ONCODAILY MEDICAL JOURNAL

review

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Published: April 01, 2025

doi.org/10.69690/odmj-002-0425-340

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Published: April 01, 2025

ABSTRACT

The gastrointestinal oncology is known for encompassing some of the deadliest tumors among all malignant neoplasms. Its recognition as a specialized branch of medicine is relatively new, particularly in countries like Mexico.

In comparison with Latin America and the world, Mexico has less incidence rate of gastric and esophageal cancer; gastric cancer has similar mortality rate. Gastrointestinal oncology has been around the world for several decades, however in developing countries such as Mexico, it has become visible and tangible in recent years.

With the advancement of precision medicine treatments, the prognosis for these tumors has notably improved. Nevertheless, challenges related to availability, registry, treatment capacity, and the need for specialized training in developing countries have become significantly more pronounced.
The objective of this review is to describe and analyze the gastrointestinal oncology in Mexico, focusing on its epidemiology, evolution, the national healthcare structure, the organization of tumor boards, the availability of treatments, training centers, the disparities within Latin-American and the opportunities within the country.

INTRODUCTION

Globally, in Latin America, and in Mexico, prostate and breast cancer rank as the most common and deadliest cancer. However, five types of gastrointestinal tumors are among the 15 most prevalent and the 10 with the highest mortality rates in these three regions.

A comprehensive breakdown of gastrointestinal cancer incidence rankings across global, Latin American, and Mexican data can be found in **Table 1.**

The main differences in incidence are that Mexico and Latin America have a lower incidence of esophageal cancer, and Mexico has a lower incidence of gastric cancer compared to Latin America and the world.

Table 1. Incidence per 100,000 habitants and ranking of incidence in gastrointestinal tumors												
Region	**Colon**		**Stomach**		**Liver**		**Esophageal**		**Pancreas**		**Gallbladder**	
	Inc*	#	Inc*	#	Inc*	#	Inc*	#	Inc*	#	Inc*	#
Mexico	10.9	4	6.3	8	5.7	10	0.9	23	3.9	15	0.8	24
LATAM	16.9	3	8.5	6	5	12	2.4	19	4.6	13	1.2	25
World	18.4	3	9.2	6	8.6	8	5	14	4.7	15	1.2	24
Inc: Incidence per 100,000 habitants*												
#: Incidence place ranking according GLOBOCAN 2022												

The gastrointestinal malignancies with the highest mortality rates worldwide are colorectal cancer (third), liver cancer (fourth), gastric cancer (seventh), esophageal cancer (eighth), and pancreatic cancer (ninth). In Latin America, the most fatal are colorectal cancer (fourth), gastric cancer (sixth), liver cancer (seventh), pancreatic cancer (eighth), and esophageal cancer (thirteenth). In Mexico, the ranking of most deadly are colorectal cancer (fourth), liver cancer (sixth), gastric cancer (seventh), pancreatic cancer (tenth), and esophageal cancer (eighteenth)[1] - **Table 2.**

Five gastrointestinal tumors now rank among the ten deadliest cancers. Notably, mortality rates for esophageal cancer are lower in Mexico and Latin America compared to other regions. However, despite its lower incidence in Mexico, gastric cancer mortality remains similar.

In recent years, the development precision medicine has reached gastrointestinal oncology[2], treatments such as immunotherapy in colon[3], gastric[4], biliary tract cancer[5] or hepatocellular carcinoma[6] or targeted therapies such olaparib in pancreatic[7] or encorafenib in colorectal cancer[8] has revolutionized the prognosis of gastrointestinal cancer. Nevertheless, challenges related to availability, treatment capacity, and the need for specialized training in developing countries have become significantly more pronounced.

Gastrointestinal oncology has been around the world for several decades, however in developing countries such as Mexico, it has become visible and tangible in recent years. The objective of this review is to describe and analyze the gastrointestinal oncology in Mexico, focusing on its epidemiology, evolution, the national healthcare structure, the organization of tumor boards, the availability of treatments, training centers, the disparities within Latin-American and the opportunities within the country.

Cancer registry and epidemiological data in Mexico

Mexico is making significant efforts to establish accurate oncology data regarding incidence, prevalence, and mortality. However, several factors affect data reliability. The most ambitious

Table 2. Mortality per 100,000 inhabitants and ranking of mortality in gastrointestinal tumors												
Region	**Colon**		**Stomach**		**Liver**		**Esophageal**		**Pancreas**		**Gallbladder**	
	Mort*	#	Mort*	#	Mort*	#	Mort*	#	Mort*	#	Mort*	#
Mexico	5.5	4	4.7	7	5	6	0.8	18	3.5	10	0.5	20
LATAM	8.2	4	6.5	6	4.5	7	2.2	13	4.3	8	0.8	20
World	8.1	3	6.1	7	7.4	4	4.3	8	4.2	9	0.8	20
Mort: Mortality per 100,000 habitants*												
#: Mortality place ranking according GLOBOCAN 2022												

initiative is The National Cancer Registry, an epidemiological surveillance system that tracks cancer incidence and survival rates in the Mexican population.

