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Main Swine Pathologies in Latin America

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ABSTRACT

Background: Swine production systems in Latin America are still vulnerable and exposed to viral, bacterial, and parasitic pathologies, causing enormous losses and risks to animal and public health. **Aim.** To study the most frequent swine pathologies presently found in Latin America. **Development:** The study made a bibliographic review of the literature from the last five years to unveil the factors that cause the appearance of etiological agents and implement preventive measures. The most frequent diseases found were influenza A (H1N), Enzootic Pneumonia, porcine reproductive and respiratory syndrome virus, Aujeszky, African swine fever, epidemic swine diarrhea, circoviruses, Parvovirosis, Swine Erysipelas, Leptospirosis, Brucellosis, Salmonellosis, Toxoplasmosis, and Taenia solium that causes Cysticercosis. **Conclusions:** The current figures showed the most frequently acquired diseases, with the highest impact percentages on swine production in Latin America. The causal agents of the main swine pathologies are presently affecting pigs and, therefore, circulating in the environment. Consequently, there is a need to implement new control strategies and biosafety protocols. The identification of pathology-causing agents is critical for the development of preventive measures.

Keywords: diseases, pigs, prevention, production (*Source*: *AGROVOC)*

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INTRODUCTION

Swine production in Latin America constitutes one of the most significant protein sources; hence, there is a growing interest in producing more animals, achieving weight gains in less time, and preventing adverse effects. The objective is to achieve more growth and favorable projections and to cope with several obstacles posed by diseases transmitted on the farms, negatively impacting production.

Pathologies are always associated with multifactorial pathogenic causes, so it is necessary to classify them and learn their transmission mechanism and pathogenesis to adopt measures that reduce their negative impact (Rodríguez *et al.*, 2021). Critical points like farm structure, location, and environmental conditions favor the transmission of these pathologies by the animals. Likewise, other important aspects to prevent the entrance and propagation of pathologies in production systems include technicians, staff management, biosafety, sanitary monitoring, feeding and quality of weaned pigs, transition phases, and fattening (Castillo and Pinto, 2021).

To minimize the presence of pathologies on swine farms in Latin America, various alternatives should be used, including the methods developed for swine production to prevent and detect these pathologies in the field. Today, scientists are developing smart systems that help detect disease on pig farms. these systems permit the generation of timely diagnostic and treatment, reducing major losses in production (Rodríguez *et al*, 2017).

Accordingly, the aim of this paper was to do a study of the most frequent pathologies still present in Latin America.

DEVELOPMENT

The research was descriptive-documentary, with a review of the scientific papers selected, to have information about the most frequent pathologies, their risk factors, prevention, and field detection. This bibliographic-documentary study was conducted through search, reading, analysis, reflection, and interpretation of the related literature.

The keywords used were prevention, pathologies, pigs, and diseases. The information search was performed between May 1st and December 30th, 2021. The following search engines were used: Google Scholar (https://scholar.google.es/), Food and Agris Fao (https://agris.fao.org/) Pnsa (https://www.pnas.org/) BMC vet res (https://bmcvetres) American Association of Swine Veterinarians (https://www.aasv.org/) Plos (https://plos.org/) and Research Gate (https://www.researchgate.net/). The selection criteria were the scientific papers published between 2015 and 2021.

Swine production accounts for over a third of the meat produced worldwide; it is part of the protein and components of world food safety, farming economies, and trade (Velez *et al*, 2018).

The pathologies are among the main limitations to swine production (Vanderwaal and Deen, 2018). The pathologies are different and at the same time similar in different countries and regions due to the management, breeding, industrial advances, and intensification of every production system. Accordingly, the pathological processes must be classified depending on the causal agents present in the respiratory, digestive, and reproductive systems (Pérez-sánchez, 2020).

The most frequent diseases found were

Influenza

Influenza A H1N1 is a respiratory disease caused by a member of the family *Ortomixoviridae*, which affects pigs of all ages. In Latin America, the mortality rate is below 15%, likewise, the mortality rates have been even much lower. The incubation period is between 7 and 10 days, and the transmission occurs through oral-nasal secretions, urine, and semen (Baudon *et al*, 2017).

The information about the prevalence and distribution of such pathology today is limited in many countries, especially, in Latin America. Traditional animal farming without the inclusion of technologies leads to more risks of virus exposure and respiratory syndrome. In Central America, Guatemala has the largest swine industry (over 2.7 million, estimated population). Although there are large-scale closed commercial farms, most of the production is peri-domestic or in yards, which brings about greater risk and ease of access by the causal agents to the country without detection (Gonzalez-Reiche *et al*, 2017).

