, and the UK for additional contextualization. Analysis was limited to the period of 2000 to 2014 to match the survival estimates from the CONCORD-3 study (14).

Country-Level Expenditures

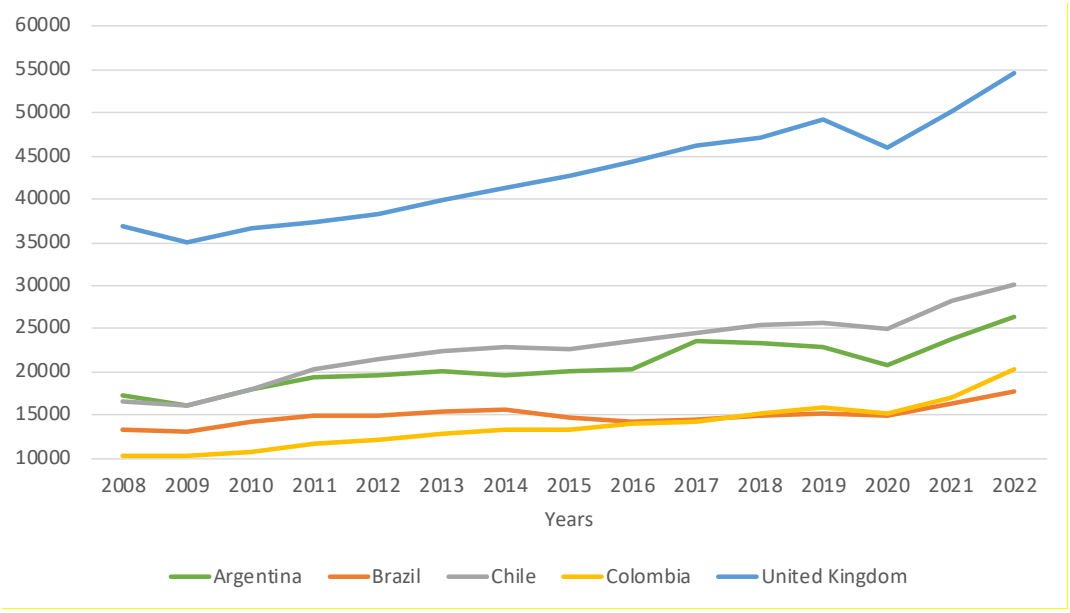
Of the countries selected, Brazil had the lowest 2022 GDP per capita, PPP, with Intl$ 15,093.46, closely followed by Colombia at Intl$ 15,651.58. In a higher cluster were Argentina and Chile, with a GDP per capita, PPP, of Intl$ 22,447.08 and Intl$ 25,886.12 each. The UK had a predictably higher GDP per capita at Intl$ 46,831.08. PPP figures are used in lieu of the nominal GDP per capita estimates for a more accurate comparison between countries.

Brazil's GDP per capita, PPP, increased 34.18% from Intl$ 13,281.074 in 2008 to Intl$ 17,821.737 in 2022. This percentage increase was below Colombia (97.13% increase from 2008 to 2022), Chile (82.52%), Argentina (52.87%) and the UK (48.47%). Appendix Figures 2 and 3 depict each country's GDP per capita and GDP per capita, PPP, from 2008 to 2022.

Appendix Figure 2: GDP Per Capita, Current USD (Source: The World Bank Open Data) (65)



Appendix Figure 3: GDP Per Capita, PPP, Current International$ (Source: The World Bank Open Data) (65)

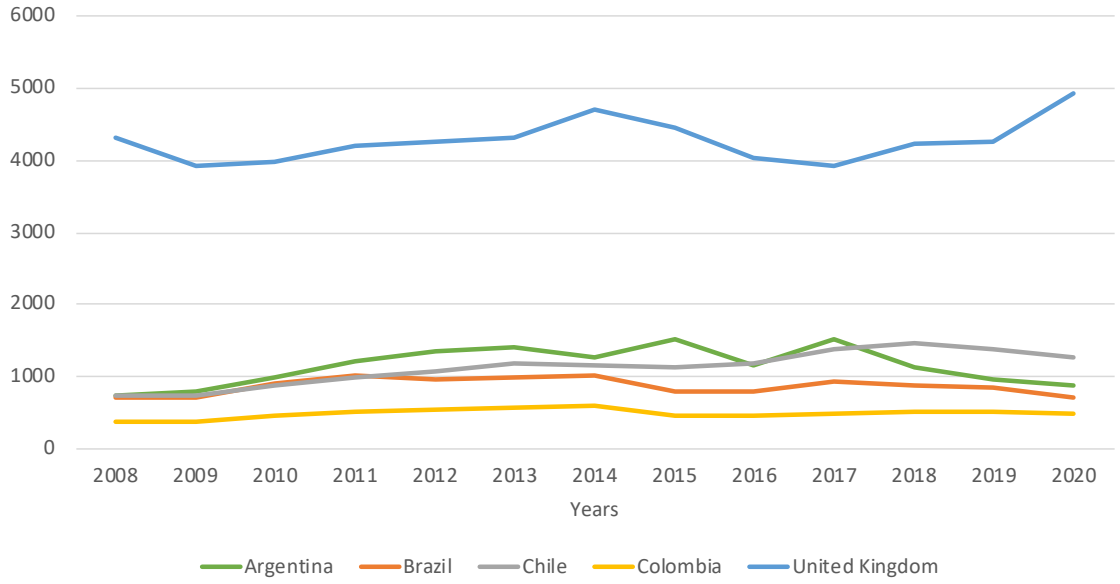


As with GDP per capita, Brazil was on the lower end for health expenditure per capita, PPP, at Intl$1,529.439 in 2020. Only Colombia (Intl$1,335.858) spent less on health per capita, PPP, while Argentina (Intl$2,089.518) and Chile (Intl$2,425.634) spent slightly more per capita. The UK spending was significantly higher at Intl$5,577.415 per person in 2020. Despite spending a smaller amount on health expenditure per capita than many of the comparison countries, Brazil spent a higher percentage of its GDP per capita, PPP, on health. Brazil spent 10.26% of its GDP per capita, PPP, on health expenditures per

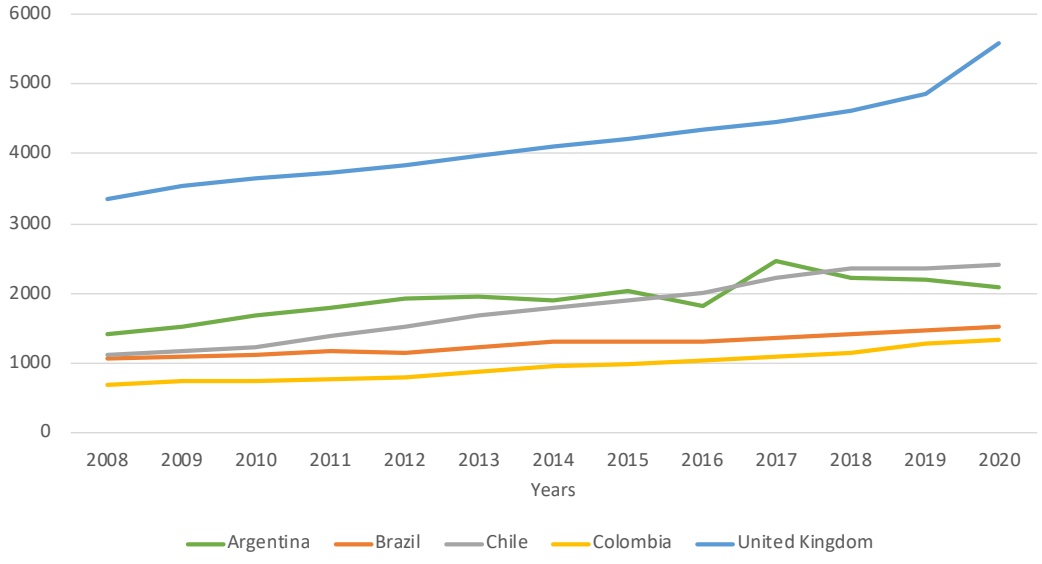
capita, PPP, in 2020. This ratio was slightly above that of Argentina (10.05%), Chile (9.72%), and Colombia (8.84%). Only the UK spent a higher percentage at 12.15% of its GDP per capita, PPP, in 2020.

Each country also substantially increased its health expenditure per capita, PPP, over time. Brazil's spending grew 43.88% between 2008 and 2020, similar to Argentina, that grew 47.43%, a figure significantly lower than the percentage increase seen in Colombia (91.81% increase from 2008 to 2020) and Chile (117.46%). Finally, the increase in UK health expenditure per capita, PPP, over time from 2008-2020 was 67.05%.

Appendix Figure 4: Health Expenditure per Capita, Current USD (Source: The World Bank Open Data) (65)



Appendix Figure 5: Health Expenditure per Capita, PPP, Current International$ (Source: The World Bank Open Data) (65)



Health Expenditure and Cancer

To mirror the CONCORD analysis (14), each financial metric discussed above was segmented into 5-year averages corresponding to the years for survival estimates: 2000-2004, 2005-2009, and 2010-2014.
The specific cancer types selected for analysis are breast, colon, and lung cancer, for which comparable data were available. Table 1 displays Cancer Type 5-Year Survival, and Table 2 the financial metrics from the World Bank Open Data (65). These data were used for the respective scatterplot analysis for each type of cancer (Breast, Colon, and Lung).

Appendix Table 1: Cancer Type 5-Year Survival (Sources: CONCORD-3 Study) (14)

Country/Year	Brazil	Argentina	Chile	Colombia	UK
Breast Cancer 5-Year Survival (% of patients diagnosed)					
2000-2004	68.7	82.3	74.6	72.3	79.8
2005-2009	76.9	82	73.5	79.1	83.8
2010-2014	75.2	84.4	75.5	72.1	85.6
Colon Cancer 5-Year Survival (% of patients diagnosed)					
2000-2004	44.5	54.2	35.5	45	52.0
2005-2009	50.6	51.2	47.1	41.3	56.5
2010-2014	48.3	54.4	43.9	34.5	60.0
Lung Cancer 5-Year Survival (% of patients diagnosed)					
2000-2004	10.7	19.5	7.1	9.4	8.3
2005-2009	7.8	12.4	6.3	10.5	10.1
2010-2014	8.5	13.1	4.6	8.7	13.3

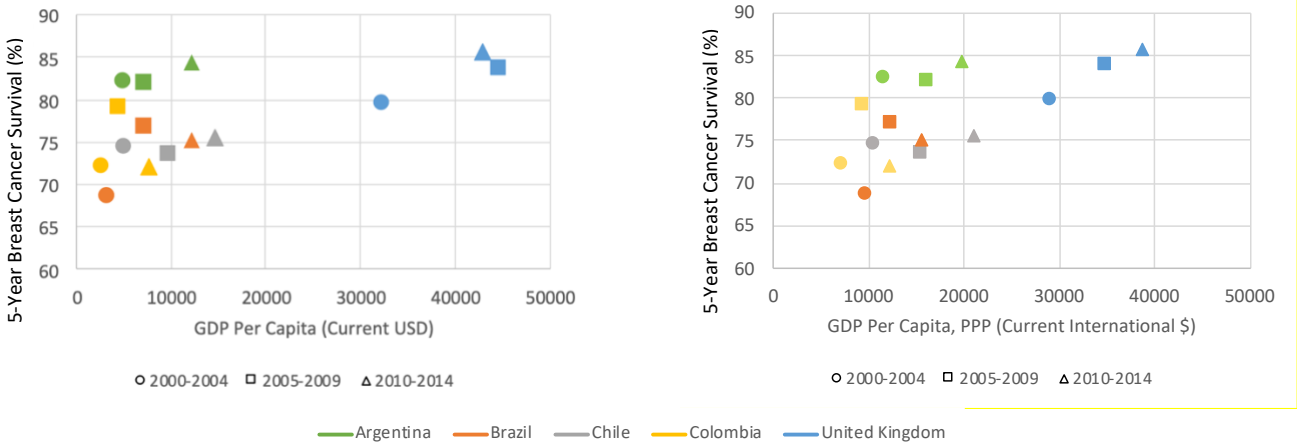
Appendix Table 2: Financial Metrics (Sources: The World Bank Open Data) (65)

