ESCUELA DE GOBIERNO
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A Systematic Analysis of Antimicrobial Stewardship Programs across Chilean Hospitals: A Mixed-Methods Study

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2. Introduction
3. Research Objectives
4. Methods
5. Key Findings
6. Discussion
7. Conclusions and Limitations

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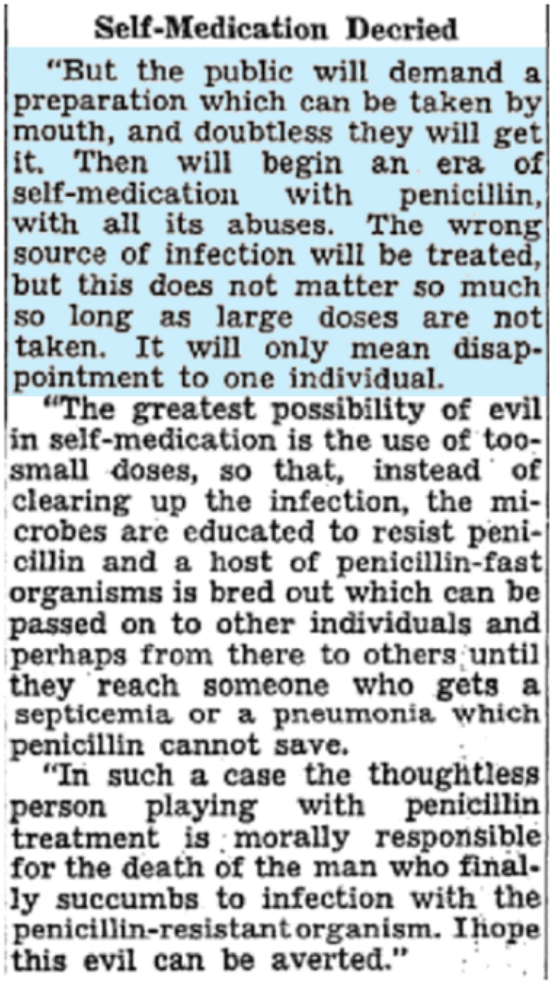


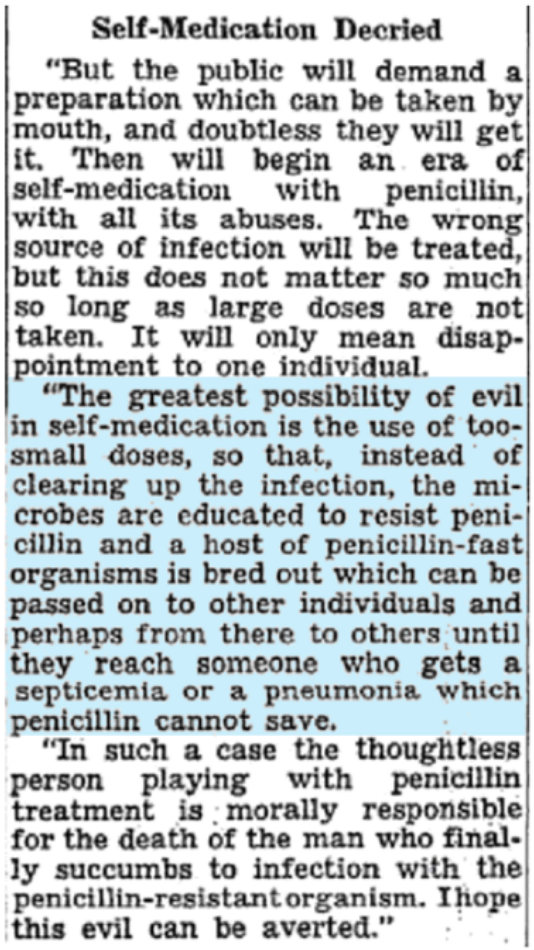
Self-Medication Decried

"But the public will demand a preparation which can be taken by mouth, and doubtless they will get it. Then will begin an era of self-medication with penicillin, with all its abuses. The wrong source of infection will be treated, but this does not matter so much so long as large doses are not taken. It will only mean disappointment to one individual.

"The greatest possibility of evil in self-medication is the use of too-small doses, so that, instead of clearing up the infection, the microbes are educated to resist penicillin and a host of penicillin-fast organisms is bred out which can be passed on to other individuals and perhaps from there to others until they reach someone who gets a septicemia or a pneumonia which penicillin cannot save.

