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Review Article

Dynamics of Antibiotic Prescription, Self-Medication and Bacterial Resistance in the Pediatric Population: A Multidimensional Study of Public and Private Health Centers in the Province of Chincha

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Abstract:

This comprehensive technical report presents an in-depth analysis of the pharmacological management of Acute Respiratory Infections (ARIs) in the pediatric population of Chincha Province, Ica Department, Peru. The research examines the operational and clinical dichotomy between public sector facilities (Ministry of Health - MINSA and Social Security Health Insurance - EsSalud) and private healthcare infrastructure (clinics, polyclinics, and medical centers), evaluating prescribing patterns, adherence to national and international Clinical Practice Guidelines (CPGs), and the impact of self-medication facilitated by pharmacies.

The findings reveal a silent but growing public health crisis. While the public sector struggles with adherence to protocols due to overcrowded healthcare facilities and limitations in rapid microbiological diagnostic tools, the private sector shows a trend toward overprescribing broad-spectrum antibiotics (third-generation cephalosporins and macrolides), driven by implicit economic incentives and the cultural demand for a "quick cure" from parents. We documented alarming rates of self-medication in districts such as Sunampe and Grocio Prado, exceeding 88%, and a sustained increase in bacterial resistance, particularly in Escherichia strains. Extended-Spectrum Beta-lactamase (ESBL) -producing coli and Staphylococcus methicillin -resistant aureus (MRSA), exacerbated after the COVID-19 pandemic. This report proposes a roadmap for regulatory and educational intervention, essential to preserving therapeutic efficacy in the region.

Keywords: blood transfusion safety; electronic identification systems; barcoding; radiofrequency identification (rfid); cost effectiveness; patient safety; blood transfusion errors

Chapter I: Introduction and Contextual Framework of the Resistance Crisis

1.1. Antimicrobial Resistance: A Global Threat with Local Repercussions

Antimicrobial resistance (AMR) has ceased to be an apocalyptic prediction and has become a tangible clinical reality that threatens the foundations of modern medicine. The World Health Organization (WHO) has listed AMR as one of the top ten threats to global public health, projecting that by 2050 it could cause more deaths than cancer if immediate corrective measures are not taken.^[1] In the Latin American context, and specifically in Peru, this phenomenon has reached critical dimensions, exacerbated by fragmented health systems, lax regulations on drug dispensing, and sociocultural factors that favor the indiscriminate use of medications.^[2]. The "post-antibiotic era," where common infections and minor injuries can once again become fatal, is a scenario already emerging in intensive care units and outpatient clinics in the Ica region. The loss of efficacy of first-line antibiotics, such as amoxicillin and cotrimoxazole , is forcing healthcare professionals to resort to second- and third-line therapies, which are more expensive, have greater adverse effects, and often require hospitalization.^[4] This report focuses on the province of Chincha, a microcosm representative of the Peruvian healthcare system, where the interaction between public and private healthcare providers creates a complex ecosystem of antimicrobial use.

1.2. Problem Statement in Chincha: The Link between Prescription and Resistance

In the province of Chincha, the management of infectious diseases in childhood faces structural challenges. Inappropriate antibiotic prescription for acute respiratory infections (ARIs) of viral etiology is an endemic practice. Despite compelling scientific evidence indicating that more than 80-90% of pharyngitis, bronchitis, and rhinopharyngitis in children under five years of age are caused by viruses (rhinovirus, respiratory syncytial virus, influenza, adenovirus), the antibiotic prescription rate in local clinics remains disproportionately high. ⁵.

This prescribing behavior is not uniform; it varies significantly depending on the setting in which care is provided. The central hypothesis of this analysis suggests that divergent incentives exist between the public and private sectors in Chincha that perpetuate the misuse of antibiotics. While public sector physicians often prescribe defensively due to a lack of follow-up and diagnostic resources, private sector physicians face pressure to satisfy clients and the perception of immediate effectiveness [7]. Added to this is the role of pharmacies and drugstores, which in districts such as Chincha Alta, Sunampe, and Pueblo Nuevo act as the first point of contact for healthcare, dispensing antibiotics without a prescription based on the recommendations of unqualified technical personnel [9].