Country/Year	Brazil	Argentina	Chile	Colombia	UK
GDP Per Capita (Current USD)					
2000-2004	3288.8	5027.5	5012.6	2484.2	32132.1
2005-2009	7090.8	7104.1	9705.2	4499.1	44639.4
2010-2014	12263.0	12346.5	14662.2	7604.0	42959.9
GDP Per Capita, PPP (Current International $)					
2000-2004	9627.7	11515.4	10502.6	7140.3	29091.8
2005-2009	12370.6	16169.9	15620.8	9522.5	34939.8
2010-2014	15471.7	19696.1	21047.6	12223.7	38608.8
Health Expenditure Per Capita (Current USD)					
2000-2004	274.4	434.0	358.3	134.8	2110.9
2005-2009	577.7	565.3	637.9	296.5	3376.4
2010-2014	970.5	1084.8	1058.4	524.0	3822.7
Health Expenditure Per Capita, PPP (Current International $)					
2000-2004	800.9	952.2	752.1	386.6	1903.8
2005-2009	1006.7	1267.9	1025.5	623.8	2652.6
2010-2014	1226.0	1643.1	1522.4	842.9	3434.4

Health Expenditure and Breast Cancer

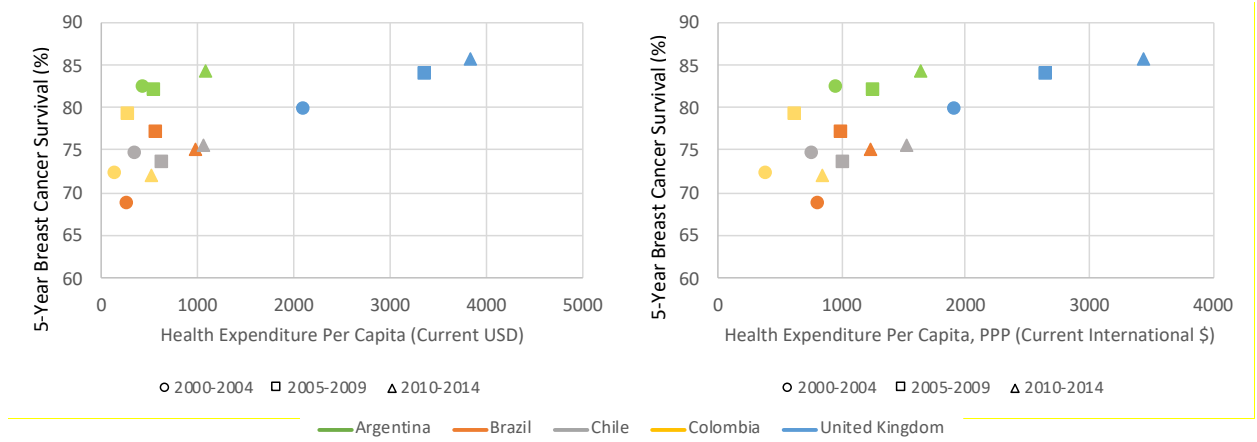
For breast cancer, 5-year survival in each of the comparator countries ranges from 72.1% in Colombia to 85.6% in the UK, with Brazil having a survival level of 75.2%. By comparison, the highest breast cancer survival in the world from 2010 to 2014 belongs to the US at 90.2% of all diagnosed cases. Plotting survival levels against GDP per capita we find a positive correlation, with the trend more evident clearer in PPP figures. Figures Appendix 6 show this comparison for GDP per capita and GDP per capita, PPP. Here it is reported the data for the available years for CONCORD-3 Study 2000-2014, compared to the same years for The World Bank Open Data (65).

Appendix Figure 6: (A) GDP per Capita vs Breast Cancer 5-Year Survival (B) GDP per Capita, PPP vs Breast Cancer 5-Year Survival (Sources: CONCORD-3 Study and The World Bank Open Data) (14,65)



Health expenditure per capita shows a tighter positive correlation between variables, as seen in Appendix Figure 7.

Appendix Figure 7: (A) Health Expenditure per Capita vs Breast Cancer 5-Year Survival (B) Health Expenditure per Capita, PPP vs Breast Cancer 5-Year Survival (Sources: CONCORD-3 Study and The World Bank Open Data) (14,65)

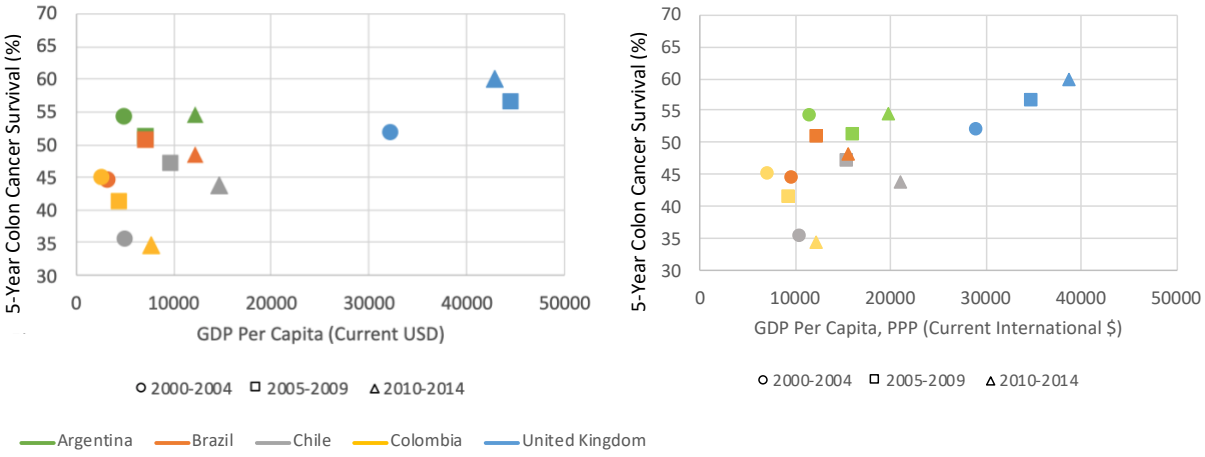


Generally, the correlation is stronger in the PPP metrics, allowing for a more accurate comparison between countries than the nominal GDP per capita figures. One way this is evident is through the R2 value, which is the percentage of the dependent variable variation, in this case, 5-year breast cancer survival, explained by a linear model. In general, the higher the percentage, the better the linear model fits the data. Both PPP graphs have higher R2 values than their nominal counterparts, with a linear trendline explaining 60% of all variation for GDP per capita, PPP versus 48.6% for GDP per capita in the data points from 2010 to 2014. With health expenditure, the trendline explained more of the survival variation than GDP per capita in the same set, and yet again, the PPP metric explained the variation more than its nominal metric. Health expenditure per capita, PPP, has its trendline explaining 65.5% of the variation compared to the nominal figure trendline explaining 53.4% of the variation.

Expenditure and Colon Cancer

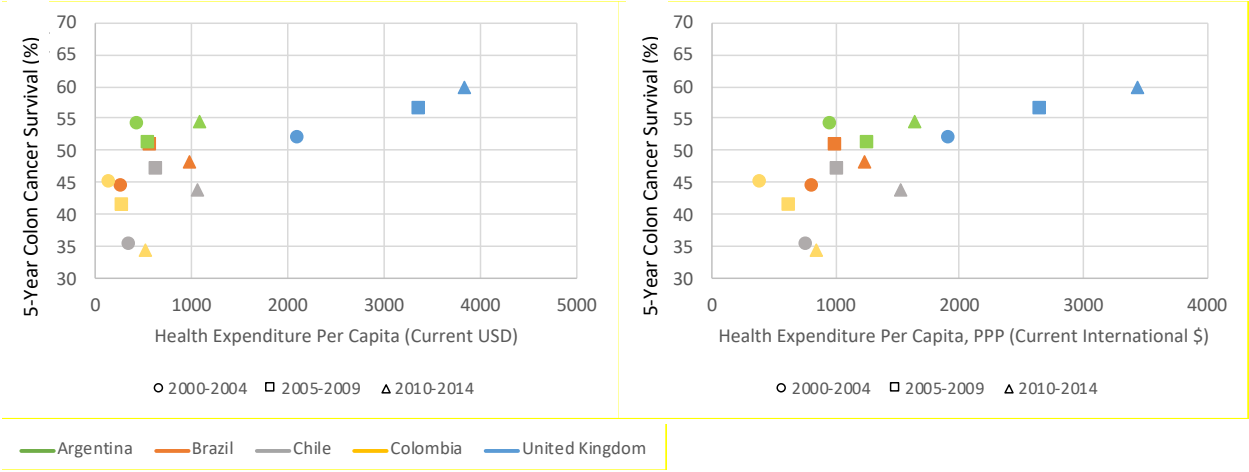
The survival rate for colon cancer is considerably lower than for breast cancer. Brazil has a 48.3% survival rate in the time period 2010-2014. This figure falls below most of the other comparison countries, like Argentina (54.4% survival), Chile (43.9%), and the UK (60%). Like breast cancer, colon cancer survival is positively correlated with both GDP per capita and health expenditure per capita (Appendix Figure 8).

Appendix Figure 8: (A) GDP per Capita vs Colon Cancer 5-Year Survival (B) GDP per Capita, PPP vs Colon Cancer 5-Year Survival (Sources: CONCORD-3 Study and The World Bank Open Data) (14,65)



Of particular note is the R2 value of the health expenditure per capita, PPP, where the trendline explains 69.1% of the variation in the 2010 to 2014 data set, the highest of any metric for colon cancer. This is followed by GDP per capita, PPP (R2 value of 63.4%), health expenditure per capita (59.7%), and GDP per capita (55.8%) (Appendix Figure 9).

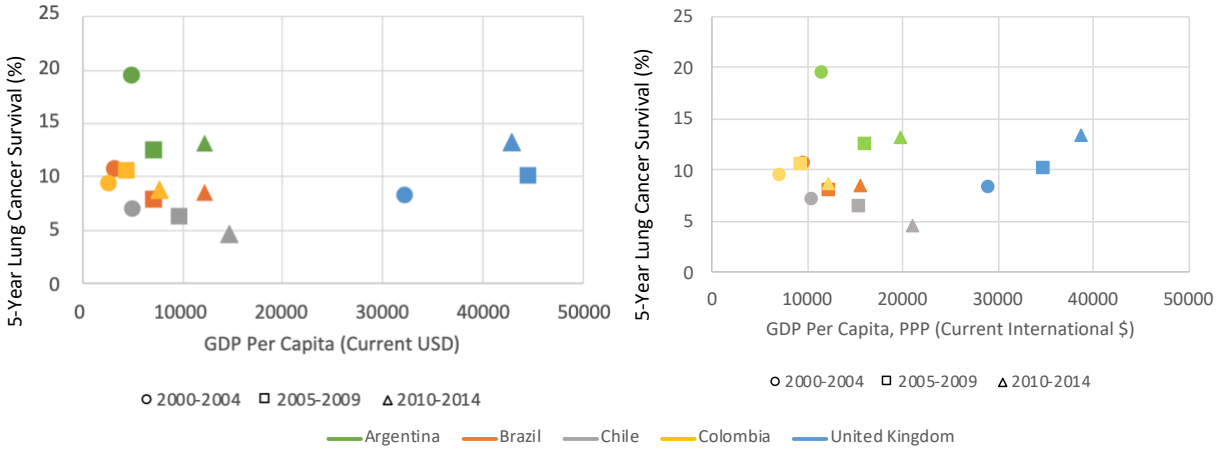
Appendix Figure 9: (A) Health Expenditure per Capita vs Colon Cancer 5-Year Survival (B) Health Expenditure per Capita, PPP vs Colon Cancer 5-Year Survival (Sources: CONCORD-3 Study and The World Bank Open Data) (14,65)



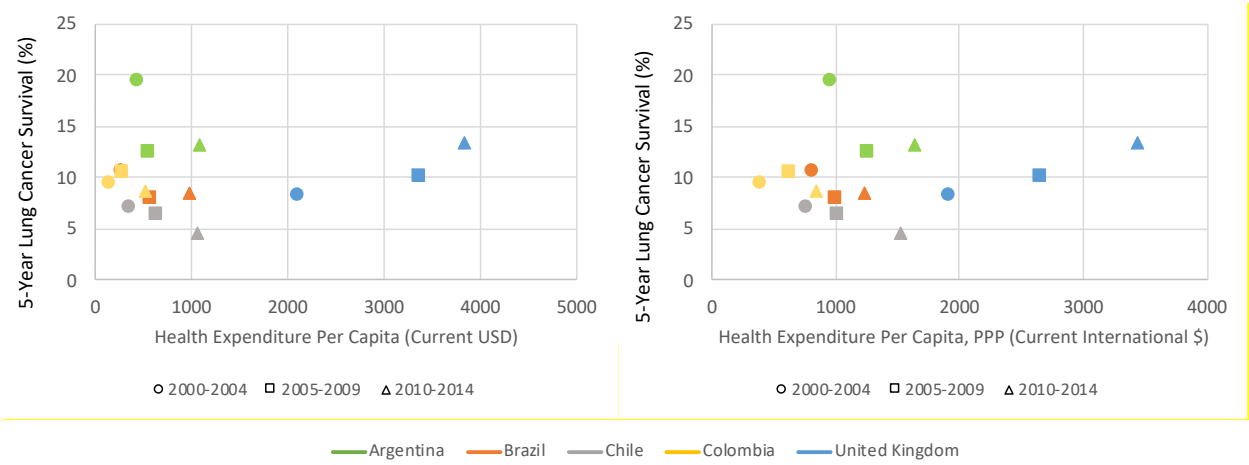
Expenditure and Lung Cancer

Lung cancer survival is significantly lower than those of breast cancer and colon cancer, with the highest survival rate in the world from 2010 to 2014 being 32.9% of diagnosed adults in Japan. Brazil's 8.5% survival during 2010 to 2014 is situated on the lower-end comparison countries- with Chile (4.6% survival) below, and Colombia (8.7%), Argentina (13.1%) and the UK (13.3%) above. Plotting these survival estimates against GDP per capita and health expenditure per capita shows a weaker positive correlation between financial metrics and lung cancer survival. Appendix Figures 10 and 11 display these findings.

