Rheumatology International (2019) 39:585–593
https://doi.org/10.1007/s00296-018-4198-7

Rheumatology
INTERNATIONAL

REVIEW

Mexican rheumatology: where do we stand?

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Received: 31 July 2018 / Accepted: 2 November 2018 / Published online: 12 November 2018

Abstract
The aim of this review was to provide an overall overview of the past, present, and future situations and main challenges that are facing Mexican Rheumatology as a medical subspecialty in the context of their national healthcare system, where a deficit of workforce at the national level coexists with a shortage of specialists in the less-developed southern states of the country and a great surplus of professionals within large metropolitan areas. We also analyzed the prevalence and burden of Rheumatic and Musculoskeletal Diseases (RMDs), the structural composition and distribution of Mexican Rheumatology, and the clinical profile of the Mexican Rheumatologist. Last, we examined comorbidities, education and training programs and one scenario for Mexican Rheumatology wherein the principal main threats and opportunities are determined.

Keywords Health services · Medical staff · Mexico · Rheumatology · Musculoskeletal diseases

Introduction

Mexico is a Federal Republic and the most populous Spanish-speaking nation worldwide, with 130 million people, accounting for about 1.7% of the world's population [1, 2]. Population density is 67 per km^2 (174 persons per sq. mile), total land area is 750,563 sq. miles, 79.2% of the population is urban (103,527,244 individuals in 2018), and the median age is 27.9 years.

Heterogeneity of ethnic background, history of colonialism, and migration patterns are some circumstances resulting in a mixed Mexican population that may differ from state to state, displaying a wide spectrum of genetic expressions and language diversity.

Key social health determinants that are also encountered in some Latin-American countries are common in Mexico, including poverty and unemployment, informal employment, deficiencies in public health, problems in education, impoverished communities, family disintegration, crime, and socioeconomic exclusion [3].

In Mexico, health inequality in the population is influenced by social determinants. In the past decade, Mexico has witnessed immense progress within its healthcare system that has allowed for greater access to health care and a decrease in mortality rate, but there are still various health inequalities caused by social factors.

Furthermore, Mexico is facing a demographic and epidemiological shift—with decreasing infectious diseases, increasing non-communicable chronic and degenerative diseases, and an increasing proportion of people living into older age—which would presuppose an increase in the demand for rheumatological care along with sufficient provision of health professionals and allied specialists.

The aim of this review was to provide a global overview of the past, present, and future situations and main challenges that are facing Rheumatology in Mexico.

Overview of the Mexican healthcare system

The Mexican healthcare system operates through a cluster of vertical and independent subsystems weighed down by dense historical and institutional legacies. Each subsystem provides different levels of care with diverse results. Mexican patients with Rheumatic and Musculoskeletal Diseases (RMDs) have no universal insurance

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plan, and they will be facing a fragmentary healthcare system divided into three main categories, according to their employment-based affiliation and wage level as follows [4]:

1. *Private sector* An aggregate of healthcare providers from profit-making agents comprising business and individual private medical professionals. According to the Organization for Economic Co-operation and Development (OECD), Mexico reveals the highest ratio of private-to-public sector facilities, showing that the private sector is an important part of the national healthcare system [5].
2. *Social security system* Provides comprehensive healthcare insurance for public and private employees (including pensioners) and their households, such as out-patient and in-patient health care, hospitalization, paid sick days, disability, and retirement plans. Funded by both the Mexican Federal Government and by contributions from employees and their employers, this system comprises a heterogeneous bundle of autonomous healthcare institutions, including out-patient clinics, general hospitals, and specialty hospitals.
3. *Public insurance subsector* Composed of a decentralized set of institutions financed by the Mexican Federal Government, State Governments, and individuals. It covers non-salaried individuals, informal workers, and unemployed persons. This category comprises the National Institutes of Health, high specialty institutions, general hospitals, regional hospitals, and nationwide healthcare programs for the uninsured, such as the National Commission of Social Protection for Health (known as *Seguro Popular* in Spanish). Patients with RMD in the public insurance subsystem receive a reduced health insurance package; thus, they must pay the out-of-pocket part of the cost of his/her medical demands [6].

