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Impact of Diagnosis on Pediatric Public Health: Epidemiological Transition, Cost–Benefit, and Equitable Access in Mexico

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Abstract

The evolution of medical diagnosis has been one of the most transformative pillars in the history of public health. In the Mexican pediatric context, this transformation acquires critical relevance in light of changes in the epidemiological profile, the emergence of chronic and genetic diseases, and persistent inequalities in access to health services. Timely diagnosis not only allows pathologies to be identified at early stages but also redefines the clinical, economic, and social course of child care. This article explores the impact of diagnosis on pediatric public health from a multidimensional perspective, integrating scientific evidence, economic analysis, and strategic proposals for the Mexican health system.

Keywords

Diagnosis; Pediatrics; Public health; Cost–benefit; Access.

Abbreviations

WHO: World Health Organization; OECD: Organization for Economic Co-operation and Development; UNICEF: United Nations Children's Fund; INEGI: National Institute of Statistics and Geography; ENSANUT:

National Health and Nutrition Survey; INSP: National Institute of Public Health; SSA: Ministry of Health (Secretaría de Salud); ALL: Acute Lymphoblastic Leukemia; ADHD: Attention-Deficit/Hyperactivity Disorder; ARI: Acute Respiratory Infection; ADD: Acute Diarrheal Disease; IEM: Inborn Errors of Metabolism; PKU: Phenylketonuria; CF: Cystic Fibrosis; HIV: Human Immunodeficiency Virus; MDTB: Multidisciplinary Tumor Board; POCT: Point-of-Care Testing; PPP: Public–Private Partnership.

Introduction

Mexico has undergone a marked epidemiological transition over recent decades. Infectious diseases, which historically represented the leading cause of childhood morbidity and mortality, have given way to chronic conditions such as asthma, obesity, type 1 diabetes, and neurodevelopmental disorders. This shift has generated new, more complex and specialized diagnostic demands that require advanced technologies, continuing medical education, and integrated models of care. In this new scenario, diagnosis becomes a strategic tool for anticipating risks, personalizing treatments, and improving quality of life from the earliest years of life [1].

The impact of early diagnosis in pediatrics is particularly evident in programs such as newborn screening, which enables the detection of diseases such as congenital hypothyroidism, phenylketonuria, cystic fibrosis, and inborn errors of metabolism [3]. If not identified in time, these conditions can lead to permanent disability, developmental delay, and a significant economic burden for families and the health system. Early detection of childhood cancer, such as acute lymphoblastic leukemia (ALL), has also been shown to significantly improve survival and reduce complications [5]. In the neurodevelopmental domain, timely diagnosis of disorders such as autism, attention-deficit/hyperactivity disorder (ADHD), and epilepsy enables early interventions that optimize the child's cognitive, emotional, and social development.

From an economic standpoint, pediatric diagnosis represents an investment with a high return. Various studies have shown that screening and early-detection strategies are cost-effective, reducing hospitalizations, complications, and prolonged treatments [7]. For example, the early identification of congenital hearing loss enables auditory therapies that support language acquisition and school integration, avoiding the costs associated with special education and late rehabilitation. In Mexico, the cost–benefit analysis of programs such as newborn screening has been favorable, although challenges persist in coverage, quality, and follow-up.

Equitable access to diagnosis remains an outstanding debt in the Mexican health system [9]. Geographic, socioeconomic, and cultural gaps limit diagnostic coverage in rural areas, Indigenous communities, and marginalized populations. Diagnostic infrastructure is concentrated in urban areas, and the lack of trained personnel, appropriate technologies, and efficient referral systems aggravates inequality. To address this challenge, strategies such as pediatric telemedicine, mobile laboratories, interoperability of clinical data, and public–private partnerships have been proposed [10]. These initiatives seek to bring diagnosis closer to vulnerable populations, reduce waiting times, and improve continuity of care.