This system lacks standardization and excludes several institutions, making its data less reliable compared to established registry systems like GLOBOCAN (Global Cancer Observatory). In Latin America registry coverage only reaches 6% of the population, while in United States and Canada it reaches 83%[9].

Survival analysis and quality of life of gastrointestinal cancer in Mexico

Mexico's lack of a precise national registry results in limited data about survival rates and even less information about quality-of-life metrics like DALYs (Disability-Adjusted Life-Years) and QALYs (Quality Adjusted Life Year).

However, some institutions do report some data for specific pathologies and treatments.

For example, a 2017 study of 192 patients with colorectal cancer from Mexico City found that having a colostomy or ileostomy was associated with impaired social functioning, directly affecting quality of life. While the factors determining quality of life for Mexican colorectal cancer patients are not well established, researchers found that survivors experienced emotional symptoms including anxiety, fatigue, and depression[10].

Pancreatic cancer survival rates and quality of life were also documented in 2021 by the National Institute of Health Sciences and Nutrition "Salvador Zubirán" in Mexico City[11]. Their study reported that surgery improved the 3-year survival rate from 5-6% to 35-40% in stage I patients, and from 3-4% to 15-25% in stage II patients. However, 50% of postoperative patients experienced recurrence, with a 3-year mortality rate of 13.6%.

While Mexico lacks reliable epidemiological and aggregated data, in 2021, the Global Burden of Disease survey[12] was conducted to assess disease burden among patients affiliated with the Mexican Social Security Institute (IMSS).

Despite its limitations and areas for improvement, this study revealed that stomach, liver, trachea, bronchial, and lung cancers contributed most significantly to the disease burden.

Historical Evolution of the Health Care System in Mexico

At the end of the 19th century, medicine in Mexico underwent a significant transformation. Medical specialties were developed, and devices and instruments that complemented physical examinations were introduced, marking the beginning of a new era in the country's medical practice.

On May 27, 1899, the Mexican Congress granted the Executive Power extraordinary authority to issue the Private Charity Law. Following this, by initiative of foreign citizens residing in Mexico, several charitable societies were founded to provide private medical assistance, such as the American-British Cowdray Medical Center and Spanish Charitable.

In 1917, with the promulgation of the Mexican Constitution, the creation of the Health Department was established, addressing the first social demands related to health care.

In 1935, the Mexican Social Security Institute (IMSS) was founded, followed by the creation of the Secretariat of Public Assistance in 1937. By 1939, both institutions merged, giving rise to the Secretariat of Health and Assistance. Over the next two decades, additional health systems were established, including the ISSSTE (Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado), SEDENA (Secretaría de la Defensa Nacional), PEMEX (Petróleos Mexicanos), and SEMAR (Secretaría de Marina)[13].

Modalities of Medical Care in Mexico

Currently, there are three main modalities of medical care in Mexico:

- *Private Medical Care: This sector provides services to citizens who have major medical expense insurance or the financial capacity to cover the costs of private care.*
- *Social Security: Responsible for providing medical care to individuals with formal employment.*
- *Public Health Institutions: Responsible for providing medical care to citizens without formal employment, or major medical expense insurance, who lack the financial resources to afford private care*[14]

The structure of the public health system in Mexico is complex and fragmented, it is composed of several different systems integrated into the government budget, which must be divided among them and each institution decides how to distribute the resources.

The public health system in Mexico can be divided in two, depending on whether the person is affiliated with social security institutions or not , as mentioned above, social security applies for people with a formal job, and public health institutions are for the ones who do not have this affiliation.

The social security health institutions are:

- *IMSS (Instituto Mexicano del Seguro Social): This is the main social security institution in Mexico and provides care to workers in the formal sector and their families.*
- *ISSSTE (Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado): Provides health services to state workers (people who work directly in a government institution) and their families.*
- *ISSEMYM (Instituto de Seguridad Social del Estado de México y Municipios.): Agency that offers social security services to state workers of the State of Mexico and their family members.*
- *SEDENA (Secretaría de la Defensa Nacional): Refers to health services for military workers and their families.*
- *Pemex (Petróleos Mexicanos): This institution is responsible for providing health care to the workers of the oil industry and their families.*
- *SEMAR (Secretaría de Marina): Refers to health services for Navy workers and their families.*

The public health institution is:

- *IMSS Bienestar: Newly established public health institution, formed through the consolidation of "Secretaría de Salubridad y Asistencia" (SSA), "Instituto de Salud para el Bienestar" (INSABI), and "Servicios Estatales de Salud" (SESA). In 2023, these entities were unified, under a single organization and are responsible for providing health services for the population in marginalized areas that lack health services because they are not affiliated with social security institutions*[15]

Each one of them has an autonomic healthcare system, which could bring advantages, such as having an annual independent governmental budget dedicated for their respective patients, although this could also mean that the systems are not unified, and resources may vary between institutions.