Enzootic pneumonia

The causal agent of swine enzootic pneumonia (SEP) is the bacterium Mycoplasma hyopneumoniae which causes a chronic respiratory pathology that is widely spread in Argentina and Mexico, causing major losses in swine production. SNP control requires optimum biosafety, proper farm animal management, antimicrobial medication, and vaccination, depending on the regions or countries where swine farming takes place (Blois *et al*, 2017).

In respiratory pathologies, several environmental factors intervene, such as ventilation, air quality, and housing, which probably exacerbate the clinical severity of a disease when the conditions are inappropriate. Considering ventilation and the quality of associated air, there has been an increase in the prevalence of pulmonary injuries related to bacterial pneumonia. Therefore, it is important to optimize the air exchange rate, temperature, humidity, housing conditions, and ammonia levels (Betlach and Pieters, 2020).

Morales *et al* (2021) pointed out in their research that in Mexico, for instance, SEP is a high-prevalence chronic respiratory disease that has high morbidity and low mortality. Between 30 and 80% of pigs for slaughter show consolidation lesions. Along a pig's productive life, the prevalence of M. hyopneumoniae increases until the age of sacrifice, even in already-immunized animals. The female breeders are a reservoir that perpetuates the continuous circulation of SEP-associated respiratory pathogens.

Pig reproductive and respiratory syndrome (PRRS)

The PRRS virus belongs to the order Nidovirales, family Arteriviridae. It is a viral pathology spread around the world that causes reproductive failure in gestating sows, along with respiratory problems at any age; it may be associated with other respiratory complexes (López-Heydeck *et al*, 2015).

PRRS causes major economic losses, so it is an infectious disease that causes an enormous economic impact, affecting the world's swine industry. The economic impact caused by PRRS outbreaks is remarkable, reducing the annual production values by 7.4%. This reduction will depend on the aggressiveness of the strain and the conditions of the farm affected, so it is important to take into consideration the sanitary measures (Castillo and Ramírez, 2021).

(A. Castillo & Ramírez, 2021) analyzed PRRS in Uruguay in a retrospective study, which demonstrated that PRRS has been affecting pigs since 2011. In Ecuador, there was no sign of the disease until a report of the presence of the virus on a farm comprising 469 animals was made in 2017. Meanwhile, in Chile, the disease was first reported in 1999, and by 2009 it was declared virus-free, though another outbreak took place in 2013.

In Colombia, there were outbreaks of the disease between 2012 and 2013, caused by imports of pigs. In Peru, the first serological study of PRRS found an initial prevalence of 13.6% on technified farms. Recently, a study done by SENASA, between 2015 and 2016, concluded that PRRS seroprevalence observed in the country was 17.3%; Lima was the most affected area.

Aujeszky (Pseudo rabies)

Aujeszky's Disease (AD), also known as pseudorabies, is caused by the Aujeszky virus, family Herpesviridae, which affects swine mainly, and other species sporadically. Pigs are the only natural host where the virus can create subclinical infections and stay in a latent state (Silva, 2012).

Castillo *et al* (2016) did a study in Peru in which they detected antibodies against Aujeszky's disease, in which all the samples tested negative for neutralizing antibodies against the AD virus. The AD virus, a herpes virus, may remain latent following a primary infection in neurons of the trigeminal ganglion and lymphoid tissues of the animal where it can reactivate periodically, triggering acute or subclinical infection.

This disease is distributed worldwide, except in Chile, Canada, Ecuador, Australia, and Africa. In the Americas, there is a similar situation due to the considerable economic losses, so the affected countries have implemented control programs to eradicate the disease. In other countries, the disease is endemic, such as in Venezuela, where no vaccination rollout is being held against the disease, and there are no official control measures (Silva, 2012).

African Swine Fever (ASF)

This pathology is acquired through viral infection and can be transmitted by contact and infected ticks to domestic and wild pigs. The occurrence of outbreaks of this disease must be notified. The clinical manifestations observed are very similar to the ones observed in the classic swine fever. Today, the disease has propagated to over 50 countries in four continents, with estimates of 78% of the world’s swine population and devastating economic losses (Sánchez and Muñoz, 2021).

Today, no vaccine or effective treatment has been developed, so its prevention is the important key to controlling it, preventing the inclusion of infected animals or their products. ASF is endemic in Africa, and sporadic in the Americas (Cuba, Brazil, the Dominican Republic, and Haiti), as well as in Western Europe. The first outbreaks were caused by contaminated meat products (Sánchez and Muñoz, 2021). The strategies for ASF control in countries with the disease for the first time or during sporadic outbreaks consist of following the classic intervention measures of quarantine and obligatory sacrifice of all the affected and suspicious animals (Carrillo, 2020).