Quality, scope, prescription drug coverage, and healthcare services differ in these three subsystems. Each possesses its own autonomous network of Rheumatologists, out-patient clinics, hospitals, pharmacies, admission criteria, and independent operative, administrative, and medical records. Each maintains its own drug and device formularies and develops its own standards of care. Significant out-of-pocket spending on healthcare also signals a deficiency of the health system in terms of offering effective insurance, high-quality services, or both.

There is a plan of the federal government to integrate healthcare services and eliminate its fragmentation until to have a single and robust public healthcare system and expand it to provide universal access to healthcare services.

Structural composition and distribution of Mexican rheumatology

Notwithstanding that Mexican Rheumatology shares a centennial tradition—as Table 1 depicts—today it remains a heterogeneous medical subspecialty. Heterogeneity implies that Rheumatology practices take place within a national healthcare system that is stratified and not articulated into the main subsystems previously mentioned.

A great disparity of the workforce distribution of Rheumatologists within the Mexican territory continues to date [7]. Nor does Pediatric Rheumatology—a branch of the specialty—maintains the proper number or distribution of professionals required by the needs of the country.

Together, heterogeneity and disparity generate a deficit in the workforce at the national level—which coexists with a shortage of specialists in the less-developed southern states of the country—and a great surplus of professionals within large metropolitan areas.

Prevalence of rheumatic diseases in Mexico

The majority of epidemiological published data on RMDs in Mexico derives from the "Community Oriented Program from Control of Rheumatic Diseases" (COPCORD) [8–17]. This program—a joint initiative of the International League of Associations for Rheumatology (ILAR) in collaboration with the World Health Organization (WHO)—concentrated on the main RMDs in rural sectors in low- and middle-income countries such as Mexico [18].

Regional surveys implemented to obtain epidemiologic information in different geographic areas in Mexico were published in 2006 as a joint effort by different organizations such the Mexican College of Rheumatology, the Mexican Foundation for Health, the National Council of Science and Technology, and the Mexican Foundation for Rheumatic Patients, AC.

One Mexican epidemiological study reported the following data regarding the prevalence of diverse RMD as follows: (1) musculoskeletal pain 25.5%, but with significant variations (7.1–43.5%) across geographical regions; (2) osteoarthritis (OA) 10.5%; (3) back pain 5.8%; (4) rheumatic regional pain syndromes 3.8%; (5) rheumatoid arthritis (RA) 1.6–2.6; (6) fibromyalgia 0.7%, and (7) gout 0.3%. The prevalence of RMDs was associated with both older age and feminine gender [19].

A high prevalence and impact on Daily Living Activities of musculoskeletal pain and RMDs was reported, with marked differences in overall and syndrome-specific prevalence among Mexican indigenous populations, such as