The clinical relevance of diagnosis varies according to the characteristics of each pediatric population. In children with rare diseases, access to genetic testing and biomarkers can be decisive for establishing appropriate treatment. In Indigenous communities, the cultural and linguistic adaptation of diagnostic tools is essential to ensure their effectiveness [8]. Personalized medicine—based on genomics,

metabolomics, and artificial intelligence—opens new possibilities for pediatric diagnosis, although it requires investment, regulation, and specialized training.

Against this backdrop, we propose the development of a pediatric diagnostic ecosystem in Mexico that integrates primary care, specialized laboratories, digital platforms, and referral networks. This model should be articulated with public policy, academic institutions, and civil-society organizations, and guided by key indicators such as diagnostic coverage, response time, clinical impact, and user satisfaction. Continuing medical education, the use of clinical simulation, and training in differential diagnosis should be central components of this strategy.

Health in Mexico

Mexico, a federation of 32 states and Mexico City, is the 15th-largest and 11th-most-populous country in the world, with more than 124 million inhabitants. Seventy-seven percent of the population lives in cities. Its population is young (27% are under 15 years of age), and the fertility rate has declined. Education has improved, with an increase in the number of people completing secondary school. Indigenous and Afro-descendant peoples (12% and 1% of the population, respectively) face health and social challenges disproportionately [2].

Despite a large increase in life expectancy over the past century, Mexico remains below the average of the Organization for Economic Co-operation and Development (OECD), with a life expectancy of nearly 75 years in 2017. The mortality gap between men and women remains significant, and infant mortality is higher than in countries such as Argentina or Chile. The most common causes of death are diabetes and heart disease, which have risen since 1990 (OECD, 2017).

A critical health challenge is obesity, in which Mexico ranks second globally in overall prevalence and first among children. This is linked to food insecurity affecting nearly one-third of households, in addition to problems of undernutrition and anemia in the child population [2].

In the field of maternal and child health, Mexico has achieved notable progress. Infant mortality was almost halved between 2000 and 2021, falling from 22.55 to 12.65 deaths per 1,000 live births [2]. Likewise, the percentage of infants with low birth weight decreased from 9.7% to 6.7% over the same period. Exclusive breastfeeding has also improved, rising from 14.4% in 2012 to 27.1% in 2019. However, vaccination coverage has regressed: by 2022, measles vaccination had fallen to 86%, representing a 10-percentage-point drop compared with the year 2000 [2].

The Mexican health system is characterized by profound fragmentation, divided into three major segments: public health, social security, and the private sector (OECD, 2016; Frenk et al., 2009). The public-health sector, under the Ministry of Health, serves the population without social security—approximately half of the total (SSA, 2021). This sector faces budgetary and infrastructure challenges, which translate into prolonged waiting times.

According to data from the National Institute of Statistics and Geography (INEGI) in the early 2010s, the leading causes of infant mortality in Mexico reflected a situation dominated by endogenous and perinatal conditions. Although the number of deaths among children under one year of age decreased significantly between 2000 and 2010, the mortality rate remained almost unchanged. Conditions originating in the

perinatal period, such as neonatal respiratory distress and bacterial sepsis, were the leading cause of death, accounting for half of all deaths. Congenital malformations ranked second, responsible for more than 22% of infant deaths, notably cardiac malformations. Finally, although pneumonia and influenza had historically been a serious problem, their trend showed a marked reduction during the decade analyzed. Together, these three causes accounted for 75% of infant deaths, evidencing an epidemiological transition toward health problems that require specialized medical care from birth.

The infant mortality rate in 2021 was 13 per 1,000 live births, meaning that 12 of every 1,000 children die before the age of five. Moreover, according to the 2022 National Health and Nutrition Survey (ENSANUT), acute respiratory infections (ARIs) affect nearly one-third of children under five years of age, especially in low-income households. Acute diarrheal diseases (ADDs) are also a significant problem: 9.4% of children under five had experienced them in the two weeks prior to the survey, meaning that nearly one in ten children suffered from ADD during that period.