Swine epidemic diarrhea

It is a common pathology caused by a virus. The coronaviruses that affect swine are mainly the transmissible gastroenteritis virus (TGEV), porcine respiratory coronavirus (PRCV), the porcine hemagglutinating virus (PHEV), PEDV, and the porcine delta coronavirus (PDCoV). Piñeros and Mogollón Galvis (2015) in an analysis detected the diseases in Colombia, in March 2014, strains PEDV. Though there is no evidence that the disease entered the country in pigs imported from the US, this possibility is not discarded. The clinical manifestations consist of vomit and diarrhea, miscarriages, and 100% mortality rates in young animals. From 2013 on, the disease appeared in various Latin American countries, causing major economic losses in swine farming.

Baek *et al* (2016) were able to develop a PEDV-inactivated vaccine using strain KNU-141112 and evaluated its effectiveness on newborn pigs. The results were satisfactory, the inactivated vaccine administered to sows considerably increased the survival rate of suckling pigs exposed to the virulent strain between 0% and 92%, along with a significant reduction of diarrhea and viral excretion in the feces. The unvaccinated pig litters lost body weight, whereas the vaccinated animals increased weight daily at 7 days following the challenge. Their antibody response against PEDV was observed in the immunized sows and their piglets were high. The data found lasting lactogenic immunity in the mothers that were vaccinated, which received passive immune protection.

Circovirosis

Circovirosis is distributed worldwide, and its presence has been confirmed in most Latin American countries. It causes Type-2 swine circovirus, which belongs to the family Circoviridae and affects pigs of all ages, causing a major economic impact on the farms affected (Segales, 2019). The most common signs and symptoms include increased respiratory frequency and weakness that may lead to death in swine farms (Gómez *et al*, 2019).

Almario *et al* (2020) did studies in Colombia to detect and characterize this pathology. They found that swine circovirus 2d is circulating clinically and sub-clinically, probably due to the existence of healthy animals that carry the virus and farms where vaccination is absent.

Parvovirus

This viral pathology is spread out in the world; it is caused by a DNA virus belonging to the family Parvovirídae. Parvovirus has a negative effect in Latin America, creating reproductive alterations and enormous economic losses in swine farms (Streck *et al*, 2021). The clinical manifestations of parvovirus (PVP) cause, in most cases, infertility in sows, especially in nulliparous animals with reproductive failures. The reproductive clinical signs are completely related during gestation when embryonic death occurs, and then mummification, which means that the clinical lesions are specific and limited to the uterus and fetus (Streck and Truyen, 2020).

González (2021) said that PVP has surpassed intercontinental barriers, and is present in most swine farms in Latin America. It can be easily transmitted through fomite and it is resistant to disinfectants, so routine vaccination is recommended on all swine farms, along with strict biosafety measures to prevent large economic losses.

Though (Carrera, 2021) stressed that PVP was previously thought of as a very stable virus because the vaccines developed through old strains produced immunity against all the variants. Currently, the discovery of new capsid profiles has changed the game, creating a challenging scenario for the new generations of biologists in their search for broader protection. Hence, new formulations of vaccines that induce more effective immunity in all viral strains circulating in the environment.

Erisipela Porcina

It is known as the Red Evil and it is caused by bacterium *Erysipelothrix rhusiopathiae*. It is distributed globally and may affect 30-50% of the population, causing economic losses due to the high costs of treatments depending on the symptoms observed in the pigs affected. The bacterium can affect many different species, including man, and the control measures must cover production animals, staff, and healthcare personnel. The entry point of the disease on the farms is the admission of new animals carrying the bacterium, flaws in biosafety, as well as the presence of rodents, dogs, and birds that carry the bacterium (Jordà and Galé, 2020).

The clinical signs and symptoms during the acute phase occur in the form of cutaneous lesions that grow all over the body until they cause septicemia and death. In the chronic phase, it causes cardiac lesions that lead to endocarditis and lesions in the joints. A look at the general symptoms is necessary to issue a diagnosis. Successful treatment will have to rely on laboratory tests through enzyme-linked immuno-absorption assay (ELISA), since the disease may produce several differential diagnostics, for instance, PRRS, influenza, PPA, PPC *Brucella suis*, Aujeszky, *Actinobacillus suis*, and *Salmonella cholerasuis*, (Sánchez *et al*, 2021).