IMSS covers 80% of the formal economic sector, it has at least 29 linear accelerators, equipment for radiosurgery and fractional stereotactic radiotherapy distributed in 10 of their medical units across the country. ISSSTE covers 18% of the formal economic sector, and lastly there's the public health services that cover 1% of the already mentioned population, including PEMEX, SEDENA and SEMAR employees. Each of these institutions provide their own hospitals, clinics and doctors. In each sector there are oncology departments, but in most of these centers there aren't highly specialized health services in oncology, for example, only a couple of them have a GI oncology department with a functional unit[16].

In addition, Mexico has national institutes that are highly specialized in each field, for example; the National Institute of Cardiology, the National Institute of Medical Sciences and Nutrition "Salvador Zubiran" and the National Institute of Perinatology or National Institute of Pediatrics. These institutes offer free medical attention to any kind of patients without coverage, however, patients with IMSS, ISSSTE and ISSEMYM must pay for these services themselves.

Some of these medical centers have tools to diagnose and treat cancer, such as PET/CT, tomography, ultrasound, linear accelerators, etc. The World Health Organization recommends having 2 PET/CT machines per million people. With a population of approximately 126 million, Mexico should have at least 250 machines. However, there are only 50 PET/CT in Mexico; 10 machines belong to public hospitals (IMSS and ISSSTE), 2 to universities (National Autonomous University of Mexico and the Autonomous University of Nuevo León), 1 to a private care institution (Hospital Infantil Teletón de Oncología) and approximately 37 to private hospitals[17].

On the other hand, the private sector is composed of the population who have private medical insurance or the ability to pay directly for health services, with access to all the diagnostic and treatment tools available for cancer disease, surgical care, patented pharmaceutical medicines for chemotherapy treatments and specialized oncologists.

Across the country there are 118 medical units specializing in cancer care; 65 are public, 48 private and 5 belong to public universities and the social sector[18]. According to the Mexican health secretary there are approximately 2,202 oncology specialists, of which; 43% are surgical oncologists, 42% are medical oncologists and 15% are radio oncologists[19] and according to the INEGI population census, there are 126 million people in Mexico, which corresponds approximately; to 1 surgical oncologist for every 133,000 Mexicans, 1 medical oncologist for every 136,000 Mexicans and 1 radio oncologist for every 382,000 Mexicans[20].

Development of Medical Oncology in Mexico

The General Hospital of Mexico "Dr. Eduardo Liceaga" was inaugurated in 1905. In 1922, this hospital marked a milestone in the fight against cancer by using radium bromide for the first time in the country to treat oncological diseases. In 1937, they established the first oncology department in Mexico.

The development of medical oncology and the administration of chemotherapy in Mexico began in the 1960s. At that time, there were no national training centers for medical oncologists, so the first specialists were trained abroad. Upon returning to Mexico, they spearheaded the promotion and advancement of this discipline.

In the 1990s, the National Autonomous University of Mexico (UNAM) officially established the first oncologic surgery, radiation oncology, and medical oncology fellowships in Mexico. This marked the beginning of the formal training of the first medical oncologists in the country. Nowadays, Mexico City has seven hospitals dedicated to training specialists in oncology and a few others out of Mexico City[20].

Gastrointestinal Oncologist in Mexico

In Mexico, there are only two medical centers where clinical oncologists can have a formal training to become gastrointestinal oncologists. The fellowship program of these two institutes is certified by the National Autonomous University of Mexico, with a duration of one year. The one-year course is designed to prepare medical oncologists for academic careers in gastrointestinal oncology, including clinical research experience[22].

The first gastrointestinal fellowship in Mexico was created by the National Institute of Medical Sciences and Nutrition "Salvador Zubirán", which started in 2020, training two to three medical oncologists per year[23]. In 2023 the National Institute of Cancer started its fellowship formation program, training one to three medical oncologists per year.