Appendix Figure 10: (A) GDP per Capita vs Lung Cancer 5-Year Survival (B) GDP per Capita, PPP vs Lung Cancer 5-Year Survival (Sources: CONCORD-3 Study and The World Bank Open Data) (14,65)



Appendix Figure 11: (A) Health Expenditure per Capita vs Lung Cancer 5-Year Survival (B) Health Expenditure per Capita, PPP vs Lung Cancer 5-Year Survival (Sources: CONCORD-3 Study and The World Bank Open Data) (14,65)



Supporting the visual interpretation of weaker correlation is the fact that the R2 values for the 2010 to 2014 trendlines are substantially lower across the board for explaining variation in lung cancer survivability. None of the values are above 32%, with health expenditure per capita having the highest at an R2 of 31.6%. The R2 values continue to decline for health expenditure per capita, PPP (30.1%), GDP per capita (25.8%), and GDP per capita, PPP (24.9%).

11.4. Sociocultural Dynamics

Brazil's extensive history involving the trans-Atlantic slave trade from the 1500s onwards forms the basis for race relations today. The slave trade would bring an estimated 3.6 to 4 million enslaved people to Brazil, accounting for about 40% of the total slaves brought to the American colonies. Relations between the Portuguese colonizers and enslaved people were common, resulting in many "mixed-race" individuals who were to populate the nation.

Though slavery was abolished in 1888, ideologies surrounding the superiority of "whiteness" and those of eugenics made their way from North America and Europe to Brazil around the same time period. Though such extreme ideologies have diminished in modern-day Brazil, racial inequalities continue to impact darker-skinned individuals in the nation. Black or mixed-race individuals, who represent 56,1% of the Brazilian population (PNAD Continua), face concerns ranging from microaggressions ("He is Black, but very honest") to stark differences in educational attainment or access to organ transplants. Blacks have a lower life expectancy, three times the poverty rate, and experience homicide at twice the rate of whites in Brazil (80). Furthermore, Black individuals are more likely than their "Brown" peers to state that they have been victims of racial discrimination. In a 2010 LAPOP survey, 57% of Blacks, compared to 88% of Browns, stated they had never been victims of racial discrimination (93).

Gentrification has made economic disparities between low-income Afro-Brazilians and rich with populations even more apparent, resulting in housing that has become too expensive for many individuals to afford. Protests against these changes have further illustrated a higher incidence of police brutality against darker-skinned individuals compared to their white peers (93).

11.5. Ecological Changes

Brazil's use of natural resources has increased in recent years, and some of its infrastructure has kept up with new emerging needs while some have not. As of the mid-2010s, Brazil outpaced many of its OECD peers in securing energy via low-carbon resources. About 40% of its total energy needs and 80% of its electricity is produced from renewable energy sources. Air pollution has decreased in recent years and remains a concern in major metropolitan areas where particulate matter concentrations exceed national air quality standards. Furthermore, only about half of the rural population has access to waste collection services, some of which are collected in uncontrolled sites (94).

Deforestation also remains a concern in Brazil. The nation holds the second-largest forest area in the world and experiences the world's highest annual loss in forest cover. While deforestation declined dramatically from 27,000 km2 in 2004 to about 4,800 km2 in 2014 (94), the election of President Jair Bolsonaro resulted in government deregulation of environmental degradation in favor of economic growth. Under his leadership, President Bolsonaro's administration reduced the budget for IBAMA, the Brazilian Environmental Agency, by 24 percent. Enforcement actions by this agency have also decreased by 20 percent since his election. His tenure resulted in a continuation of trends seen since 2012: a gradual increase in deforestation not seen since 2004 (95).

Following his election in late 2022, President Luis Inácio Lula da Silva has already signed several climate- and environment-related decrees. One re-establishes the Amazon Fund, an international mechanism frozen by the Bolsonaro administration that finances efforts to reduce deforestation. President Lula also revoked a 2022 edict, signed by Bolsonaro, that sought to expand and legalize small-scale 'wildcat' gold mining, which strips the land of vegetation, pollutes waterways, and is often carried out illicitly in Indigenous territories in the Amazon. Global leaders and scientists are waiting to see whether President Lula can fulfill his pledges and commitment to reaching net-zero deforestation by 2030 (96).

Managing climate change in Brazil is all the more important as these changes have consequences for the health sector. To name a few issues, the endangerment of biodiversity is linked to the high risk of pandemics and infectious diseases; fires and the release of pollutants cause major health problems, including cancers (43).). Finally, Brazil is also one of the countries with the most important natural medicinal resources, thanks to the Amazon forest, but these are endangered by their exposure to global climate change (97).

11.6. Technological Changes

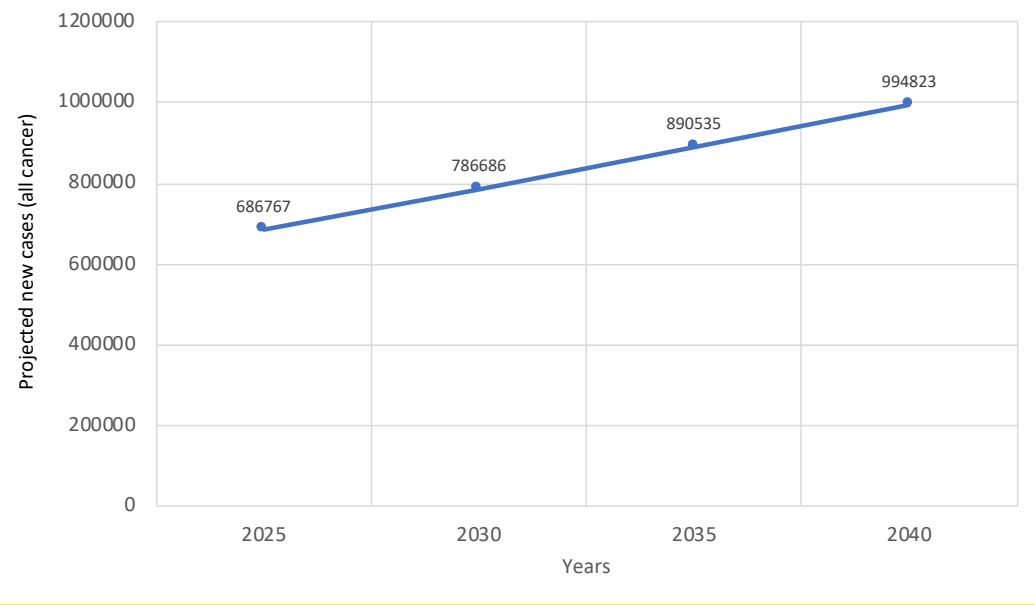
Brazil continues to make technological changes to advance equality among its various social classes, though challenges remain as it tries to improve access for its most vulnerable communities. As of 2014, about 85% of people over the age of 10 has access to a mobile phone, one of the main ways information can be disseminated. However, income continues to define whether a patient has internet access. About 98% of Brazil's most affluent social classes have access to the Internet, whereas only about 8% of the country's poorest have similar access (85). In response to perceived gaps in information access, the government has actively sought to provide young rural populations with information and communication technologies. These projects have benefitted about 6.4 million young people already. The government has also prioritized the acquisition of computers for public schools and the creation of apps that provide information about traffic and public transport, public places with free wireless internet, and job seeking (98).

Much as in the rest of the world, the COVID-19 pandemic has spurred innovative change in how technology is used in healthcare. One such instance involves the use of a telemedicine platform named "Ciudar Digital," included an "electronic medical record, access to test results, and a digital prescription interface for all doctors to use free of charge. Specifically, doctors have been able to monitor a patient's diabetes virtually and use videoconferencing platforms, provided they have access to glycemic reports via email or other apps/platforms such as GlucoTrends. Teles et al. note that while these advances have been significant, particularly for low-income Brazilians, their sustainability remains tenuous. Business incentives to finance these changes will need developing to make these changes permanent and available to those with less access to a physical healthcare setting (99).

12. Appendix D: Projected Cancer Incidence in Brazil and Selected Comparator Countries

Total cancer incidence in Brazil is projected to rise 68.0% between 2020 and 2040 to an alarming 994,823 new cancer cases in 2040 alone. This figure represents an additional 402,611 cases on top of the 592,212 cases in 2020. Brazil's high rate of change is on par with many large Latin American peer countries. Colombia's total incident cancer is projected to rise by 69.3% between 2020 and 2040, Mexico by 65.4%, and Chile by 66.5%, while Argentina is projected to increase at a slightly slower pace, with new cases of cancer rising by 41.8% between 2020 and 2040 (63).

Appendix Figure 12: Estimated number of new cases from 2025 to 2040, Males and Females, age (0-85+) in Brazil (Source: IARC Cancer Tomorrow) (63)

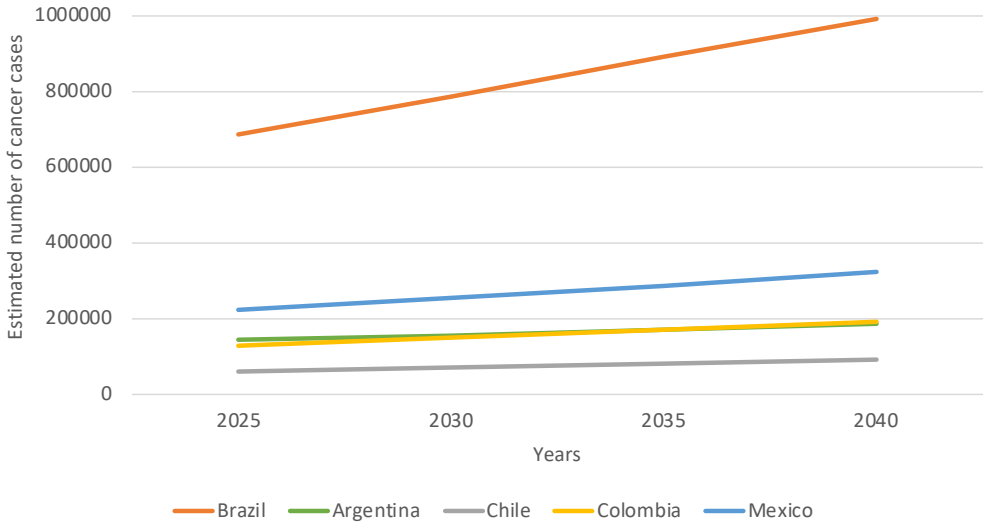


Appendix Table 4 and Figure 13 show the number of cancer cases projected for 2025-40. Though comparisons between countries drawn from crude numbers do not account for different population age structures or sizes, examining the percentage increases can help understand the shape of the region's projected cancer burden.