The disease is present in many Latin American countries, but few epidemiological studies demonstrate the percentage of incidence. So far, in the same region, there have been four reports of zoonosis in the staff handling carrier pigs. To prevent zoonosis and prevent propagation, biosafety measures should be met not only on the farm but also around the personnel, particularly using vaccines (Haro *et al*, 2017).

Leptospirosis

It is a bacterial disease whose causal agent is the bacterium genus Leptospira interrogans. It causes acute infection and fever. It is distributed worldwide and affects the kidneys and the reproductive apparatus of pigs causing miscarriages, mortality, low viability, and infertility in sows. People may be contaminated due to direct sick animal contact (González, 2020).

In Latin America, leptospirosis is a zoonotic disease with a high epidemic potential; however, so far there is little evidence of reports on the presence of a new outbreak, which makes it difficult to determine the incidence and prevalence of the disease accurately (Davila *et al*, 2022). Pigs are the main reservoir and the most commonly affected production, so the personnel must be vaccinated as well as the animals, particularly maternity sows, to reduce the prevalence of the disease and the number of miscarriages (Rodríguez *et al*, 2017).

Zambrano *et al* (2021) concluded that the seroprevalence detected in sacrifice pigs in canton Portoviejo, Ecuador was 16.5% in 200 pigs. They determined that the frequent serovariety identified was *L. canicola* 6.5 % (13 / 200) and *L. pyrogenes* 6 % (12 / 200), 48 % of the positive cases showed lesions like interstitial nephritis originated by *Leptospira spp,* which created a significant risk alert for the technicians. These results demonstrate the existence of a large number of asymptomatic pigs carrying the disease, so the confiscations due to this pathology should be recorded and notified to the surveillance, prevention, and control organization to reduce the propagation on the farms affected.

Brucellosis

This infectious-contagious and zoonotic disease is caused by the bacterium *Brucella suis*, and it is distributed globally. It affects pigs and different species of domestic animals, and it is transmitted by direct contact, oral-nasal, and ingesting infected products (Dibarbora *et al*, 2017).

It poses a high risk still unknown in many countries. The most important symptoms in female animals are miscarriages and increased perinatal mortality, whereas it can cause orchitis and affect the accessory sexual glands (Micheloud *et al*, 2012).

Brucella suis causes 80% morbidity in animals. An outbreak took place in Buenos Aires, Argentina, on a farm with 118 females and 6 breeding males. The number of miscarriages affected 4.2% of reproduction, including 5 females, which showed no other symptoms. Today, in countries like Peru B. suis prevalence is 4-12%. Likewise, outbreaks of B. suis have occurred in Bolivia, Cuba, and Uruguay (Román y Luna, 2017). B. suis must be isolated using serological tests to detect the disease in time and reduce its propagation on the farm (Olsen & Tatum, 2017). Although brucellosis causes economic damage in swine production, the prevention of infection in humans is the main reason for control programs in Latin America. No commercial vaccine has been demonstrated to be effective against the disease (Meirelles *et al*, 2020).

Salmonellosis

Swine salmonellosis is caused by a bacterium of the genus *Salmonella spp*., which is spread out in the world. It tends to affect intestinal cells, splitting into three important groups; group 1, septicemic; group 2; diarrheic; and group 3, asymptomatic, which causes no problems to pigs' health. The disease causes enteritis and mainly affects suckling pigs before weaning; in the septicemic phase, mortality may reach 100% (Arruda *et al*, 2019).

In swine production, salmonellosis is a permanent problem because it is transmitted through subclinical infections, the bacterium spreads without detection, making animals intermittent carriers. Transmission takes place in two ways: oral-fecal when the animals have contact with the excreta from infected animals, and through sprays, dust, and infected fomites. For proper diagnostic, individual tests must be run in the laboratory, particularly PCR, which is the most reliable and common (Morillo *et al*, 2022).

When the pathology contaminates swine production systems, morbidity could be 10% and mortality 50%, especially in cases that were not treated in time (Del Pilar *et al*, 2014). Usually, the disease contaminates the production systems through infected animals, and control measures are based on antibiotics, despite high resistance. However, they have managed to establish strict safety measures, proper hygiene, and the inclusion of mixed bacterial vaccines in many Latin American countries to prevent the occurrence of new outbreaks in the production units (Colello *et al*, 2018).