"In such a case the thoughtless person playing with penicillin treatment is morally responsible for the death of the man who finally succumbs to infection with the penicillin-resistant organism. I hope this evil can be averted."

- Public demand for oral antibiotics is inevitable.
- Will lead to self-medication.



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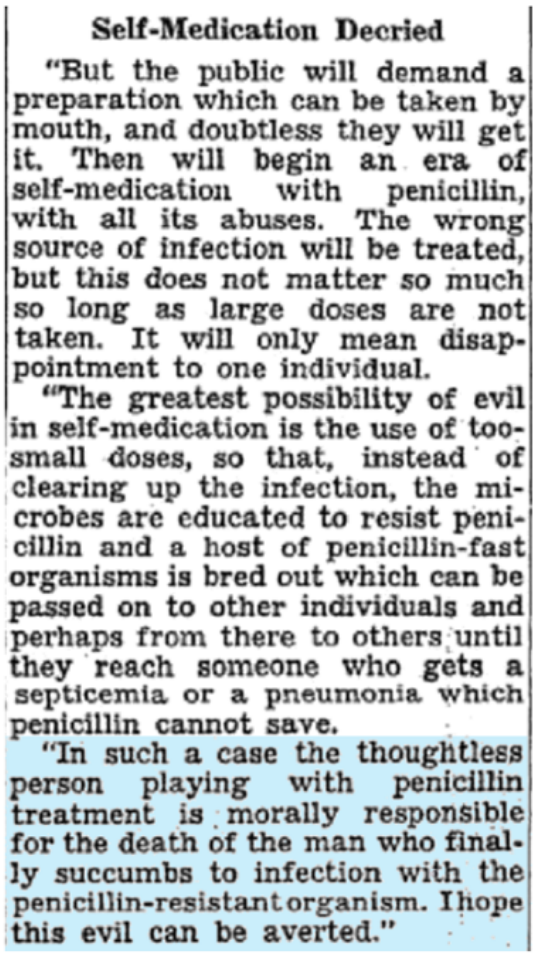
- The use of inadequate (small) doses that, instead of curing the infection, create bacteria resistant to penicillin.
- These resistant bacteria can be transmitted between people, potentially causing life-threatening infections such as septicemia or pneumonia.



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- Those who use penicillin irresponsibly become morally responsible for deaths caused by penicillin-resistant organisms.
- Concludes with the hope that this harm can be prevented.

The New York Times

26 de Junio
De 1946
Página 21

PENICILLIN'S FINDER ASSAYS ITS FUTURE

Sir Alexander Fleming Says Improved Dosage Method Is Needed to Extend Use

Sir Alexander Fleming, discoverer of penicillin, said last night that a better method of administering the drug than by injection every two or three hours as at present was needed to extend its use. The British scientist warned, however, in speaking at a dinner in his honor in the Hotel Waldorf-Astoria, that administration by mouth would lead to "self-medication and all its abuses."

He gave full credit to the American Pharmaceutical Manufacturers Association for the "phenomenal increase in production" of penicillin to the point where it was obtainable by all persons who needed it. He spoke with regret of attempts in England and America to patent penicillin.

The dinner, attended by 200 scientists who have worked with the drug, was arranged by Charles Pfizer & Co., Merck & Co. and E. R. Squibb & Sons, three of the pioneer manufacturers of the drug. Other speakers included Dr. Vannevar Bush, director of the Office of Scientific Research and Development, and Dr. A. N. Richards, chairman of its medical research committee.

Other Scientists Praised

Sir Alexander related the story of his discovery of penicillin in 1928 and praised Dr. Howard W. Florey and other scientists for their later development of the use of the drug to combat infections on the battlefield.

"As to the future," the speaker said, "we have been giving penicillin by injection every two or three hours. This has to be changed if penicillin is to be used generally in patients other than those who are desperately ill. The present method is effective but it is quite impracticable without hospitalizing the patient, and there is no need to hospitalize most of the patients.

"An injection once, or at the most twice, a day is possible, or it might be preferred to be taken by the mouth, like the sulfa drugs. From the doctor's point of view the injection method is preferable, for when it is injected he knows it gets into the bloodstream and so reaches the infection microbe.