1.3. Epidemiological and Social Justification

Acute respiratory infections are the leading cause of morbidity in children under five years of age in the department of Ica. ¹¹ Epidemiological bulletins from the Regional Health Directorate (DIRESA) of Ica confirm that the districts of Chincha Alta and Grocio Prado consistently present high incidence rates of ARI, associated with climatic factors (high humidity), environmental pollution, and housing conditions. ¹²

The social cost of bacterial resistance in this population is incalculable. A child colonized by multidrug-resistant bacteria (such as ESBL-producing E. coli or MRSA) due to prior and unnecessary antibiotic use has a significantly higher risk of treatment failure if they develop a subsequent serious bacterial infection, such as pyelonephritis or complicated pneumonia. ¹⁴ Furthermore, the economic impact on families in Chincha is considerable, given that out-of-pocket expenses for brand-name medications and private consultations increase due to the ineffectiveness of initial treatments. ¹⁶

Chapter II: Characterization of the Health Ecosystem in Chincha

The healthcare system in Chincha is dual and fragmented, which directly impacts the quality of prescriptions and access to accurate diagnoses. Analyzing this infrastructure is vital for understanding patient flows and treatment decisions.

2.1. The Public Sector: MINSA and EsSalud

The public sector in Chincha is primarily represented by the network of facilities belonging to the Ministry of Health (MINSA) and the Social Health Insurance (EsSalud). These centers form the backbone of healthcare for the low- and middle-income population.

• **Infrastructure and Resources:** Primary healthcare facilities (health posts and centers in districts such as El Carmen, Alto Larán, or Sunampe) often have limited capacity. They frequently lack microbiology laboratories capable of performing cultures or rapid antigen detection tests (for example, for Streptococcus). pyogenes), which forces the physician to base their diagnosis exclusively on clinical observation [17].

• **Protocols and Restrictions:** Prescribing in these centers is strictly governed by the National List of Essential Medicines (PNUME). This, in theory, promotes rational use by limiting the availability of broad-spectrum antibiotics not indicated for primary care. However, the lack of therapeutic options and the pressure to "resolve" the condition in a 15-minute consultation often led to the empirical prescription of amoxicillin or cotrimoxazole, even when viral suspicion is high [19].

• **Overcrowding:** The high demand for care at hospitals such as Hospital San José (a MINSA referral hospital) and Hospital René Toche Groppo (EsSalud) generates long waiting times, which encourages parents to seek faster alternatives in the private sector or at pharmacies [21].

2.2. The Private Sector: Clinics and Medical Centers

The private sector in Chincha has experienced remarkable growth, offering an alternative for those who can afford it or have private insurance. Key institutions identified in the region include:

In this sector, the prescribing dynamic is different. There is greater availability of brand-name and latest-generation drugs. Physicians, often specialists or general practitioners with experience in the private sector, may feel pressure to prescribe "stronger" treatments to ensure the satisfaction of the parent, who often associates the prescription of an expensive antibiotic with quality care [9].

2.3. The "Gray Sector": Pharmacies and Drugstores

The network of pharmacies and drugstores in Chincha is extensive and widespread, reaching areas where medical services are scarce. In districts like Sunampe and Pueblo Nuevo, these pharmacies effectively serve as primary care centers.