Child health in Mexico faces significant challenges, especially malnutrition. Chronic undernutrition affects nearly 14% of children under five years of age, whereas overweight and obesity affect more than one-third of children aged 6 to 11 years, increasing the risk of chronic diseases in adulthood [2]. Infectious diseases such as pneumonia and diarrhea remain a threat to child survival. In addition, the leading causes of mortality in children aged 5 to 14 years include accidents, malignant tumors, and congenital malformations, underscoring the complexity of the problem. Added to these are conditions requiring specialized care, such as developmental disorders (autism, Down syndrome, and cerebral palsy) and childhood cancer, of which leukemia is the most common type [5].

Pediatric Impact of Diagnosis

The World Health Organization (WHO) defines child health as a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity. This definition encompasses the child's growth and development; the promotion, prevention, and treatment of diseases; and emotional and social well-being. It implies guaranteeing optimal conditions for adequate growth and development through access to preventive and curative health care, education, and safe environments that promote comprehensive well-being (WHO, 2024).

Child health is a crucial public-policy issue in Mexico. Children without access to quality health care not only face greater risks of illness but also experience school absenteeism and poor academic performance, with negative effects that persist throughout life, affecting their families and society. Beyond the human costs, this represents a significant economic burden, since treating diseases and the associated loss of productivity are costly. In Mexico specifically, the situation is aggravated by high malnutrition, limited access to health services, low vaccination coverage, and unsafe environments, which together increase the magnitude of the problem [6].

Neonatal screening

Screening—a term coined by Lester Breslow in 1949—is a fundamental public-health tool, used not for diagnostic purposes but as a method of presumptive identification. It consists of the rapid application of tests, examinations, or other procedures to distinguish people who might have an unrecognized disease or defect from those who do not.

Newborn screening is a crucial tool for the health of neonates, enabling the early, asymptomatic detection of congenital, genetic, metabolic, or structural diseases. Identifying these conditions in time is essential because, if left untreated, they can cause irreversible harm to children's development and quality of life. Early diagnosis is fundamental to ensuring that treatments are timely and effective, making it possible to halt disease progression and prevent serious harm such as interruption of physical and mental development, organ damage, disability, and even death [3]. In Mexico, two types of screening tests are performed: metabolic screening and point-of-care testing (POCT) of the newborn [4].

Newborn screening is a highly valuable preventive-medicine tool. By analyzing various substances in drops of blood collected on specific filter paper, it can promptly detect conditions ranging from a single disease—such as phenylketonuria (PKU) or congenital hypothyroidism—to nearly fifty diseases, including congenital adrenal hyperplasia, cystic fibrosis, galactosemia, maple syrup urine disease, urea-cycle defects, tyrosinemia, congenital organic acidemias, fatty-acid oxidation defects, thalassemia's, and Duchenne muscular dystrophy, as well as infectious diseases such as toxoplasmosis and human immunodeficiency virus (HIV) infection [3].

Management of the pediatric oncology patient

In Mexico, cancer is the second leading cause of death in the population aged 4 to 15 years. By 2025, more than 20 million new cancer cases are expected worldwide. Over the past two decades in Mexico, significant changes have been observed in the incidence, prevalence, survival, and mortality of childhood cancer. Acute leukemias have been shown to constitute 50% of all childhood cancer cases, followed by lymphoma (Hodgkin and non-Hodgkin) and primary malignant brain tumors [5].

Pediatric oncology care is offered at several centers across the country, but infrastructure and resources vary widely among them. Although long-term survival of children with cancer is good in high-income countries, outcomes are considerably worse in low- and middle-income nations. This is due to several factors, including late diagnosis, limited access to quality care, and a high rate of treatment abandonment.

A recent study (2018) evaluated the care provided at 62 pediatric cancer units across 29 states of Mexico. The findings revealed notable variability in the annual case volume managed by each center. One-third of these units treat fewer than 30 patients per year; nevertheless, the vast majority of children (more than 90%) are treated at higher-volume centers. High-volume centers have better availability of medical and surgical specialists, such as pediatric oncologists and hematologists, and are much more likely to have multidisciplinary tumor boards (MDTBs), which are crucial for decision-making and quality of care. The study also revealed limitations in essential services: radiotherapy was available at only 42% of centers, and palliative-care clinics at 63%. Although palliative care does not always require an on-site specialist physician, its limited availability remains an area for improvement [5].