Parasitic agents

Bacterial and viral diseases are the main cause of major losses in swine production. Though the presence of ectoparasites, helminths, and coccidia in pigs does not seem relevant, it threatens 5% of production. It can cause stress, diarrhea, growth retardation, slow weight gain, a reduction in mineral absorption, metabolic changes, and damage to several organs. Another critical point is the high number of zoonotic parasites that affect public health. One of the shortcomings of prevention is that different from bacterial and viral diseases, diseases caused by parasites cannot be prevented with vaccines, but through deworming programs (Noa and Lafargue, 2021).

In Latin America, parasitosis in pigs is responsible for major economic losses due to organ and carcass confiscation caused by different parasites. Infestation results from direct contact with eggs or infecting larvae present in the environment or intermediate hosts consumed by the pigs. The most common helminths are strongyles and ascarides. The figures are not accurate due to the lack of interest and study on the prevalence and incidence of swine parasitosis in Latin America, but it is recommended to implement sanitary and hygiene policies to prevent production losses and damage, using anthelmintics and anti-protozoaries on regular dates (Ciocco *et al*, 2019).

Swine toxoplasmosis

The etiological agent of this pathology is the protozoan parasite *Sarcocystidae*, subclass Coccidia, widely spread in the world, affecting 10% of farm populations. It may cause miscarriages, reproductive failure, coughing, diarrhea, lack of coordination, and seizures, though it occurs subclinically in most cases. However, there is great interest in detecting the disease in time to prevent public health consequences. Contagion to humans is closely linked to hygiene, socioeconomic levels, and direct contact with infected animals, meat, or by-products with the parasite (Papatsiros *et al*, 2021).

Carranza *et al* (2017), determined through indirect immunofluorescence (IFI) that Peru has 21.7% of pigs positive to toxoplasmosis in technified farms, whereas, it was 25.5% in Brazil. The highest toxoplasmosis frequencies have been reported in Costa Rica (43.8%) and Chile (28.1%). Although in Brazil (Capriogli *et al*, 2018) demonstrated that the prevalence of toxoplasmosis in pigs is 7.02%, and that 21.6% of traditional farms had, at least, one infected animal. Keeping these figures down requires strict biosafety measures and proper hygiene practices, such as the control of other hosts. Cats are the main carriers of the disease, contaminating feeds with their stools. Another suitable measure is laboratory tests, and avoiding the consumption of poorly cooked animal foods or tissue (Luyo *et al*, 2017).

Cysticercosis by Taenia solium

This zoonotic parasite is endemic to Latin America; it causes taeniasis in humans and cysticercosis in pigs and humans. Intestinal taeniasis does not cause discomfort, nor does cysticercosis cause health problems in pigs (Flisser, 2017). The distribution is observed in low-mid-income countries, where the sanitary protocols are insufficient, and the production systems are extensive. Likewise, there is evidence of the presence of swine cysticercosis in 11 departments of six countries (Colombia, Guatemala, Honduras, Mexico, Nicaragua, and

Venezuela), which creates potential problems for public health in those countries (Braae *et al*, 2017).

In Latin America, there are prevalences between 0.25 and 22.2%. The latest epidemiological reports and behavior of cysticercosis in pigs vary in every country. In Mexico it is 23-35%, Honduras 27.1%, Guatemala 4%, Colombia 5.34%, Peru 47.3%, Bolivia 37%, Brazil 9.71%. In Ecuador, the lack of interest in government policies and little information about the positive cases in endemic regions have favored non-mandatory reporting (Rodríguez and Benitez, 2007). *T. solium* is the cause of 30% of cases of epilepsy cases in humans in many endemic areas. The most frequent cause of epilepsy in the world is neurocysticercosis, with estimates of 30% of the cases in countries where this parasitosis is endemic, and in some communities, it could reach 70% (Forero *et al*, 2017).

The main factor of transmission is humans, through contaminated water and foods with feces. Control and prevention must focus on improvements in sanitation, massive treatment of taeniasis in humans, improvements in swine production, not leaving pigs at large, and improvements in the verification and manufacture of products containing pork (Rojas, 2021).

CONCLUSIONS

This bibliographic review showed the current figures related to the most frequently acquired diseases, with the highest impact percentages on swine production in Latin America.

The causal agents of the main swine pathologies have not been eradicated at all, and they are circulating in the environment. Consequently, new control strategies and biosafety protocols should be implemented.

The identification of pathology-causing agents is critical for the development of preventive measures.

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AUTHOR CONTRIBUTION STATEMENT

Research conception and design: CAMH, JJZV, EOPP; data analysis and interpretation: CAMH, JJZV, EOPP; redaction of the manuscript: CAMH, JJZV, EOPP.

CONFLICT OF INTEREST STATEMENT

The authors state there are no conflicts of interest whatsoever.