• The Pharmacist as Prescriber: Local studies indicate that a large proportion of the population goes directly to the pharmacy at the first sign of an acute respiratory infection (ARI). Pharmacy staff, often technicians rather than licensed pharmacists, recommend and dispense antibiotics without a prescription, contravening national regulations. 9

• Perverse Incentives: There is evidence of economic incentives (the " push" therapy " by laboratories and pharmaceutical chains so that pharmacy employees recommend certain brands of antibiotics, prioritizing sales over clinical indication. 28

Chapter III: Epidemiology of Respiratory Infections in Children of Chincha

To understand the use of antibiotics, we must first understand the burden of disease that motivates the consultation.

3.1. Respiratory Morbidity Profile (2023-2024)

According to epidemiological surveillance reports, ARIs consistently represent the number one cause of outpatient and emergency visits in pediatrics in the Ica region.

• **Rhinopharyngitis (Common Cold):** This is the most frequent pathology, responsible for approximately 40-50% of consultations for acute respiratory infections (ARIs). Its etiology is viral in almost 100% of cases (Rhinovirus, seasonal Coronaviruses).

• **pharyngotonsillitis:** Presents a diagnostic challenge. Although only 15-30% of cases in children are bacterial (caused by Streptococcus). pyogenes), the antibiotic prescription rate for this diagnosis in Chincha exceeds 70-80% in the private sector. 12

• **Bronchitis and Bronchiolitis:** Predominantly viral conditions (Influenza, Parainfluenza, RSV) that, nevertheless, frequently receive antibiotic coverage under suspicion of bacterial superinfection, often without radiological or laboratory evidence [29].

Pathology	Predominant Etiological Agent	Estimated Antibiotic Prescribing Rate (Public)	Estimated Antibiotic Prescription Rate (Private)	Actual Clinical Justification
Acute Rhinopharyngitis	Viral (Rhinovirus, Coronavirus, Adenovirus)	20% - 30%	40% - 55%	None (except for complications such as otitis media)
Pharyngotonsillitis	Viral (70-80%) / *S. pyogenes* (20-30%)	55% - 65%	> 85%	Indicated only if bacterial (Centor Criteria /Culture)
Acute Bronchitis	Viral (Influenza, Parainfluenza, RSV)	35% - 45%	65% - 80%	Generally, not indicated (self-limited)
Acute Otitis Media	Viral/Bacterial (*S. pneumoniae*, *H. influenzae*)	75% - 85%	> 95%	Indicated according to severity and age (<2 years)
Pneumonia	Viral (RSV, Influenza) / Bacterial (*S. pneumoniae*)	> 95%	100%	Indicated (mandatory empirical treatment)

Table 1: Estimated Epidemiological Profile of Respiratory Infections in Children Under 5 Years Old (Chincha/Ica, 2023-2024).

Source: Prepared by the authors based on regional trends, local prescribing studies, and data from the CDC in Peru. 12

3.2. Impact of the COVID-19 Pandemic on the Virological Profile

The COVID-19 pandemic significantly altered the circulation of respiratory viruses. Following the lifting of isolation measures, Chincha, like the rest of Peru, experienced a resurgence of influenza and respiratory syncytial virus (RSV) cases in 2023 and 2024. This phenomenon, known as "immunological debt," led to more severe respiratory illnesses in children who had not previously been exposed to these pathogens. Clinically, this translated into increased parental anxiety and a greater demand for antibiotics, leading to the misdiagnosis of severe viral infections as bacterial infections. ²⁹

Chapter IV: Prescribing Patterns: A Comparative Analysis

Prescribing an antibiotic is not only a clinical act, but also a social and economic one. In Chincha, the differences between the public and private sectors are stark and revealing.

4.1. Public Sector: The Protocolized but Limited Prescription

In the MINSA and EsSalud health centers in Chincha, prescription patterns are characterized by:

1. Penicillin Dominance: Amoxicillin is the most prescribed antibiotic, followed by Benzathine Penicillin G (for streptococcal pharyngotonsillitis) and Cotrimoxazole (although its use has decreased due to high rates of resistance) [11].

2. Adherence to National Guidelines: There is greater formal adherence to the MINSA Clinical Practice Guidelines, which recommend amoxicillin as first-line treatment for most uncomplicated bacterial respiratory infections [32].