Appendix Table 4: Estimated number of cancer cases in Brazil and selected Latin American countries (2025-40), all cancer types (Source: IARC Cancer Tomorrow) (63)

	Brazil	Argentina	Chile	Colombia	Mexico
2025	686,767	142,922	62,235	130,919	223,624
2030	786,686	156,063	71,139	150,502	254,665
2035	890,535	170,312	80,817	171,044	288,603
2040	994,823	185,606	90,264	191,631	323,432

Appendix Figure 13: Estimated number of cancer cases in Brazil and selected Latin American countries (2025-40), all cancer types (Source: IARC Cancer Tomorrow) (63)



Incidence Projections in Other Regions

Compared to other regions of the world, Brazil's cancer incidence from 2020 to 2040 is projected to increase by about the same percentage as Latin America and the Caribbean (65.6% increase from 2020 to 2040), both of which are much higher than the Northern American (37.9% increase) and Western European (23.5%) projections (63).

Appendix Table 5: Percentage Projected to Increase in Number of Cancer Cases – Brazil and selected world regions 2020-40 (Source: IARC Cancer Tomorrow) (63)

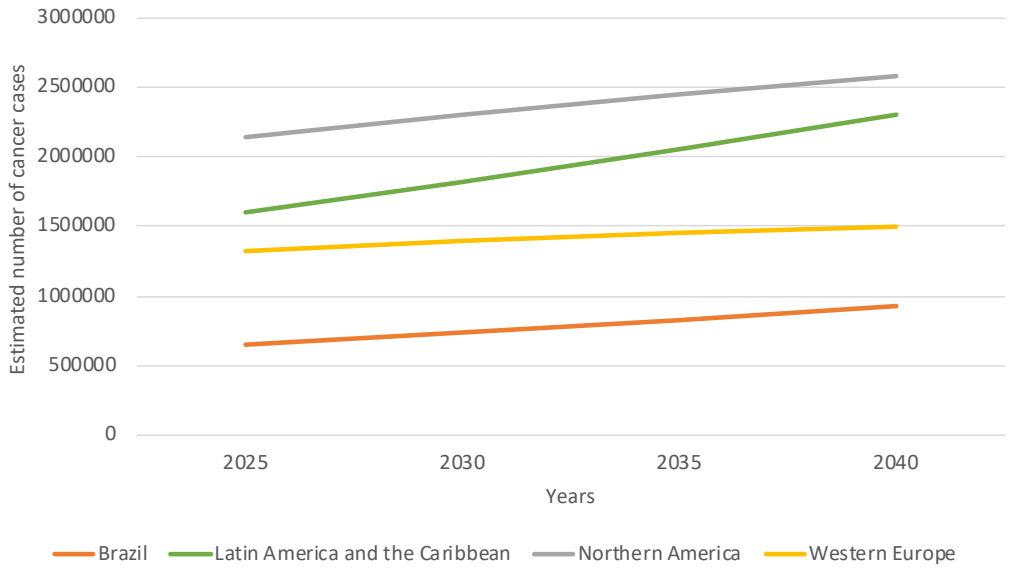
	Brazil	**LAC**	**NA**	**WE**	**World**
2020-2030	32.9%	31.0%	20.1%	12.9%	27.5%
2020-2040	68.0%	65.6%	37.9%	23.5%	56.7%

In 2020, the Latin America and Caribbean region had comparable incident cancer cases to Western Europe, with 45,880 cases separating their estimates. However, because cancer in Brazil and Latin America as a whole is projected to rise much faster than estimates for Western Europe, the gap between the two regions in 2040 is projected to be 675,524 cases (63).

Appendix Table 6: Estimated number of cancer cases in Brazil and selected world regions (2025-40), all cancer types (Source: IARC Cancer Tomorrow) (63)

	Brazil	LAC	NA	WE
2025	644,183	1604,352	2145,033	1321,384
2030	735,731	1826,118	2307,246	1394,182
2035	830,106	2060,143	2457,081	1457,628
2040	924,183	2298,922	2582,263	1505,347

Appendix Figure 14: Estimated number of Cancer Cases in Brazil and selected world regions (2025-40), all cancer types (Source: IARC Cancer Tomorrow) (63)



Disaggregated Incidence Projections

Specific cancer types in Brazil that are projected to nearly double in number of new cases per year within the next 20 years include prostate cancer (83.2% increase from 2020 to 2040), lung cancer (82.1%), stomach cancer (78.8%), and bladder cancer (91.8%). Prostate cancer is of particular concern because it

is already the cancer with the highest incident ASR within Brazil. These alarming trends are not necessarily unique to Brazil, with the incidence of prostate, lung, and stomach cancers projected to increase by over 80% in Chile, Colombia, and Brazil. Argentina, though still projected to increase substantially, has a considerably lower estimate of a 48.8% increase in prostate cancer, 47.6% increase in lung cancer, and 47% in stomach cancer (63) **(Appendix Table 7).**

Appendix Table 7: Percentage Projected to increase in the number of new cancer cases in Brazil and selected countries between 2020 and 2040, by cancer type (Source: IARC Cancer Tomorrow) (63)

	Brazil	Argentina	Chile	Colombia	Mexico	UK
Prostate	83.2	48.8	90.7	92.5	88.6	32.2
Breast	47.5	35.0	35.0	49.1	51.5	17.8
Colorectal*	43.3	46.4	71.3	78.6	72.9	31.8
Lung	82.1	47.6	80.2	91.9	89.7	33.1
Cervical	38.3	26.4	27.3	42.5	47.0	4.2
Thyroid	23.5	25.6	18.5	32.5	36.9	9.8
Stomach	78.8	47.0	79.7	80.6	77.3	37.5
Uterine	59.4	40.0	36.3	59.6	53.6	20.5
Bladder	91.8	52.0	86.5	96.7	85.4	39.5
Ovary	52.6	34.6	33.0	48.3	50.6	23.1

***Colon, rectum and anus**

Cancer types in this analysis were chosen and ordered according to age-standardized rate, a different metric than the crude number of new cases. Despite this difference, prostate and breast cancer are still projected to have the highest number of new cases, with 178,179 new cases of prostate cancer estimated and 130,498 new cases of breast cancer in 2040. Appendix Table 8 further breaks down the projected number of new cases for each of Brazil's top 10 cancers by ASR (63).

Appendix Table 8: Projected incidence by cancer type for cancers with the highest mortality rates in Brazil (Source: IARC Cancer Tomorrow) (63)

Year/ Country	Brazil	Argentina	Chile	Colombia	Mexico	UK
Prostate Cancer Incidence Projection						
2020	97278	11686	8157	14460	26742	56780
2030	136185	14148	11671	20764	37360	66639
2040	178179	17388	15555	27838	50443	75066
Breast Cancer Incidence Projection						
2020	88492	22024	5331	15509	29929	53889
2030	110790	25812	6269	19410	37701	59061
2040	130498	29739	7197	23121	45344	63478
Colorectal* Cancer Incidence Projection						
2020	55102	15895	6219	10783	14901	52128
2030	75030	19235	8255	14755	19855	60614
2040	97229	23264	10542	19257	25760	68694
Lung Cancer Incidence Projections						
2020	40409	12110	3969	6876	7588	51983
2030	56162	14664	5474	9803	10562	51983
2040	73592	17876	7153	13195	14398	69184
Cervical Cancer Incidence Projections						
2020	17743	4583	1503	4742	9439	3791
2030	21455	5216	1697	5782	11645	3874
2040	24538	5791	1913	6758	13873	3949
Thyroid Cancer Incidence Projections						
2020	30607	4106	1164	5304	11227	5527
2030	35014	4657	1268	6239	13438	5830
2040	37789	5156	1379	7026	15367	6068
Uterine Cancer Incidence Projections						

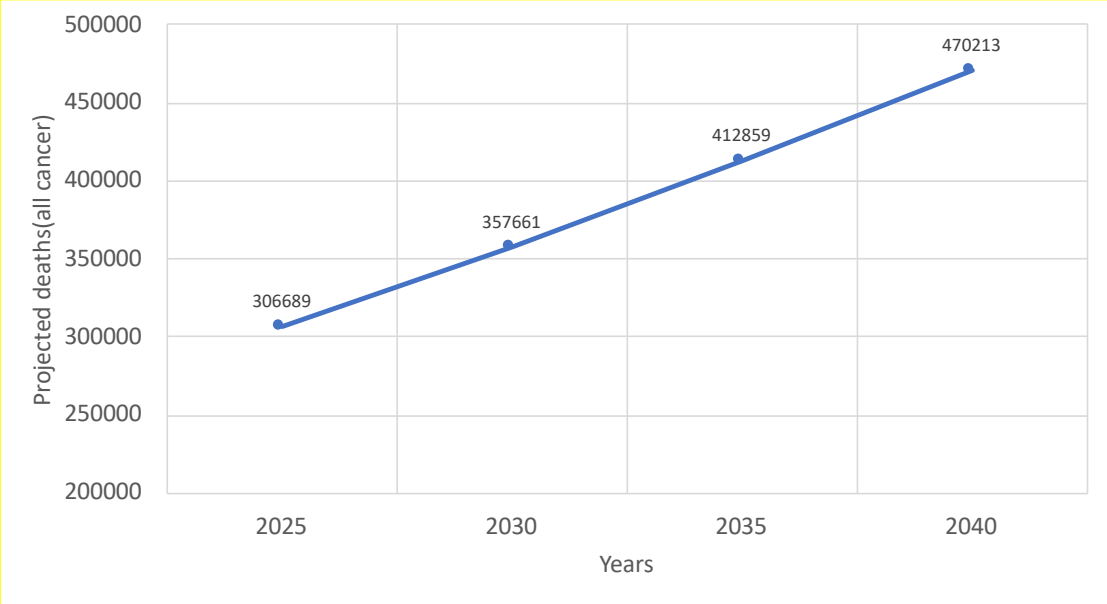
2020	11791	2455	937	2635	5508	11385
2030	15368	2917	1114	3441	7034	12684
2040	18793	3437	1277	4206	8460	13716
Stomach Cancer Incidence Projections						
2020	20139	4003	4208	8214	8804	6568
2030	27615	4855	5759	11290	11839	7807
2040	36017	5883	7563	14834	15611	9028
Bladder Cancer Incidence Projections						
2020	15854	3785	1546	1995	3422	12434
2030	22520	4636	2144	2871	4719	14907
2040	30408	5754	2884	3924	6345	17346
Ovary Cancer Incidence Projections						
2020	7298	2199	837	2391	4963	6056
2030	9241	2574	976	2391	6226	6783
2040	11136	2960	1113	3545	7475	7454

***Colon, rectum and anus**

13. Appendix F: Projected Cancer Mortality in Brazil and Selected Comparator Countries

According to IARC projections, Brazil's total number of cancer deaths are projected to nearly double between 2020 and 2040, increasing 80.9% to 470,213 deaths from cancer in 2040. This represents an additional 210,264 deaths on top of the 2020 estimate of 259,949 deaths (63).

Appendix Figure 15: Projected number of deaths from 2025 to 2040, both sexes, in Brazil (Source: IARC Cancer Tomorrow (63)



Brazil's large increase in cancer deaths is consistent with a troubling regional trend, with deaths from cancer projected to double or nearly double in Chile (81.3% increase from 2020 to 2040), Colombia (85.3%), and Mexico (78.7%). Argentina is the only country with a lower projected increase at 47.7% from 2020 to 2040. Though percentage increase is not as robust a metric as age-standardized rates, examining them allows for some deduction of which countries will face future challenges (63).

It is important to notice that, compared to the projections in the previous report on Rio Grande do Sul, the mortality rate growth appears to have experienced a decrease (100). The previous report also used the predicted mortality for 2020, 2030 and 2040 from IARC Cancer Tomorrow, however the base numbers were from 2018. For instance, Brazil's prediction was 95.5% (2018) vs. 80.9% (2020); Chile's 95.8% vs. 81.3%; Colombia 107.8% vs. 85.3%; Mexico 107.2% vs. 78.7%; Argentina's 53.9% vs. 47.7%. Brazil

presented the steeper slope in absolute mortality growth over the years, compared to Argentina, Chile, Colombia and Mexico (Appendix 34) (63).