One of the most concerning findings is the high rate of patient loss during the transition to adult care. One-third of centers reported that at least half of their patients are lost during this process, which may be related to the fact that insurance coverage in many programs does not extend beyond 17 years of age.

The challenges reported by treatment units are diverse and complex. Administrative barriers were cited by 44% of centers, while others pointed to limited access to diagnostic services (29%) and patient-level difficulties, such as poverty and distance to the hospital (21%).

In summary, this study underscores the need for a coordinated national approach to strengthen pediatric cancer care in Mexico. The authors emphasize the importance of improving access to multidisciplinary, supportive, and palliative care across all units. These data serve as a crucial starting point for future initiatives aimed at improving the quality of life and outcomes of children with cancer in the country.

Cost–benefit

Child health is a major public-health issue because it has a significant impact on society. Children who lack access to quality health care are more likely to experience health problems, miss school, and have lower academic performance, which can negatively affect the individual throughout life [6].

Childhood health problems generate a considerable economic cost. Treating childhood illnesses and injuries can be expensive and is compounded by the loss of income for parents who cannot attend work because of the care their children require. In addition, missed schooling must be considered, which affects children's educational development and limits their future opportunities. This affects not only the well-being of families but also has repercussions for the national economy [7].

Child health in Mexico presents a landscape of complex and contrasting challenges. On the one hand, malnutrition is a dual problem: chronic undernutrition affects nearly 14% of young children, while more than one-third of school-age children already have overweight or obesity, foreshadowing a future of chronic diseases [2]. On the other hand, health problems of diverse natures coexist. While infectious diseases still claim lives, the leading causes of mortality in older children are accidents, cancer (mainly leukemia), and congenital malformations, each requiring highly specialized care. The complexity of these problems ranges from disorders such as autism and cerebral palsy to the need for tertiary-level care for childhood cancer, demonstrating the diversity of challenges facing the health system.

Challenges and Future Perspectives

Telemedicine as a strategy to improve access and diagnosis

Telemedicine emerges as a key tool for overcoming geographic and socioeconomic barriers to pediatric care in Mexico, especially in a context of epidemiological transition toward chronic and specialized diseases. A recently published review highlights the growing use of this technology in neonatology and pediatrics, mainly for follow-up activities [11]. Telemedicine—defined as the combination of communication technologies with traditional medical care—improves the quality of care, facilitates access to remote diagnostic services, and enables continuous monitoring of vital parameters. Its applications are diverse, ranging from postoperative follow-up in pediatric surgery to the management of metabolic diseases such as obesity and diabetes, neurological disorders, cancer, and psychological conditions.

However, its implementation faces significant practical challenges, including the lack of technical knowledge among health professionals and patients, the high cost of maintaining technological networks, and the perception that telemedicine is of little use compared with in-person consultations. A crucial obstacle is its inapplicability to visits that require physical contact. Overcoming these limitations will require investment not only in technology but also in continuing-training programs for professionals and in patient education. The evidence highlights the importance of technology in ensuring the efficiency and quality of health services, provided that these practical limitations are addressed [10,11].

Conclusion

Diagnosis in pediatrics is not merely a clinical tool but a transformative axis of public health. Its impact extends to child development, social equity, economic sustainability, and the quality of the health system. Mexico has the opportunity to strengthen its diagnostic capacity through technological innovation, inclusive policies, and collaborative models that place the child at the center of care. Investment in diagnosis is, ultimately, an investment in the future of the country.

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Conflict of interest

One of the authors (E. Conrad Ortiz) is employed by Roche Diagnostics; this affiliation did not influence the content, analysis, or conclusions of this review. The authors declare no other conflicts of interest.

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