3. Diagnostic Gaps: The lack of rapid tests (streptotest, viral PCR) in public primary care leads to "empirical prescribing due to uncertainty." Faced with doubt as to whether a high fever is due to influenza or a bacterial infection, and given the impossibility of close follow-up (due to access barriers), the physician opts to prescribe antibiotics to "cover up" the patient [17].

4.2. Private Sector: The Prescription of "High-End" Products and Marketing

In private clinics and private practices in Chincha, a shift in the prescriptive profile is observed:

1. Use of Cephalosporins and Macrolides: It is common to find prescriptions for Cefixime, Cefuroxime, and Azithromycin as first-line treatments for conditions that, according to guidelines, should be treated with amoxicillin or symptomatic management. The use of intramuscular Ceftriaxone for "severe flu" is a widespread and culturally accepted practice in the private sector, perceived as a more "potent" intervention [5].

2. Brand Influence: Prescriptions for brand-name medications predominate over those for generics. This reflects the perception of superior quality among physicians and patients, as well as the promotional strategies of the pharmaceutical industry, which regularly visits these offices [31].

3. Defensive Medicine and Satisfaction: Private physicians often prescribe antibiotics to meet the expectations of parents, who may feel the consultation "wasn't worth it" if they are only prescribed paracetamol and fluids. The antibiotic acts as a psychological placebo for parental anxiety [6].

Post-COVID Azithromycin Phenomenon

A critical issue in Chincha is the excessive use of azithromycin. During the COVID-19 pandemic, this drug was included in treatment kits and became extremely popular. Despite evidence ruling out its effectiveness against COVID-19, the population of Chincha incorporated azithromycin into their mental medicine cabinet as a standard remedy for any respiratory ailment. In the period 2023-2024, it was observed that many parents administered azithromycin to their children before attending a doctor's appointment, or explicitly requested it from the doctor or pharmacist. This massive and unnecessary use (given that most respiratory pathogens are viral or require beta-lactams) is exerting tremendous selective pressure on bacteria such as Streptococcus. pneumoniae in the community.5

Chapter V: Self-Medication: The Hidden Engine of Resistance in Chincha

Self-medication is not a marginal phenomenon in Chincha; it is a central practice in health-seeking behavior.

5.1. Prevalence and Local Reality

Recent studies conducted in pharmacies in the districts of Sunampe and Grocio Prado reveal alarming figures. A 2023 investigation at the "J and M" pharmacy in Sunampe found a self-medication prevalence of 88.9% among the adult population, who often purchase medications for their young children. ^[37] Another study in Chincha Alta corroborated this trend, reporting that more than 80% of pharmacy users acquire antibiotics without a prescription. ^[27]

Factor	Description of Local Impact
Economic	Pharmacy consultations are free. Avoid clinic co-payments or transportation costs and waiting times at public hospitals.
Cultural	Deep-seated belief that antibiotics "cut off the infection" or "dry up the phlegm." Previous use of old prescriptions for similar symptoms.
Access	High density of pharmacies and drugstores in urban and peri-urban areas of Chincha. 24/7 availability.
Pharmaceutical Counseling	Pharmacy technicians recommend antibiotics in more than 70% of cases of respiratory symptoms (cough, sore throat). [9]

Table 2: Factors Associated with Self-Medication with Antibiotics in Chincha

5.2. The Role of Pharmacies and Small-Dose Sales

A particularly harmful practice observed in Chincha is the sale of antibiotics in smaller quantities. Due to financial constraints, many parents buy only two- or three-days' worth of antibiotics (what they can afford that day) instead of the full 7- or 10-day course. Pharmacies accept this practice to avoid losing customers.

This creates an ideal biological scenario for resistance: the pathogen is exposed to the antibiotic, but not eradicated, allowing surviving bacteria to develop and transmit resistance mechanisms [10].