Table 1 Timeline of rheumatology in Mexico

Pre-Hispanic era-1521	Several cases of bones with OA and other rheumatic disorders throughout Meso-America exhibit an incidence of musculoskeletal diseases among individuals in pre-Hispanic societies The Nahuatl culture attributed rheumatic conditions such as gout to Quetzalcóatl-Ehécatl, the god of the wind. Diverse remedies and therapeutic treatments—compiled by the chroniclers of the Indies—were available [60]
1524	Hernán Cortés opens the first Hospital on the American continent, known as "Hospital de Jesús" [61]
1552	The Codex de la Cruz-Badiano (also named *Libellus de medicinalibus indorum herbis*), a manuscript detailing the medicinal properties of many plants used by the Aztecs, refers to some types of rheumatic diseases as "joint disease" [62]
XVI–XVIII century	New-Spain authors such as Francisco Hernández [63], Alonso López de Hinojosos [64], and José Ignacio Bartolache [65] describe the remedies and plants used to treat diverse rheumatic conditions such as gout [66]. The galenic scheme of physiology and anatomy prevailing at the time did not yet enable clinical observations [67]
XIX century	Beginning of Modern Mexican Rheumatology. During the nineteenth century, the *Gaceta Médica de México* published the earliest clinical writings on rheumatic diseases; also, there appeared the first thesis on rheumatism in the National School of Medicine of Mexico [68]
1944	The first Mexican Rheumatology Service began operations within the National Institute of Cardiology
1959	Foundation of the Mexican Society of Rheumatology, AC, as a replacement for the Mexican League Against Rheumatism started in 1940
1968	Setting up of the first evaluation program for the training centers of Rheumatologists
1975	Establishment of the Mexican Council of Rheumatology. From this year, Rheumatology was officially accepted as a subspecialty [69] First 31 Mexican Rheumatologists certified in the country
1986	Launching of the Revista Mexicana de Reumatología
1992	285 Rheumatologists certified
2002	Transformation of the Mexican Society of Rheumatology into the Mexican College of Rheumatology, AC
2005	*Reumatología Clínica* launched by both the Mexican College of Rheumatology and the Spanish Society of Rheumatology as the official journal of the joint societies
Today	Mexican Rheumatology research on the pathogenesis, clinical manifestations, and treatment of multiple RMD. Solid and consolidated presence of Mexican clinical and basic rheumatologic research in Rheumatology journals with an impact factor and in international congresses [70]. The Mexican Council of Rheumatology recently assessed the reliability and objectively structured clinical examination [71]

Chontal, Mixteco, and Maya-Yucateco [9], suggesting the need to establish culturally sensitive community-centered interventions for preventing RMD-related disabilities [20].

Burden of RMD in Mexico

There is a high burden of RMDs worldwide, with an estimate of 2.5% of the total disease burden in the developing world due to musculoskeletal diseases, with OA considered the greatest contributor [21].

In general terms, according to the Global Burden of Disease Collaborative Network, Mexico RMDs in Mexico accounted to 6.56% of total disability adjusted life years (DALY) [22]. This percentage is above the 5.83% of global world RMDs, but below the 6.98% corresponding to Latin America and the Caribbean region.

By type of musculoskeletal disorder (RA, OA, low back pain, neck pain, and gout, among others), Mexico occupies position number 18 among 35 Latin-American countries, as Table 2 depicts.