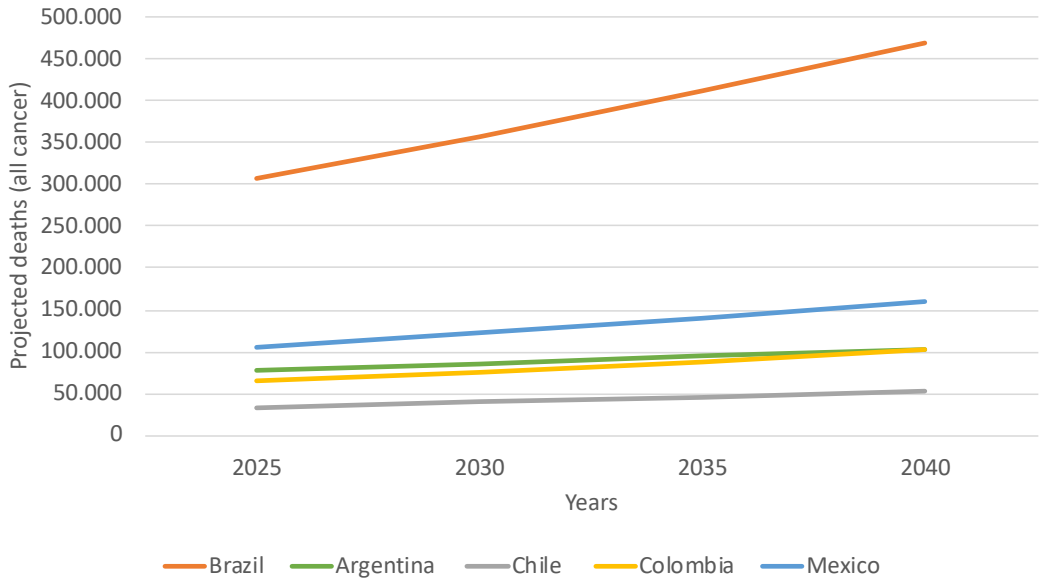
Appendix Table 9: Projected number of deaths over time, all cancer types, both sexes, selected countries in Latin America (Source: IARC Cancer Tomorrow) (63)

	Brazil	Argentina	Chile	Colombia	Mexico
2025	306,689	77,127	33,391	64,901	104,703
2030	357,661	85,131	39,001	76,271	121,484
2035	412,859	93,947	45,359	88,807	140,690
2040	470,213	103,474	51,831	101,881	161,221

Appendix Table 10: Percentage increase in number of deaths from 2020, selected countries in Latin America (Source: IARC Cancer Tomorrow) (63)

	Brazil	Argentina	Chile	Colombia	Mexico
2020-2030	37.6%	21.5%	36.4%	38.7%	34.7%
2020-2040	80.9%	47.7%	81.3%	85.3%	78.7%

Appendix Figure 16: Projected number of deaths over time, all cancer types, both sexes, selected countries in Latin America (Source: IARC Cancer Tomorrow) (63)



Mortality Projections in Other Regions

Brazil's increase in mortality between 2020 and 2040 is similar to the Latin American and Caribbean regions' overall figure of a 77.3% increase. However, both estimates are well above the projected increase in Northern America (49.3% increase), Western Europe (33.2%), and the global estimate (63.7%) (63).

Appendix Table 10: Percentage increase in number of deaths from 2020-2040, all cancer types, both sexes, selected world regions (Source: IARC Cancer Tomorrow) (63)

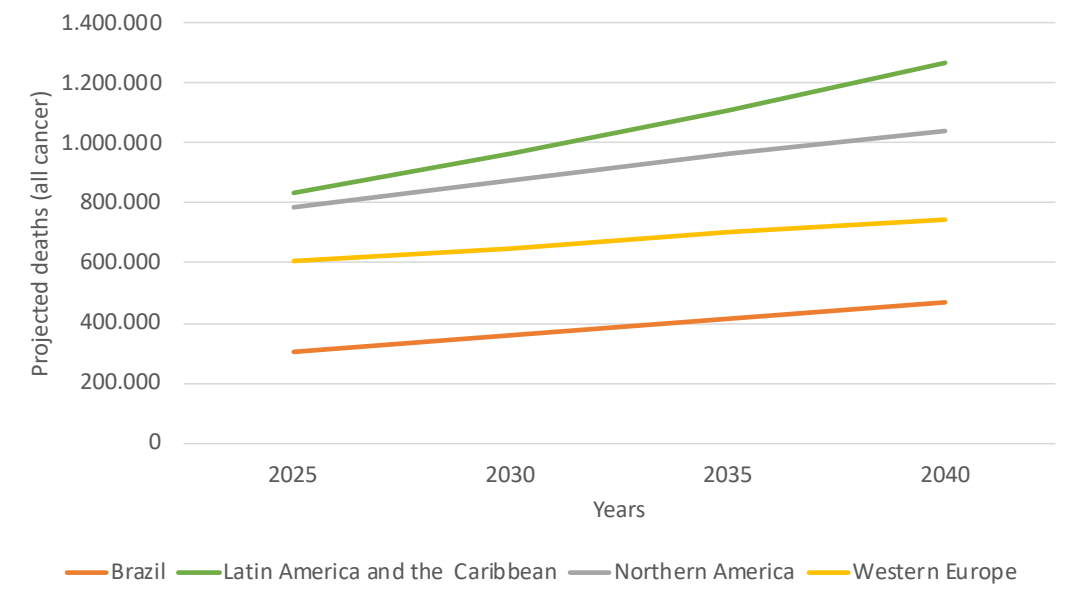
	Brazil	LAC	NA	WE	World
2020-2030	**37.6%**	**35.1%**	**24.7%**	**16.2%**	**29.9%**
2020-2040	**80.9%**	**77.3%**	**49.3%**	**33.2%**	**63.7%**

Appendix Figure 17 shows the projected number of deaths over time for selected world regions, with the rate of increase steeper for Brazil, Latin America, and the Caribbean compared to other selected geographies. Though Northern America, Latin America, and the Caribbean had a similar number of deaths in 2020, Latin America is expected to pass Northern America within the next few years and continue distancing itself from Northern America over time (63).

Appendix Table 11: Projected number of deaths over time, all cancer types, both sexes, selected world regions (Source: IARC Cancer Tomorrow) (63)

	Brazil	LAC	NA	WE
2025	306,689	831,182	782,433	604,004
2030	357,661	963,520	872,026	650,597
2035	412,859	1,109,879	964,554	700,086
2040	470,213	1,265,179	1,044,049	745,248

Appendix Figure 17: Projected number of deaths over time, all cancer types, both sexes, selected world regions (Source: IARC Cancer Tomorrow) (63)



Disaggregated Mortality Projections

Prostate cancer already holds the highest mortality rate in Brazil and is projected to increase in its crude number of deaths by the highest percentage from 2020 to 2040. In that span, Brazil is expected to experience a 125.5% increase in deaths from prostate cancer. This is not necessarily unique to Brazil, with other countries, except for Argentina, projected to increase by a similar margin. Namely, Chile's deaths from prostate cancer will increase by 135.1%, Colombia by 126.7%, and Mexico by 106.5%. For comparison, Western European countries are projected to increase by a smaller but still worrying margin, with France (metropolitan)increasing by 67.2% and the UK by 62.6% (63).

The pattern continues to other cancer types in Brazil, where deaths are predicted to double or nearly double for lung cancer (85.4% increase from 2020 to 2040), colon cancer (86.3%), stomach cancer (82.7%), pancreatic cancer (88.0%), and liver cancer (82.4%). Other cancers that will increase significantly include breast cancer (61.8% increase) and cervical cancer (47.9%). Appendix Figure 39 details these percentage increases across countries by the top 10 cancers in mortality, by ASR, in Brazil, according to the IARC Cancer Today. We aggregated colon, rectum, and anus data to match the IARC Cancer Today data described in this report (9).

Appendix Table 12: Percentage increase in number of deaths between 2020 and 2040, by cancer type in Brazil and selected countries (Source: IARC Cancer Tomorrow) (63)

	Brazil	Argentina	Chile	Colombia	Mexico	UK
Prostate	61.8%	42.9%	54.7%	66.6%	64.2%	30.7%
Breast	125.5%	63.2%	135.1%	126.7%	106.5%	62.6%
Colorectal*	85.4%	47.9%	82.3%	95.6%	91.1%	37.3%
Lung	86.3%	50.7%	84.1%	90.0%	81.0%	70.3%
Cervical	47.9%	31.8%	47.1%	61.9%	62.6%	18.6%
Thyroid	82.7%	48.7%	86.3%	86.7%	81.7%	41.2%
Stomach	88.0%	49.6%	75.8%	91.0%	87.2%	36.5%
Uterine	82.4%	48.8%	81.0%	94.5%	91.3%	37.8%
Bladder	58.3%	38.4%	44.5%	55.4%	56.7%	25.1%
Ovary	73.3%	50.7%	99.4%	101.1%	85.5%	36.9%

***Colon, rectum and anus**

Appendix Table 13 continues the analysis by showing the crude number of projected deaths over time by country and cancer type. In 2040, lung cancer is projected to kill the most people in Brazil with 65,189 deaths. This is followed by colorectal cancer (48,749 deaths), prostate (41,364), and breast (33,542), and stomach cancer (28,830). The cancers included in this section of analysis were chosen and ordered by the top 10 cancers in mortality, by ASR, in Brazil, according to the IARC Cancer Today (9).

Appendix Table 13: Projected number of deaths by cancer type, for cancers with the highest mortality rates in Brazil (Source: IARC Cancer Tomorrow) (63)

Year/ Country	Brazil	Argentina	Chile	Colombia	Mexico	UK
Breast Cancer Mortality Projection						
2020	20725	6821	1674	4411	7931	11839
2030	27025	8191	2088	5810	10352	13573
2040	33543	9746	2589	7347	13023	15475
Prostate Cancer Mortality Projection						
2020	18345	3964	2296	3846	7457	13168

2030	28084	5053	3546	5867	10598	17116
2040	41364	6471	5397	8720	15398	21414
Lung Cancer Mortality Projection						
2020	35160	10729	3550	6090	7100	36518
2030	49252	12997	4928	8759	9907	43361
2040	65189	15863	6472	11911	13568	50156
Colorectal* Cancer Mortality Projections						
2020	26170	8756	3179	5417	7755	21682
2030	36560	10739	4360	7075	10,522	26074
2040	48749	13191	5852	10295	14039	30834
Cervical Cancer Mortality Projections						
2020	9168	2553	799	2490	4335	1121
2030	11443	2961	972	3235	5614	1228
2040	13561	3364	1175	4032	7050	1329
Stomach Cancer Mortality Projections						
2020	15783	3214	3317	6451	6735	4381
2030	21886	3919	4610	8990	9141	5261
2040	28830	4779	6180	12047	12240	6186
Pancreatic Cancer Mortality Projections						
2020	12911	4830	1721	2639	4720	10222
2030	18167	5906	2328	3741	6536	12090
2040	24269	7226	3026	5041	8837	13958
Liver† Cancer Mortality Projections						
2020	12139	2189	1473	2220	7175	7061
2030	16849	2668	2039	3176	10015	8392
2040	22142	3257	2666	4318	13728	9730
Brain# Cancer Mortality Projections						
2020	10920	1488	537	1650	2571	4736
2030	14054	1755	654	2093	3261	5361
2040	17282	2059	776	2564	4028	5926

Esophageal Cancer Mortality Projections						
2020	9786	1751	627	842	1238	8450
2030	13234	2145	899	1221	1701	10015
2040	16958	2638	1250	1693	2296	11569

*** Colon, rectum and anus**

 # Brain and nervous system

† Liver and intrahepatic bile ducts

14. Appendix G: Projected Incidence of Childhood Cancers and Estimates of 5- Year Net Survival for Selected Childhood Cancers

After disaggregating by cancer group, Leukemia, Central Nervous System (CNS) Neoplasms and Lymphoma are the most common childhood cancer groups in Brazil at a projected incidence of 2864, 1041, and 1282 cases respectively. Appendix Table 2 outlines each of the 10 childhood cancer groups in Brazil by incidence, with Appendix Table 3 defining which specific cancer types comprise each cancer group (17).