Chapter VI: Bacterial Resistance: Mechanisms and Local Profile

The inappropriate use of antibiotics in the public and private sectors, coupled with widespread self-medication, has created a worrying profile of bacterial resistance in the Ica region.

6.1. Predominant Resistance Mechanisms

Microbiological research in hospitals in the region identifies specific molecular mechanisms that are proliferating:

1. Extended-Spectrum Beta-Lactamases (ESBLs): Present mainly in enterobacteria such as Escherichia coli and Klebsiella pneumoniae. These enzymes hydrolyze penicillins and cephalosporins (including third- and fourth-generation cephalosporins), leaving very limited oral options. In Ica, the prevalence of ESBL-producing E. coli in pediatric urine cultures is estimated to be between 40% and 50%. 39

2. Methicillin Resistance (mecA gene): In Staphylococcus aureus (MRSA). This mechanism alters the penicillin-binding protein 2a (PBP2a), conferring resistance to all beta-lactams. An increase in community-acquired MRSA (CA-MRSA) skin and soft tissue infections has been documented in children on the Peruvian coast. 15

3. Macrolide Resistance: In Streptococcus pneumoniae and S. pyogenes, mediated by ribosomal methylation (erm) mechanisms or efflux pumps (mef). The massive use of azithromycin post-COVID has presumably triggered this resistance, although precise local molecular surveillance data in Chincha are lacking to quantify the exact current magnitude. 36

6.2. Surveillance Data in Hospitals of Ica (2023-2024).

The analysis of bacterial isolates in reference hospitals in Ica (such as the Ica Regional Hospital) shows a grim picture that can be extrapolated to the hospital reality of Chincha:

• Escherichia coli:

Ampicillin Resistance: > 70-80% (Practically useless empirically).

Ciprofloxacin resistance: > 50-60% (Very high for empirical use in complicated UTI).

Ceftriaxone resistance (ESBL marker): > 40-50%. 14

• Klebsiella pneumoniae:

High ESBL rate.

The worrying emergence of resistance to carbapenems (KPC or NDM-type enzymes), although still at low percentages (<10%), represents a lethal threat given the lack of advanced therapeutic options (such as ceftazidime-avibactam) in provincial hospitals. 42

Microorganism	Antibiotic	Resistance Rate (%)	Clinical Implication
E. coli	Ampicillin	70 - 85%	Do not use empirically.
E. coli	/ Clavulanic Acid	30 - 45%	Use with caution.
E. coli	Ciprofloxacin	50 - 65%	Not recommended for pediatric use (safety/resistance).
E. coli	Ceftriaxone	40-50%	High suspicion of ESBL; risk of therapeutic failure.
S. aureus	Oxacillin (Methicillin)	25 - 35%	Consider Clindamycin or Vancomycin if risk factors are present.
S. pneumoniae	Oral Penicillin	30-40%	Intermediate resistance; increase dose or switch to Amox .
S. pneumoniae	Macrolides (Azithromycin)	> 40%	Do not use as empirical monotherapy in pneumonia.

Table 3: Estimated Resistance Profile for Key Pathogens in Ica (Pediatrics/Adults)

Source: Synthesis of extrapolated regional and national surveillance data [39].

Chapter VII: Regulatory, Ethical and Research Aspects

7.1. The Legal Framework and its (Non)Compliance

Peru has Law No. 29459 and various Technical Health Standards that regulate the prescription and dispensing of medications. A prescription is required for the sale of antibiotics.20 However, the gap between the law and reality in Chincha is wide. Oversight of pharmacies by the Regional Health Directorate (DIRESA) or municipalities is sporadic and insufficient to control the vast number of pharmaceutical establishments. Furthermore, there are no effective mechanisms for immediate sanctions against "suggested dispensing" by pharmacy technicians.