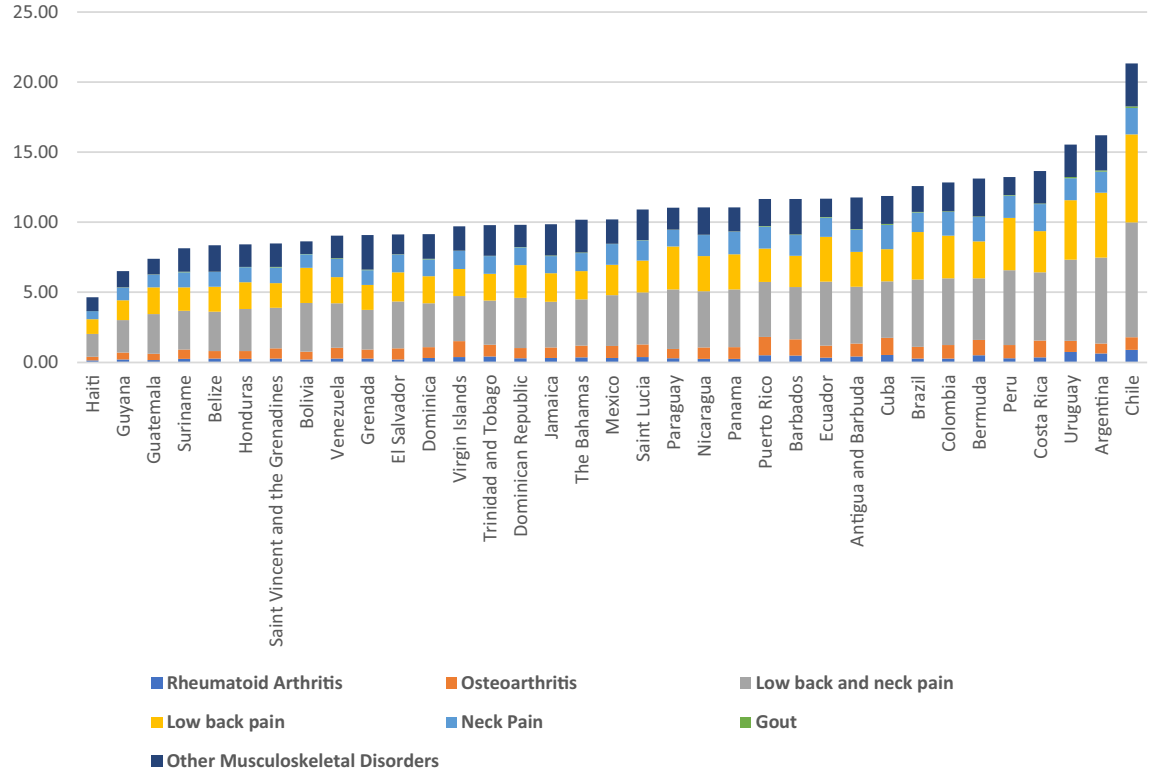
As with other chronic non-communicable diseases, RMDs exert a high impact on countries such as Mexico. Projected worldwide RMDs-related deaths by the WHO estimates an increase to 271,000 deaths by 2030, with 201,000 (74%) of these taking place in low-and middle-income countries [23].

Mexican rheumatology workforce

We cannot deny that, as in other countries on the American continent, the Rheumatology workforce in Mexico has maintained advances. However, despite all of improvements achieved, the growing demands continue to be unmet for rheumatological care in rural, poor, distant, or small localities.

According to the Mexican Rheumatology Council (Board), by 2018 the number of certified Mexican Rheumatologists per 100,000 inhabitants was 0.55—including a total of 556 active specialists divided between 507 for adult care and 49 Pediatric Rheumatologists with maintained certification. This figure falls within the average of 0.62 and 0.47 ratio estimated by Reveille and Al Maini, respectively [24, 25]. Table 1 depicts a comparison between the number of

Table 2 Main musculoskeletal disorders in Latin America and the Caribbean (both sexes, all ages) as % of total DALY



Source: Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2016. Disability-Adjusted Life Years and Healthy Life Expectancy 1990–2016. Seattle, WA, USA: Institute for Health Metrics and Evaluation, 2017

certified Mexican Rheumatologists for the years 1975 and 1992.

Rheumatology national representativeness

The Mexican College of Rheumatology (MCR) is the sole professional organization of Rheumatologists in the country. To date, the MCR has produced the following: (1) diverse consensus guidelines on RA [6]; management of pregnancy in women with autoimmune rheumatic diseases; [26, 27] appropriate use of non-steroidal anti-inflammatory drugs (NSAID) [28], and the guidelines and recommendations of the Mexican College of Rheumatology for the use of biological agents in rheumatic patients [29]; (2) a journal supplement on therapeutic novelties [30], and (3) reviews on clinical manifestations, epidemiology, outcomes, and treatment in systemic sclerosis [31], OA [32], inflammatory myopathies [33], vasculitis [34], musculoskeletal ultrasound, and clinical anatomy [35]. Mexican rheumatologists have additionally produced outstanding clinical and basic research papers contributing to the knowledge and advancement of worldwide rheumatology.