Appendix Table 14: Projected Number of Incidence Cases of Childhood Cancer in 2030, by Cancer Group (Source: Harvard Database) (17)

Cancer Group	Projected Number of Cases in 2030
Leukemia	2864
Lymphoma & Related	1041
CNS Neoplasms	1282
Neuroblastoma	286
Retinoblastoma	269
Renal Tumors	372
Hepatic Tumors	122
Bone Tumors	430
Soft Tissue Sarcoma	540
Germ Cell Tumors	302
Carcinoma & Melanoma	299
Other & Unspecified	125

Appendix Table 15. Cancer Group Definitions

Cancer Group	Cancer Type
Leukemia	a. Lymphoid
Leukemia	b. Acute myeloid
Leukemia	c. CMD
Leukemia	d. MDS & other
Leukemia	e. Unspecified
Lymphoma & Related	a. Hodgkin
Lymphoma & Related	b. Non-Hodgkin except BL
Lymphoma & Related	c. Burkitt (BL)
Lymphoma & Related	d. Lymphoreticular
Lymphoma & Related	e. Unspecified
CNS Neoplasms	a. Ependymoma
CNS Neoplasms	b. Astrocytoma
CNS Neoplasms	c. CNS embryonal
CNS Neoplasms	d. Other gliomas
CNS Neoplasms	e. Other specified
CNS Neoplasms	f. Unspecified CNS
Neuroblastoma	a. (Ganglio)neuroblastoma
Neuroblastoma	b. Peripheral nervous
Retinoblastoma	Retinoblastoma
Renal Tumors	a. Nephroblastoma
Renal Tumors	b. Renal carcinoma
Renal Tumors	c. Unspecified
Hepatic Tumors	a. Hepatoblastoma
Hepatic Tumors	b. Hepatic carcinoma
Hepatic Tumors	c. Unspecified
Bone Tumors	a. Osteosarcoma
Bone Tumors	b. Chondrosarcoma
Bone Tumors	c. Ewing & related

Bone Tumors	d. Other specified
Bone Tumors	e. Unspecified
Soft Tissue Sarcoma	a. Rhabdomyosarcoma
Soft Tissue Sarcoma	b. Fibrosarcoma
Soft Tissue Sarcoma	c. Kaposi sarcoma
Soft Tissue Sarcoma	d. Other specified
Soft Tissue Sarcoma	e. Unspecified
Germ Cell Tumors	a. CNS germ cell
Germ Cell Tumors	b. Other extragonadal
Germ Cell Tumors	c. Gonadal germ cell
Germ Cell Tumors	d. Gonadal carcinoma
Germ Cell Tumors	e. Unspecified gonadal
Carcinoma & Melanoma	a. Adrenocortical
Carcinoma & Melanoma	b. Thyroid
Carcinoma & Melanoma	c. Nasopharyngeal
Carcinoma & Melanoma	d. Melanoma
Carcinoma & Melanoma	e. Skin carcinoma
Carcinoma & Melanoma	f. Other & unspecified
Other & Unspecified	a. Other specified
Other & Unspecified	b. Other unspecified

Further disaggregating the cancer groups into cancer types, the three most common types of childhood cancer, regardless of group are lymphoid leukemia (2,156 projected cases in 2030), acute myeloid leukemia (442), and astrocytoma (431) (Appendix Table 16). For astrocytoma, the 5-year survival is the second lowest among the top ten types of cancer, by incidence in Brazil (second only to CNS embryonal tumors) (16).

Appendix Table 16: Estimated 5-Year Survival for the Top 10 Incident Childhood Cancer Types in Brazil (Source: Harvard Database) (17)

Cancer Group	Cancer Type	Projected Incidence in 2030	5-Year Survival (% of diagnosed cases)
Leukemia	Lymphoid	2156	69.4%

Leukemia	Acute Myeloid	442	54.8%
CNS Neoplasms	Astrocytoma	431	37.8%
Lymphoma & Related	Hodgkin	372	71.3%
Lymphoma & Related	Non-Hodgkin except Burkitt	356	69.8%
Renal Tumors	Nephroblastoma	333	61.1%
CNS Neoplasms	CNS Embryonal	324	28.8%
Retinoblastoma	Retinoblastoma	270	60.8%
Neuroblastoma	Ganglioneuroblastoma	270	56.0%
Bone Tumors	Osteosarcoma	237	49.9%

15. Appendix H: Analysis of Brazilian Health System and Its Performance Generally and in Relation to Cancer

15.1. Health System Outcomes

15.1.1. Population Health

The Brazilian Institute of Geography and Statistics (IBGE) census states that the country had a population of 190,755,799 in 2010. It also estimates a population of 215,820,569 in 2023 and a population of 47,228,705 in the state of São Paulo in the same year, the most populated state in Brazil (101). Life expectancy at birth in Brazil was estimated to be 73.74 and 80.67 years in 2022 for men and women respectively, with 76.61 and 82.34 years of life expectancy at birth for people living in São Paulo. There was a decline in 2020 life expectancy at birth of an estimated 1.3 years, a mortality level not seen since 2014, because of COVID-19 but the increase in 2021 and 2022 have brought the figures back to normal (102). The population is expected to grow to 229.2 million in Brazil by 2035 (101).

Between 1990 and 2019, the proportion of people 65 years of age and older increased while the proportion of children aged 0-18 decreased, suggesting movement through a demographic transition typical of nations achieving greater levels of income and development. Brazil continues to note burdens of disease related to non-communicable (NCD) and communicable diseases. Currently, NCDs cause 75% of deaths in Brazil. The top five causes of death, in order of mortality rates, are ischemic heart disease, stroke, lower respiratory infections, COPD, and interpersonal violence (103). In São Paulo, specifically, the top four causes are the same. In fifth place, interpersonal violence is replaced by Alzheimer's disease (104). In terms of combined morbidity and mortality, neonatal disorders continue to plague the nation, placing third behind interpersonal violence and ischemic heart disease (103). However, neonatal disorders fall to fifth in São Paulo (104).

Appendix Table 17. Population by state/district – Brazil 2010 Census (101)

State/District	**Population**				
	Total	Male (%)	Female (%)	Urban (%)	Rural (%)
North Region	**18,672.591**	**50.5**	**49.5**	**73.5**	**26.5**
Rondônia	1,796.460	50.9	49.1	73.6	26.4
Acre	894.470	50.2	49.8	72.6	27.4

Amazonas	4,207.714	50.3	49.7	79.1	20.9
Roraima	631.181	50.8	49.2	76.6	23.4
Pará	8,690.745	50.4	49.6	68.5	31.5
Amapá	861.773	50.1	49.9	89.8	10.2
Tocantins	1,590.248	50.8	49.2	78.8	21.2
Northeast Region	**57,374.243**	**48.8**	**51.2**	**73.1**	**26.9**
Maranhão	7,114.598	49.6	50.4	63.1	36.9
Piauí	3,281.480	49.0	51.0	65.8	34.2
Ceará	9,187.103	48.7	51.3	75.1	24.9
Rio Grande do Norte	3,534.165	48.9	51.1	77.8	22.2
Paraíba	4,039.277	48.4	51.6	75.4	24.6
Pernambuco	9,616.621	48.1	51.9	80.2	19.8
Alagoas	3,351.543	48.4	51.6	73.6	26.4
Sergipe	2,318.822	48.6	51.4	73.5	26.5
Bahia	14,930.634	49.1	50.9	72.1	27.9
Southeast Region	**89,012.240**	**48.6**	**51.4**	**92.9**	**7.1**
Minas Gerais	21,292.666	49.2	50.8	85.3	14.7
Espírito Santo	4,064.052	49.3	50.7	83.4	16.6
Rio de Janeiro	17,366.189	47.7	52.3	96.7	3.3
São Paulo	46,289.333	48.7	51.3	95.9	4.1
South Region	**30,192.315**	**49.1**	**50.9**	**84.9**	**15.1**
Paraná	11,516.840	49.1	50.9	85.3	14.7
Santa Catarina	7,252.502	49.6	50.4	84.0	16.0
Rio Grande do Sul	11,422.973	48.7	51.3	85.1	14.9
Central-West Region	**16,504.303**	**49.7**	**50.3**	**88.8**	**11.2**
Mato Grosso do Sul	2,809.394	49.8	50.2	85.6	14.4
Mato Grosso	3,526.220	51.1	48.9	81.8	18.2
Goiás	7,113.540	49.7	50.3	90.3	9.7
Distrito Federal	3,055.149	47.8	52.2	96.6	3.4

Barbosa et al. were able to model current trends and future projections in cancer mortality among the different regions of Brazil. The table below illustrates observed and projected cancer mortality rates by region and sex, adjusted by standard world populations and expressed per 100,000 inhabitants. The Northeast Region is projected to experience an increase the most in terms of mortality rates for both females and males. The region containing São Paulo, the Southeast, will experience a decrease their mortality rates the most for both females and males (Appendix Table 18) (105).

Appendix Table 18. Observed and Projected Cancer Mortality Rates per 100,000 population by Brazilian Region and Sex (Source: Cancer Mortality in Brazil) (105)

Region	Observed (2006-2010)	Projected (2026-2030)
Females		
Brazil	73.25	70.27
Northeast	62.02	80.57
North	60.37	67.58
Central-west	73.26	61.69
Southeast	76.28	66.59
South	86.1	72.78
Males		
Brazil	99.02	88.04
Northeast	76.57	107.13
North	70.39	74.51
Central-West	97.38	85.67
Southeast	112.70	94.7
South	137.31	110.12

In 2023, estimated incidence of cancer in terms of absolute numbers is about 181,340 in São Paulo (10). In 2020, latest available mortality data per state, the cancer with the highest mortality rates in men in the state is lung cancer, with a rate of 14.85 / 100,000, adjusted for world standard population. The next four types of cancer with the highest mortality rates in men are prostate, stomach, colon, and pancreas. Among women, the cancer with the highest mortality rate is breast cancer, with a death rate of 18.88 / 100,000, adjusted for world standard population. The next four types of cancer with the highest mortality rates in women are lung, colon, pancreas and stomach (13).

Risk factors

Obesity: In Brazil, the prevalence of obesity has increased by 60% among the population aged 25 to 34 years of age from 2006 to 2016. In this age range, about 17% of people qualified as obese in 2016. The National Health Survey found in 2013 that older age, less education, and male sex were associated with less physical activity and lower consumption of fruits and vegetables (106).

Smoking: Brazil has made significant strides in reducing tobacco consumption in its population since the inception of the National Tobacco Control Program in 1989, despite being the second greatest producer of tobacco in the world. Despite the gains made, men and lower socioeconomic populations have reduced their rates of consumption the least since then. In 2016, nearly 4 million more men than women smoke in Brazil. The nation plans to continue battling the tobacco epidemic with "national and state-level smoke-free air laws; packaging, marketing, and age restrictions; minimum pricing and taxation; cessation treatment; and behavior change campaigns" (106).

Alcohol, Road Injuries, and Interpersonal Violence: Alcohol use continues to be one of the major contributions for road injuries, disproportionately affecting young males and pedestrians. Though safety laws involving zero tolerance for alcohol consumption while driving have passed, there continues to be self- reported consumption levels above the legal limit.

Alcohol also contributes to burdens related to interpersonal violence, which was one of the leading causes of DALYs in 2016. Brazil suffers from high levels of homicides due to firearms, conflicts that arise from drug trafficking, the circulation of illegal firearms, and the use of alcohol and drugs. Young men are disproportionately affected by these instances of violence (106).

Social Determinants of Health

Sex: Heavy alcohol consumption (defined in de Azevedo Barros' study as "consumption of four or more alcoholic drinks for women and five or more for men in a single occasion during the last 30 days" (106)) reached a prevalence of 24.3% among men and 7.9% among women aged 18-59 in 2016. While men have nearly a 3-fold higher prevalence of heavy drinking, and while both men and women have been found to have higher drinking rates in the last decade, women have seen an increased consumption rate compared to men. According to the same study, men also consume fewer vegetables and fruits, according to the same study (107).

Race: The Black population has been found to have higher rates of hazardous alcohol consumption, in part attributed to racial segregation. At the same time, according to de Azevedo Barros et al., it appears that race alone accounts for only a slight difference in educational attainment between Brown, Black, and white individuals. However, Brown/Black communities have a higher prevalence of sedentary lifestyles (27% higher) than their white counterparts (106).

Lower Socioeconomic Background: Low socioeconomic backgrounds are associated with lower levels of education and a heavier dependence on the public health system for assistance. Sedentary lifestyles are more common among individuals with less education, as is the consumption of fewer vegetables and

fruits. People without private health insurance were also found to have a 49% higher prevalence of sedentary lifestyles than compared to those dependent on SUS (106).

15.1.2. Financial Protection

In its 1988 constitution, Brazil denoted health to be a universal right. Subsequently, its government organized the publicly funded national health system. It would eventually be called the Unified Health System (SUS), created with the goal of achieving universal coverage for all Brazilians (108). Today, 100% of Brazilians are covered by public insurance, which covers a variety of services stated under section 16.3.4 "Service Delivery." Of note in the pharmaceutical realm, Brazil became one of the first middle-income countries to offer HIV/AIDS medication in 1996. Furthermore, the Popular Pharmacy of Brazil provides subsidies for specific medications and contraceptives (109).