7.2. The Need for Research Ethics Committees (RECs)

To generate high-quality local evidence to combat this problem, rigorous clinical and epidemiological research in Chincha is imperative. This requires the operation of Research Ethics Committees (RECs) accredited by the National Institute of Health (INS).

Currently, conducting clinical trials or complex observational studies in hospitals like San José or in private clinics requires the approval of an accredited IRB to ensure the protection of participants (especially children, considered a vulnerable population) through appropriate Informed Consent and Assent processes.45 The lack of strengthened local IRBs limits Chincha's capacity to lead its own resistance studies, depending on data from Lima or Ica city.48

Chapter VIII: Discussion and Synthesis

The situation in Chincha reflects a systemic failure in the drug use chain.

1. Failure at the Origin (Community): The lack of health education leads parents to demand antibiotics and self-medicate their children, valuing speed over safety.

2. Failure at the Point of Sale (Pharmacies): Commercial interest and lack of ethics/regulation turn pharmacies into indiscriminate dispensers of antibiotics, often in sub-therapeutic doses.

3. Failure in the Consultation (Doctors):

In the private sector: Economic incentives and defensive medicine drive the use of broad-spectrum and brand-name antibiotics.

In the Public Sector: The lack of diagnostic tools and time encourages empirical prescription for "safety".

The result is a vicious cycle where bacterial resistance increases, causing cheap and safe antibiotics to stop working, which in turn (erroneously) justifies the use of more expensive and powerful antibiotics, restarting the cycle.

Chapter IX: Conclusions and Strategic Recommendations

9.1. Conclusions

1. Duality of the Problem: The irrational use of antibiotics in Chincha is a hybrid phenomenon: in the public sector it is a problem of resources and diagnosis; in the private sector, it is a problem of commercial incentives and patient expectations.

2. Self-medication as a Crisis: With rates close to 90%, self-medication in pharmacies in Chincha is probably the biggest driver of selective pressure of resistance in the community, surpassing even medical prescription.

3. Critical Resistance: The loss of efficacy of third-generation cephalosporins against E. coli and the emergence of community MRSA in Ica place the region in a vulnerable situation in the face of serious bacterial outbreaks.

4. Post-Pandemic Effect: The normalization of Azithromycin use post-COVID has created a dangerous consumption habit that must be actively dismantled.

9.2. Recommendations

A. For the Health Authorities (DIRESA Ica / MINSA)

1. Implementation of Rapid Diagnosis: Equip the I-3 and I-4 health centers of Chincha with rapid antigen tests for Streptococcus pyogenes and Influenza. This would allow bacterial infections to be ruled out in minutes and drastically reduce antibiotic prescriptions.

2. Intelligent Inspection: Conducting surprise operations with "simulated patients" in pharmacies in Chincha to penalize the sale of antibiotics without a prescription and the sale of fractional doses.

3. Sentinel Surveillance: Establish a sentinel laboratory in Chincha that reports local resistance profiles monthly, allowing doctors to adjust their empirical treatments with data from their own province, not from Lima or abroad.

B. For the Private Sector (Clinics and Medical Offices)

1. Antimicrobial Stewardship Programs (ASPs): Clinics should implement internal prescription audit programs (ASPs) as a standard of quality and patient safety. 19

2. Patient Education: Include in private consultations education on the viral nature of infections and the risks of resistance, as an added value of "good medical practice".

C. For Civil Society and Academia

1. Local Research: Promote theses and studies in universities in Ica on the use of antibiotics and resistance in Chincha, under the supervision of accredited Ethics Committees.

2. "Less is More" Campaign: Launch a mass communication campaign in Chincha aimed at parents: "Antibiotics don't cure the flu; love and care do."

Final Note: This report has been prepared with a technical and scientific approach, integrating clinical, microbiological and socio-health data available up to the year 2025. The mention of specific private institutions is for descriptive purposes of the local health ecosystem, based on their relevance in the provision of services in the province.

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