On the other hand, the Mexican Rheumatology Council (MRC) has served as an advisory body in relation to the certification and recertification processes of the Rheumatologists since 1975 (Table 1). It has been a long-held view that earning and maintaining certification through MRC shows a physician's commitment to achieve expertize in rheumatology. Certification has also meant that the physician demonstrated to their peers they have the clinical judgment, skills and attitudes essential for the delivery of patient care. In recent years, an average of 42 specialists becomes certified annually. In 2018, the Council certified 48 new professionals, (43 adult and 5 pediatric rheumatologists).

Clinical profile

To explore the clinical profile of the Mexican Rheumatologist is a complex task, in that official data on the quantity of the centers/hospitals/institutions providing Rheumatology services are, to our knowledge, unknown. To date, the following challenges, barriers, and obstacles are known [4]:

1. Government institutions offer insufficient wages, but job security and salary packages explain why Rheumatologists have a mixed work (public- and private-type practice), assigning approximately 6–8 h per day to public

institutions and 4–6 h additional hours to private practice.
2. Due to the scarcity of working opportunities in the public healthcare system as a specialist, rheumatologists in big cities work as Emergency Medicine Physicians or Internists.
3. The average consultation time assigned by public institutions in out-patient clinics is around 30 min for new patients, and 20 min for follow-up appointments.
4. The Mexican healthcare system does not provide "portability"; thus, patients with RMDs cannot access facilities belonging to any other healthcare institution except their own, regardless of their proximity.
5. Waiting time for new patients to visit a rheumatologist for the first time in the public sector is between 3 and 6 months.
6. For patients outside public sector coverage, there are two options: in the first, the patients must self-finance RMD-related services through out-of-pocket expenses, frequently leading families to catastrophic expenses. In the second, less common scenario, affluent patients can access rheumatologist consultations and services from private health insurers/institutions, based on a pre-established honorarium.
7. The medications most often prescribed by Mexican rheumatologists comprised analgesics and NSAID, followed by glucocorticoids, synthetic disease-modifying antirheumatic drugs (DMARD), biological DMARD, and biosimilar medications. It is noteworthy that glucocorticoids are sold Over The Counter; consequently, widespread self-medication, improper use, and abuse are common in Mexican clinical practice [36].
8. Rheumatologists are usually located in the second and third levels of healthcare, meaning that patients often need to go through the first and some by the second level before attended by a specialist. This leads to long referral times, delay in diagnosis, late start of treatment and progression of the underlying condition.

The majority of institutions of the social security system offer their affiliated patients access to biological therapies and high-cost medications, such as small molecules, through a lengthy and detailed administrative procedure, a thorough individual study of each case, and the presentation of the case to a centralized committee.

The success of biosimilars requires efficient pharmacovigilance systems and enough drug competition to drive down prices [37, 38]. However, the majority of Latin-American countries has been left out by developed countries in terms of providing regulatory supervision and effective pharmacovigilance programs for these types of drugs [39]. The MCR position on biosimilar drugs can be found in two documents [40, 41].

In 2007, the Pan American League of Associations for Rheumatology (PANLAR) and the Sociedad Española de Reumatología (Spanish Society of Rheumatology) established the Pan-American Registry of Adverse Events of Biological Therapies in Rheumatic Diseases to track the safety of biologics. The Registry is recognized as a source for studying biologic-related adverse drug reactions in Latin America (BIOBADAMERICA) [42–44].

Different efforts are being made by the MCR to increase the number of patients admitted to the Mexican registry (BIOBADAMEX). Phase III of this project was recently launched [45].

There are two major obstacles to effective pharmacovigilance in Latin America: (1) a lack of unanimity on the interchangeability between original biologics and biosimilars [39, 46, 47], and (2) a shortage of qualified human resources instructed and qualified in pharmacovigilance, in order for them to perform effective post-marketing surveillance of biosimilars. In addition to these two key barriers to effective pharmacovigilance, there is the lack of precise guidance on the interchangeability and substitution of biosimilars for originator biologics [39, 48].