Gastrointestinal Oncology tumor boards in Mexico

Oncology should be led by tumor boards, which are conformed by a multidisciplinary team that discusses the best treatment options for individualized patients. Usually, the panel includes; surgeons, medical oncologists, radio oncologists, gastroenterologists and interventional radiologists. Nevertheless, in Mexico, tumor boards are limited to areas from highly specialized public systems, which are less than five in the whole country. Some of the institutions that have tumor boards and functional units in their system are the National Institute of Medical Sciences and Nutrition "Salvador Zubirán" and the National Institute of Cancer. Some private systems have tumor boards, such as American British Cowdray Medical Center. Efforts are being made to make this model nationally accepted throughout the population.

Cancer treatment availability in Mexico

Overall, in Mexico, we have limited access to some treatments, especially the recently developed drugs despite having already FDA approval. Mexico is regulated by the "Federal Commission for the Protection against Sanitary Risks"(COFEPRIS for its acronym in Spanish), they are responsible for the approval

Table 3. Availability of high cost first-line treatments for gastrointestinal cancers in Mexico						
Type of cancer	**Treatment**	**IMSS^**	**ISSSTE^**	**National Institutes* ^**	**ISSEMYM^**	**Private hospitals^**
Hepatocellular carcinoma	Sorafenib	+	+	+	+	+
	Atezolizumab and Bevacizumab			+	+	+
	Durvalumab and Tremelimumab					+
	Lenvatinib		+	+		+
Cholangiocarcinoma	Durvalumab		+	+		+
	Pembrolizumab				+	+
Gastric	Trastuzumab		+	+	+	+
	Trastuzumab and Pembrolizumab		+	+	+	+
	Nivolumab			+	+	+
Colorrectal	Bevacizumab	+	+	+	+	+
	Panitumumab		+	+	+	+
	Cetuximab	+	+	+	+	+
	Pembrolizumab		+	+	+	+
This table is based on an anonymous survey conducted with 2-3 medical oncologists from each institution and should not be considered official information						
IMSS: Mexican Social Security Institute (Instituto Mexicano del Seguro Social). ISSSTE: Institute of Security and Social Services for State Workers (Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado). ISSEMYM: Social Security Institute of the State of Mexico and Municipalities (Instituto de Seguridad Social del Estado de México y Municipios)						
** National Institute of Medical Sciences and Nutrition "Salvador Zubirán" and the National Institute of Cancer*						
^ Availability depends on the yearly budget						

of new drugs in Mexico and will establish and implement policies, programs and projects at the level of international best clinical practice. Although this system works, we face different problems that cause disparities in the availability of the treatments. **(See table 3)**

Challenges and opportunities

The Mexican healthcare system strengths compared to other Latin American countries are: tumor boards in high-specialized centers, fellowship programs in gastrointestinal oncology and access to high-cost treatment molecules in several institutions.

Nevertheless, Mexico faces multiple limitations to give patients the best medical attention and treatment for gastrointestinal cancer in all centers and institutions across the country. Some of them are lacking tumor registry, heterogeneity in the availability of treatments, dependence on inconsistent government budgets across Mexican institutions, irregular distribution of resources in each center and centralization of Mexican gastrointestinal oncologists, since most of them reside in Mexico City. This happens not only between private and public systems, but also within public institutions. Heterogeneity in medical attention needs to be improved so each institution in Mexico can offer the same quality of treatment for each of their patients.

Efforts are being made to make this model nationally accepted throughout the entire population, creating more fellowship programs in gastrointestinal oncology. It is crucial to give the patients an integral and multidisciplinary care, this can be achieved through the implementation of specialized tumor boards in all medical centers.

CONCLUSIONS

This review examines the state of gastrointestinal oncology in Mexico, focusing on its epidemiology, evolution, national healthcare system, tumor board organization, treatment availability, training centers, disparities within Latin America, and opportunities for growth within the country.

Compared to the rest of Latin America and the world, Mexico has a lower incidence of gastric and esophageal cancer, although the mortality rate for gastric cancer remains similar. While gastrointestinal oncology has been established globally for several decades, it has only recently gained visibility

and prominence in developing countries like Mexico. Gastrointestinal oncology in Mexico faces numerous challenges, including a lack of comprehensive registries and epidemiological data, as well as disparities in healthcare infrastructure and access to treatments across the country. Despite these limitations, Mexico is home to first-level hospitals with fellowship programs in gastrointestinal oncology, attracting doctors from across Latin America to train as specialists.

Efforts are underway to standardize this model nationwide, with plans to expand fellowship programs in gastrointestinal oncology. Ensuring patients receive comprehensive, multidisciplinary care is essential, and this can be achieved through the implementation of specialized tumor boards in all medical centers.

Although the gap toward achieving first-level gastrointestinal oncology practice remains significant, the collective impact of these ongoing efforts offers hope and encourages continued progress in the field.

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