Despite these significant milestones, Brazilians are considerably burdened by high out-of-pocket (OOP) expenditures. The World Bank Data estimates that spending accounts for about 22.39% of total health expenditures. Compared to several of its Latin American peers, in 2020, Brazil had lower out-of-pocket (OOP) expenditures compared to Argentina (24.21%), Chile (29.37%), and México (38.76%). However, Colombia (13.58%) had lower out-of-pocket (OOP) expenditures compared to Brazil, similar to other countries like the UK (13.60%). While care in the public sector is provided free of charge, only a particular set of drugs are offered free of charge under SUS. Conversely, about 23% of the population purchases supplemental voluntary private insurance, 70% of whom receive it as an employment benefit. However, there are currently no limits to copays for services covered by private insurance, nor are there maximum OOP annual maximum costs. Furthermore, private insurance does not cover outpatient prescription drugs (110). Current health expenditure (% of GDP) and domestic general government health expenditure (% of current health expenditure) in 2020 in Brazil were the highest (10.31%) and lowest (44.75%), respectively, of its selected Latin American peers.

Appendix Table 19: Health spending in selected Latin American countries, 2020 (Sources: The World Bank Open Data) (65)

Country	Current health expenditure (% of GDP)	Domestic general government health expenditure (% of current health expenditure)	Out-of-pocket expenditure (% of current health expenditure)
Argentina	9.98%	66.27%	24.21%
Brazil	10.31%	44.75%	22.39%
Chile	9.75%	56.40%	29.37%
Colombia	8.99%	72.66%	13.58%

Mexico	6.24%	52.88%	38.76%
United Kingdom	11.97%	83.70%	13.60%

15.1.3. User Satisfaction

An IPSOS study published in 2018 detailed opinions and attitudes from citizens of 28 different countries toward their healthcare systems, including Brazil's. Questions from the survey were targeted toward individuals from a variety of middle- to high-income nations, from Turkey, Serbia, South Africa, Peru, and Mexico to South Korea, Italy, Great Britain, Germany, and the United States (111).

Overall satisfaction with Brazil's health system ranked lower than many of its peers in this study. The table below details survey statements and the percentage of people in agreement, answered by individuals ages 16-64 in Brazil and peer countries.

Appendix Table 20: Percentage of Brazilians agreeing with various survey satisfaction statements regarding Brazil's Healthcare System. Comparisons made with other Latin American ICCI countries (Source: IPSOS) (111)

Survey Statements (% Agree)	Brazil	Argentina	Colombia	Chile
Waiting times to get an appointment with doctors are too long in my country	73%	70%	74%	77%
Many people in my country cannot afford good healthcare	74%	64%	78%	81%
The healthcare system in my country is overstretched	66%	60%	69%	70%
I am concerned that my personal data will be made available to third parties (government, private companies) without my consent	54%	52%	59%	62%
In my country, information about how to look after my health is readily available when I need it	25%	47%	35%	46%
In my country, information about healthcare services is readily available when I need it	22%	46%	27%	40%
I find it easy to get an appointment with doctors in my local area	24%	41%	31%	37%
I trust the healthcare system in my country to provide me with the best treatment	20%	47%	26%	34%
The healthcare system in my country provides the same standard of care to everyone	18%	34%	17%	19%

15.2. Health System Objectives

15.2.1. Equity

Brazil's health system has made significant progress since the end of the military government in the late 1980s. With health enshrined in the newest constitution as a human right, the government has decreased gaps between the poorest and wealthiest members of its society. Brazil's SUS has created a universal health system that aims to provide free treatment to all Brazilian citizens. The scope of health services provided is comprehensive, providing coverage for primary care and high-cost medications (22,108).

Moreover, the Family Health Strategy of 1994, mentioned and elaborated on below under "Resource Management," has expanded primary care access for urban and rural communities. According to Federico Guanais, "in 2009, 95.6 million people (52% of the population) were served by the family health program. Out of this total, 73.9 million lived in urban areas, and 21.7 million lived in rural areas, representing a coverage of 47% for urban areas and 73% for rural areas." Between 1998 and 2007, infant mortality was found to have decreased as a proportion to those covered by the Family Health Strategy. Improvements to children's health, access to services, and reduced hospital admissions for chronic diseases in females have also been associated with the program (112).

However, out-of-pocket costs remain high in Brazil. The lack of limits on copays and OOP maximums under private insurance plans makes for situations where a patient may easily run costs that exceed the ability to pay. Additionally, access to services, particularly specialist care, remains out of reach or is slow to access for the poorer populations of Brazil, especially among those who are highly dependent on SUS for their medical needs. This inequity, disproportionately hurting the poor, will need addressing as the country continues to advance universal health coverage for its citizenry.

15.2.2. Efficiency

A study by the World Bank in 2013 examined the efficiency of the healthcare system in Brazil. It noted that few long-term studies examined efficiency but that the evidence available suggested a significant level of inefficiencies plaguing the system. One of the notable causes of inefficiency is related to the use of medical technology. The report states that CT and MRI scanner density exceeds that of the lowest quartile of the OECD countries and that the density is close to a group of five rich nations (Australia, Canada, France (metropolitan), the Netherlands, and the UK) that have regulated the use of new technology extensively. However, most of this technology is only available through the private sector. Furthermore, 70% of the technology is centered around areas with smaller populations (less than 30,000 inhabitants). Without a way to regulate the entrance of medical technology into the market, demand and costs grow. Another technology that appears overused involves that surrounding diagnostic testing, where investigations estimate that up to 60% of tests are unnecessary. The World Bank has also noted that hospitals need to be run more efficiently. They attribute the problems to "inefficiency was small scale of operations, high use of human resources, and low use of installed capacity and technical resources". SUS bed occupancy rates are too low, falling at 37% for acute care hospitals and 45% for all hospitals,

compared to the international average at 70-75%. Moreover, resources within hospitals such as operating rooms are underutilized on average. However, disaggregated data shows that large referral hospitals are heavily used, with crowded rooms and long lines, while smaller referral hospitals are significantly underused. The report notes that Brazil's primary care system may also over-refer patients, resulting in unnecessary admissions that may be prevented by having more robust communication networks between facilities (113).

Current payment mechanisms encourage a fee-for-service model that incentivizes potentially unnecessary and/or harmful treatments. Though inpatient care involves predetermined payments from the Ministry of Health to states and municipalities for specific diagnoses, the latter reimburses hospitals on a fee-for-service basis, which may result in inefficient use of funds. Further, under a separate reimbursement system for high-complexity procedures and high-cost treatments, the Ministry of Health reimburses municipalities or states according to the number of services provided, thus furthering a fee-for-service model for the costliest health services in the country (113,114).

15.2.3. Effectiveness

Brazil has significantly improved several key health indicators since the creation of SUS. Life expectancy has increased by about 10.1 years from 1991 to 2021 (114,115). Infant mortality (defined in the World Bank report as deaths of children under age 1 per 1,000 live births) rates have decreased by 40.8% from 1990 to 2019, from 58.7 to 17.9 deaths per 1,000 live births. Child mortality (defined in the World Bank report as deaths of children under age 5 per 1,000 live births) has also significantly decreased, dropping 49.16% during the same time frame (116). Infectious disease in children has also been better controlled, with the country noting a drop in mortality from acute diarrhea in children less than 5 years of age from 12.3 to 3.5 deaths per 1,000 live births between 1990 and 2008. With these statistics in mind, it bears stating that between it and its Latin American peers, Brazil has made greater improvements to boost the health of its citizens. Life expectancy and infant mortality, measured in percentage changes between 1985 and 2009, have increased and decreased twofold, respectively, compared to its Latin American and Caribbean peers (113).

At the same time, other indicators suggest that the health system still has room for improving its effectiveness for Brazilians. Maternal mortality remains high, for example. The Millennium Development Goal for maternal mortality was 35 deaths per 100,000 in 2015, not met by Brazil with a rate of about 50 deaths per 100,000 around the same time. Furthermore, other infectious diseases continue to affect Brazilians, with Dengue and malaria incidences showing, on average, that further control is needed to prevent unnecessary morbidity and mortality. Mortality from traffic accidents remains a concern, and homicide continues to be a massive burden on society (113).

15.2.4. Responsiveness

Brazil has improved responsiveness since the fall of the military government but still has problems to address within its federal system. Responsiveness has been examined within the primary care sector through a study by Guanais and Macinko (117). They preface their study by contextualizing primary care in Brazil, stating that decentralization had occurred in 1996 within the Family Health Program and Community Health Agents Program (where restricted services have been provided by community health workers). Like the World Bank report, they found massive decreases in neonatal mortality between 1998 and 2006. They also found that municipalities that pursued both decentralization of primary care facilities and expansion of primary care had reduced post-neonatal mortality by about 25% compared to those that did neither, which bolsters the case for greater responsiveness in Brazil over time (117).

At the same time, the decentralized management of SUS has been recognized as a barrier to achieving better responsiveness to the health needs of Brazilians. Fragmentation, redundancy, and gaps in health care provision continue to plague the system without a solid basis for coordinated care (20). One of the most recent attempts to deal with fragmentation involves Ministerial Ordinance Nº 4.279/10 and Decree Nº 7.508/11, which aim to integrate healthcare and services. A study examined their effects in Minas Gerais, finding that they have led to "both a significant input of resources and innovative funding tools, which has contributed to increased implementation of the care network model in the various regions of the state"(118). Yet, the federal government's impositions that stipulate greater financing of medium and high-complexity services continue to limit the degree to which local governments can allocate their resources efficiently and do not always result in prioritization of patient health needs. Under its federal system, Brazil must continue to improve communication pathways that support its ability to respond adequately to local needs while also keeping the federal government aware of what is needed within each region (118).

15.3. Health system functions

15.3.1. Governance and Organization

The Ministry of Health is the principal manager of the SUS. It formulates, regulates, inspects, monitors, and evaluates the actions of SUS in combination with the National Health Council. Its equivalents in the state and municipal governments are the State Departments of Health and the Municipal Health Departments. The former formulates health policies while supporting the municipalities alongside the state council. It also participates in the Bipartite Inter-Management Commission to approve and implement the state's health plan. The municipal health department organizes and executes health actions to, in turn, implement municipal health plans (119).

Regulatory Bodies of Brazil's Health System (120)

The National Private Healthcare Insurance and Plans Agency (ANS) was created in 2000 to regulate private health plans in Brazil. It does so by regulating interactions among private insurers, service providers, and beneficiaries. The ANS is funded via federal taxes collected from private insurance companies.

Healthcare facilities are regulated by the Ministry of Health. They must be registered through the National Registry of Health Facilities (CNES). The National Sanitary Surveillance Agency (ANVISA) is tied to the Ministry of Health and regulates pharmaceutical products and medical devices, specifically their production, marketing, and use. Alongside it is the Chamber of Medicine Market Regulation (CMED), which regulates the market and prices of medications.

15.3.2. Health Financing

Health is financed through a combination of public and private funds in Brazil. As of 2019, health spending in Brazil comprised 9.59% of the gross domestic product (GDP). Of that 9.59%, public spending accounted for 40.7% (121). Public insurance provided by the SUS is financed by a combination of tax revenues and social contributions from the three levels of government: federal, state, and municipal. By law, each of the three levels must contribute a set percentage of their incomes toward the public health system. The federal government must provide 15% of total revenues, the state 12%, and municipalities 15%. Within the last 30 years, federal funding has declined and contributions from municipal governments have increased, a trend that continued during the pandemic (121,122).

Private insurance is purchased directly by the consumer or is provided as an employee benefit. According to the Commonwealth Fund, about 0.5% of Brazil's GDP is spent as tax exemptions for private care, serving as a subsidy for those who pay for private insurance. In addition, a person can deduct expenses from health services, medicines, and medical supplies from taxable expenses.
As stated above under "financial protection," a significant portion of health financing comes from out-of-pocket funds. These funds pay primarily for outpatient prescription medications, which are not covered by private insurance but are only partially covered by public insurance (123).

15.3.3. Resource Management

Primary care is organized around units called family health teams, following a model called the Family Health Strategy implemented in 1994. The teams consist of a doctor, nurse, nurse assistant, and a maximum of 12 community health workers, all of whom can cover approximately 2,000-4,000 individuals across a defined area. Patients need referrals to access either outpatient specialties or non-emergency inpatient admissions. Specialist care can be delivered by public or private facilities, though specialists in the public sector may also take private work. Capacity shortages in the public sector for specialist care have resulted in a growth of the private market to fill the needs of the population (123).

The federal government contributes to funding and delivering services at public hospitals but contracting and reimbursement of services falls to either state or municipal governments around the country. In 2015, 71% of hospital beds were allocated to patients utilizing the SUS public health system. Among hospitals, 38% were public and 62% private, with the breakdown of public hospitals being 4% federal, 25% state-owned, and 70% municipal hospitals. The breakdown of private hospitals had 38% falling under non-profit and 63% falling under for-profit (124).