Comorbidities

Mexican subjects with RMDs such as RA are at significant risk for comorbid conditions, which raise mortality, the number of hospital admissions, the costs of medical care, related out-of-pocket expenses, and disabilities.

One cross-sectional study analyzing 225 Mexican patients with RA found the most common associated comorbid conditions were the following: (1) arterial hypertension 29.8%; (2) dyslipidemia 27.1%; (3) osteoporosis 19.1%; (4) type 2 diabetes 12.4%; (5) hypothyroidism 6.2%, and (6) solid malignancies 4.4%. Among the most prevalent risk factors that the study reported are found overweight 44.9%, obesity 31.6%, high blood pressure 12.4%, hyperglycemia 27.1%, and hyperlipidemia 49.8% [49].

Another international cross-sectional ASAS-COMOSPA study from Argentina, Colombia, and Mexico, carried out to establish the prevalence of comorbidities in subjects with spondyloarthritis, found that the most common comorbidities were arterial hypertension (25.3%), hypercholesterolemia (21.8%), osteoporosis (9.4%), and gastrointestinal ulcer (7.8%). The prevalence of hypertension was 25.3% (95% CI 21.2–29.4) and this was higher compared with general population (13.4%) (95% CI 11.5–15.2). The overall prevalence of tuberculosis was 3.3% (95% CI 1.8–5.7) and the prevalence of the hepatitis B virus infection was 1.03% (95% CI 0.3–2.7), both increased as compared with general population (0.03% and 0.01%, respectively) [50].

Education in rheumatology

At the beginning of the twenty-first century, undergraduate education in rheumatology was poor; it represented only 1% of program credits. In various medical schools in Latin America, rheumatology accounted for ≤ 1% of the entire programs' credits [51], resulting in reduced competence between graduates and students, which results in a deficient capacity to evaluate, diagnose, and manage the more than 200 RMDs.

Some areas of education that have been developed and promoted nationally and internationally by Mexican Rheumatologists, through different educational modalities (lectures, theoretical–practical courses with hands-on workshops, diploma courses, and highly specialized courses) include the following: ultrasound in rheumatology; vasculitis, and clinical anatomy. These courses have resulted in a number of medical residents, rheumatologists, and related professionals enrolling in these courses, which also currently possess university endorsement. Additionally, these courses have obtained support from international institutions such as ILAR, the American College of Rheumatology, and PANLAR [52–55].

Rheumatology training programs

At the present time, we have 15 Adult Rheumatology and five Pediatric Rheumatology training programs. These programs are comprehensive and include clinical and research training.

All of these programs are approved and supervised by the MCR and local university authorities.

In the case of a program being weak in some educational area, for example in immunology or in specific clinical aspects, the trainees participate in a rotation in that particular area at another Rheumatology Service with a training program.

An uncertain scenario for Mexican Rheumatology

For Mexican Rheumatologists, the depreciation of the Mexican peso and the recrudescence of US migratory policy could entail the ensuing outcomes [56]:

1. Decrease in opportunities of obtaining international funding for clinical, basic, and technological research projects.
2. Reduce the capability to engage in international collaboration in research projects.
3. Diminish opportunities for Mexican studying rheumatology in the US, one of the main sites for biomedical resource training abroad.
4. Decrease subscriptions to scientific journals, catalogs, and specialized repositories, and few economic resources for publication in peer-reviewed international journals requiring the payment of a fee in US dollars.

Health-related tourism: an opportunity to explore

However, an ancillary effect of this scenario—along with the increased uncertainty derived from the reform of the US health system—can open an opportunity for Mexican rheumatology through an increased demand for medical tourism.

According to the US: Centers for Disease Control and Prevention, Mexico is now the second destination for this market in the world, with expanding opportunities for healthcare services such as plastic surgery, dentistry, cardiology, orthopedic surgery, bariatric surgery, fertility, transplants, and eye surgery [57].

The Ministry of Economy of Mexico estimates that health tourism will reach 3,935 million US dollars in 2018, with an annual growth rate of 7% during the last 3 years. The average range of savings in US dollars for a US citizen is between 36 and 89%, for a variety of specialties and procedures [58]. All of these factors could lead to the search for new medical options in Mexico, with the aim of patients with RMDs not incurring in catastrophic expenses. A similar scenario in Europe could occur with Brexit [59].

Conclusions

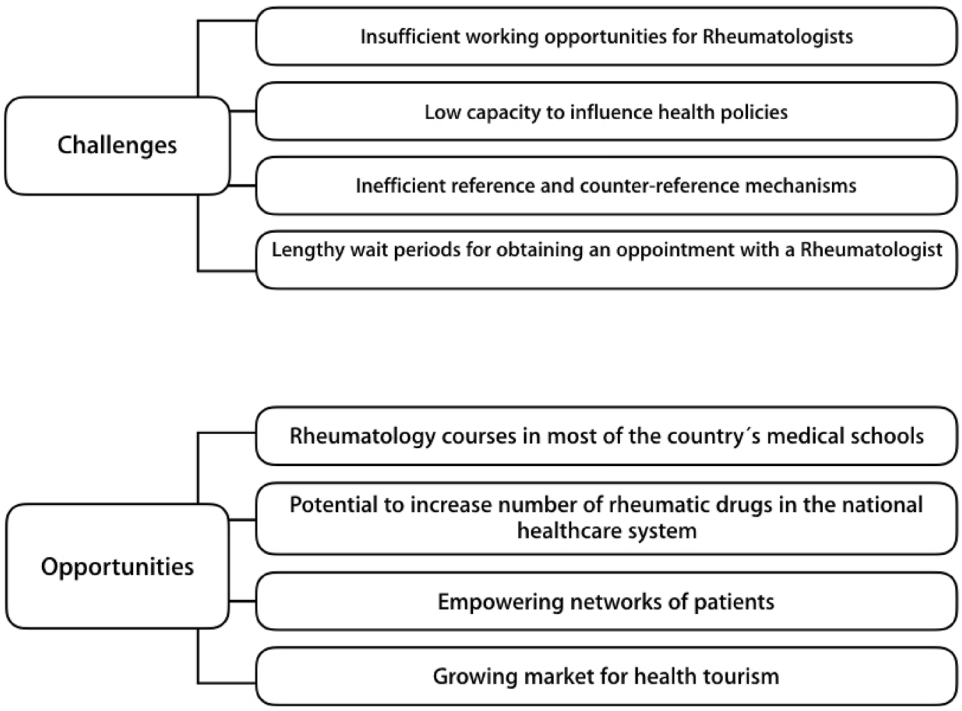
Mexican rheumatology is a young subspecialty that is presently facing great challenges deriving from the increasing number of patients and the shortage of economic resources and specialists as depicted in Table 3.

In terms of opportunities, Mexican rheumatology engages in the worldwide research of the pathogenesis, clinical manifestations, and treatment of multiple RMD, with contributions presented at international academic forums and publications in medical journals with an impact factor.

To strengthen these achievements, it is necessary to promote better academic formation for new generations of rheumatologists, encourage their competences in scientific research, promote patients' rights, and seek collaborative interinstitutional and multidisciplinary work.

Finally, we would like to comment that in the near future the burden of the RMDs will continue to increase in Mexico,

Table 3 Main challenges and opportunities of Mexican rheumatology



so the health authorities should be aware of the situation to implement improvements in the administration of diseases and preventive measures, with the participation of health professionals and patients.

Author contributions All authors were involved in drafting the article or revising it critically for important intellectual content. All authors approved the final version to be submitted for publication.

Compliance with ethical standards

Conflict of interest The authors report no relationships that could be construed as a conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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