The federal government is also in charge of ensuring the availability of "strategic medications" such as antiretrovirals, blood products, and other expensive drugs under the National Pharmaceutical Assistance Policy (125).

15.3.4. Service Delivery

All individuals in Brazil, including the undocumented, can use SUS benefits. Under SUS, several services are offered free of charge (124):

- preventive services, including immunizations
- primary health care
- outpatient specialty care
- hospital care
- maternity care
- mental health services
- pharmaceuticals
- physical therapy
- dental care
- optometry and other vision care
- durable medical equipment, including wheelchairs
- hearing aids
- home care
- organ transplant
- oncology services
- renal dialysis
- blood therapy

According to Santos et al., the supply of services for those under private health plans is more comprehensive than for those who exclusively use SUS. This applies to the following services, which they classify as either involving treatment that is highly complex or uses high-cost equipment (126):

- Mammography
- Lithotripsy
- Ultrasound
- Computed Tomography (CT)
- Magnetic Resonance Imaging (MRI)

- Radiotherapy
- Nuclear medicine
- X-ray for hemodynamics

Underfunding of the public health system accounts for the gap in treatment availability for those benefitting from SUS only. Those who use SUS are subject to long wait times to see a specialist (127). According to da Silva et al., SUS covers most high-cost cancer treatments, at least in theory. However, they also noted that accessibility to radiotherapy is limited. The “Plan for the Expansion of Radiation Therapy in the SUS” in 2012 attempted to expand the availability of radiotherapy, but it has not kept up with the growing incidence of cancer and demand for services (128).

Additionally, it is estimated that most pediatric oncology services in the country are delivered at facilities not accredited for this purpose and that specific guidelines for treating pediatric cancers are largely absent in Brazil, with the national policy for pediatric cancer in Brazil being instituted in 2022 (129).

16. Appendix I: Principles and Guidelines of Brazil's National Cancer Policy

Appendix Table 21: Principles and Guidelines of Brazil's National Cancer Policy, Chapter II, 2013 (Source: Brazilian Virtual Library of Health) (30)

Section I: The General Principles of the National Policy for the Prevention and Control of Cancer	
1.	Recognition of cancer as a preventable chronic disease and the need to offer comprehensive care, considering the guidelines of the Health Care Network for People with Chronic Diseases within the scope of the SUS
2.	Organization of regionalized and decentralized care networks, with respect to access, scale and scope criteria
3.	Training of professionals and promotion of permanent education, through activities aimed at the acquisition of knowledge, skills and attitudes of health professionals for the qualification of care at different levels of health care and for the implementation of this Policy
4.	Intersectoral articulation and guarantee of broad participation and social control
5.	The incorporation and use of technologies aimed at the prevention and control of cancer in the Health Care Network for People with Chronic Diseases within the scope of the SUS must be the result of recommendations made by government agencies from the Technology Assessment Process in Health (ATS) and Economic Evaluation (AE)
Section II: Principles and Guidelines Related to Health Promotion The following are guidelines related to health promotion within the scope of the National Policy for the Prevention and Control of Cancer	
1.	Strengthening of public policies that aim to develop to the maximum the potential health of each citizen, including policies that have as their object the creation of favorable environments for health and the development of individual and social skills for self-care
2.	Carrying out intersectorial actions, seeking partnerships that favor the development of health promotion actions
3.	Promotion of healthy eating habits such as exclusive breastfeeding until six months of life, and increased consumption of fruits and vegetables, including educational actions and environmental and organizational interventions
4.	Promotion of bodily practices and physical activities, such as gymnastics, walking, dancing, and sports

5.	Coping with the impacts of pesticides on human health and the environment, through health promotion practices with a preventive and sustainable nature
6.	Development of actions and public policies to combat smoking, alcohol consumption, overweight, obesity and inadequate food consumption, considering risk factors related to cancer
7.	Promotion of activities and practices related to health promotion to be developed in spaces that even go beyond the limits of health services, reaching, for example, schools, workplaces and homes
8.	Advances in actions to implement the Framework Convention on Control of Tobacco Use, referred to in Decree No. 5658, of January 2, 2006
9.	Fostering the preparation of normative documents aimed at regulating the production and consumption of products and foods whose composition contains carcinogens and/or high concentrations of calories, saturated or trans fats, sugar and salt
10.	Encouraging the expansion of restrictive measures to the marketing of foods and beverages with a high content of salt, calories, fat, and sugar, especially those aimed at children
Section III: Principles and Guidelines Related to Cancer Prevention The elimination, reduction, and control of physical, chemical, and biological risk factors and the intervention on their socioeconomic determinants, in addition to integrating them, constitutes the principle of cancer prevention within the scope of the National Policy for the Prevention and Control of Cancer.	
1.	Encouragement to eliminate or reduce exposure to carcinogens related to work and the environment, such as benzene, pesticides, silica, asbestos, formaldehyde, and radiation
2.	Prevention of smoking initiation and alcohol use and consumption of unhealthy foods;
3.	Implementation of cancer early detection actions, through screening and early diagnosis, based on government recommendations, based on ATS and AE
4.	Guarantee of timely diagnostic confirmation of suspected cancer cases
5.	Structuring of monitoring and quality control actions for screening exams
Section IV Principles and Guidelines Related to Surveillance, Monitoring and Evaluation The following are guidelines related to surveillance, monitoring, and evaluation within the scope of the National Policy for the Prevention and Control of Cancer:	
1.	Monitoring of risk factors for cancer, in order to plan actions capable of preventing the disease, reducing damage, and protecting life
2.	Use, in an integrated manner, of data and epidemiological and care information available for the planning, monitoring, and evaluation of actions and services for the prevention and control of cancer, produced:

	a) by the various SUS information systems, including those on mortality, morbidity, outpatient and hospital procedures b) population-based and hospital-based cancer registries c) by population surveys and surveys; d) by Brazilian demographic and socioeconomic statistics
3.	Implementation and permanent improvement of the production and dissemination of information, with a view to supporting the planning of actions and services for the prevention and control of cancer
Section V: Principles and Guidelines Related to Comprehensive Care The principle of comprehensive care is within the scope of the National Policy for the Prevention and Control of Cancer. It comprises of the organization of actions and services aimed at the comprehensive care of people with cancer in the Health Care Network for People with Chronic Diseases in the scope of the SUS, based on parameters and criteria of need and guidelines based on scientific evidence. Integral care includes prevention, early detection, diagnosis, treatment and palliative care, which must be offered in a timely manner, allowing continuity of care. The following are guidelines for diagnosis, treatment and comprehensive care within the scope of the National Policy for the Prevention and Control of Cancer:	
1.	Timely and safe treatment of patients diagnosed with cancer and precursor lesions as close as possible to the person's home, observing the criteria of scale and scope
2.	Multidisciplinary care to all users with cancer, offering care compatible with each level of care and disease evolution
3.	Carrying out treatment of rare or very rare cases that require a high level of specialization and greater technological capacity in national reference health establishments, ensuring their regulation and regulation
4.	Offer of rehabilitation and palliative care for cases that require it
Section VI: Principles and Guidelines Related to Science and Technology The following are guidelines related to science and technology within the scope of the National Policy for the Prevention and Control of Cancer:	
1.	Establishment of methods and mechanisms for analyzing the economic-sanitary feasibility of public undertakings in the Health Industrial Complex, aimed at preventing and controlling cancer
2.	Implementation of the research network for the prevention and control of cancer in accordance with the objectives of the National Policy on Science, Technology and Innovation in Health, in order to increase the production of national knowledge related to this area

3.	Implementation of scientific opinion elaboration practices, ATS and AE to support decision-making in the process of incorporating new technologies in the SUS
Section VII: Principles and Guidelines Related to Education The following are guidelines related to education within the scope of the National Policy for the Prevention and Control of Cancer:	
1.	Fostering the training and specialization of human resources for the qualification of professional practices developed in all the fundamental axes contained in this Policy
2.	Implementation, in the State Commissions for Teaching-Service Integration (CIES), of educational projects aimed at the prevention and control of cancer in all its care and management dimensions and involving science, technology and innovation in health
Section VIII: Principles and Guidelines Related to Health Communication The guidelines for communication in health within the scope of the National Policy for the Prevention and Control of Cancer:	
1.	Establishment of communication strategies with the population, with Health professionals and with other social actors, which allow the dissemination and expansion of knowledge about cancer, its risk factors and the various prevention and control strategies, seeking the translation knowledge for the various target audiences
2.	Encouragement of actions to strengthen individual and collective capacity for communication in health, promoting changes in favor of health promotion, prevention and cancer control

17. Appendix J: Stakeholder Workshop

On May 19th, 2023, the HSCI-LA held a stakeholder Workshop in-person at Fundação Getúlio Vargas, São Paulo, Brazil. Four roundtables were held, each with a particular cancer policy topic: Organization and Governance, Financing, Resource Management, and Service Delivery.

The workshops allowed questions to be posed by moderators and responded to by stakeholders who work in and around Brazil's health system. The first half of stakeholder workshop discussions sought to identify the main challenges of the country with regard to cancer, taking into account the particular context of the country.

In the second half of the workshop discussion, participants were encouraged to propose potential solutions to the previously identified challenges. The workshop helped to raise important discussions about the state of cancer in Brazil. Hopefully, it will lead to a better understanding of the problem and identification of policy options that lead to the improvement of cancer outcomes. The workshop agenda and list of participants are furnished below. Deliberations were conducted in Portuguese with English translation.

17.1. Workshop agenda

May 19th, 2023, 8:30am-4:30pm	
Moderator:	Professor Rifat Atun
# of Participants:	32 people
Duration:	6 hours
Format:	Lectures and Interactive Discussion Roundtable
Logistical Support:	HSIL and FGV
Notetakers:	Harvard research team and members of the Organizing Committee
Agenda	
8:30am	**Welcome – Prof. Rifat Atun & Prof. Adriano Massuda**
	Welcome, introductions, and order of proceedings
8:45am	**Presentation of HSCI-LA – Prof. Rifat Atun**
	Overview, objectives, methodology and outputs of the HSCI-LA
9:00am	**Keynotes & Panel: The Challenge of Cancer and Health Systems in Brazil** **Moderator: Prof Ana Maria Malik**

	Dr. Fernando Maia – Coordenador-Geral da Política Nacional de Prevenção e Controle do Programa de Câncer Dr. Mauro Junqueira – Secretario Executivo CONASEMS
9:40am	**Keynotes & Panel: The Opportunities of Cancer and Health Systems in Brazil**
	Dr. Roberto de Almeida Gil – Instituto Nacional de Cancer - INCA Dr. Maira Caleffi - IGCC - Instituto de Governança e Controle do Câncer Dr. Geraldo Reple – Secretário de Saúde de São Bernardo do Campo e Presidente do COSEMS/SP
11:00am - 12:20pm	**Group discussions: Challenges related to the Health System in General and for Cancer (Organization and Governance, Financing, Resource Management and Service Delivery).**
	Prompts to initiate Deliberations within Groups: - What are the principle challenges facing the Brazilian health system in relation to its THEME (**Organization and Governance, Financing, Resource Management and Service Delivery)** capabilities in general, and in relation to the following topics? Responsibility, transparency, ensuring decisions are made in an inclusive way, planning and coordination of the health system - What are the main challenges facing the Brazilian health system in relation to its organization and governance capacities **specifically in its management and control ofcancer**, and in relation to the following topics? Responsibility, transparency, ensuring decisions are made in an inclusive way, planning, and coordination of the health system
12:20pm-1:40pm	**Group Discussions: Opportunities related to the Health System in General and for Cancer (Organization and Governance, Financing, Resource Management and Service Delivery)**
	Prompts to initiate Deliberations within Groups: - What are the three priorities to improve the THEME (**Organization and Governance, Financing, Resource Management and Service Delivery)** of the Brazilian health system in general, and in relation to the following topics? Responsibility, transparency, ensuring decisions are made in an inclusive way, planning and coordination of the health system - What are the three priorities to improve the THEME of the Brazilian health system with regard to cancer control and cancer care, and in relation tothe following topics? Responsibility, transparency, ensuring decisions are made in an inclusive way, planning, and coordination of the health system - What should be changed to improve the organization and governance of thesepriorities?
1:40pm-2:30pm	**Groups report back & closing remarks**

17.2. Participant Names and Affiliations

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