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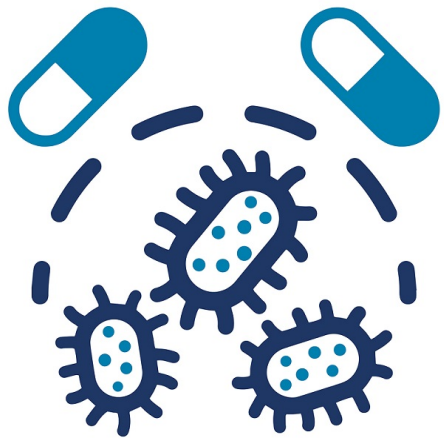
Global Context of AMR

- Antimicrobial resistance (AMR) is a critical public health threat.
- It occurs when bacteria and other microorganisms develop the ability to survive the medications designed to kill them.
- One of the main drivers of this growing crisis is the misuse and overuse of antibiotics in both human medicine and agriculture.



Deaths Attributable To AMR Every Year

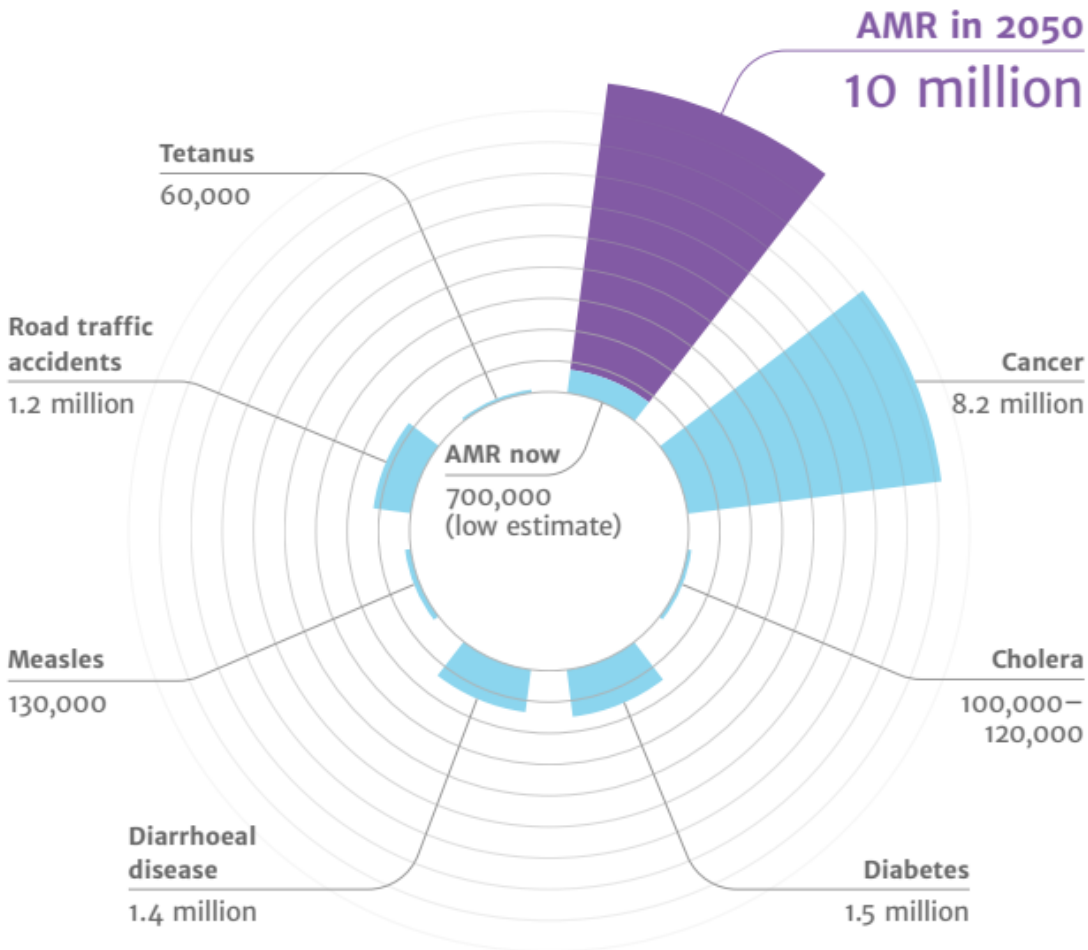


Figure: O'Neill, 2016

AMR Economic Impact Projection

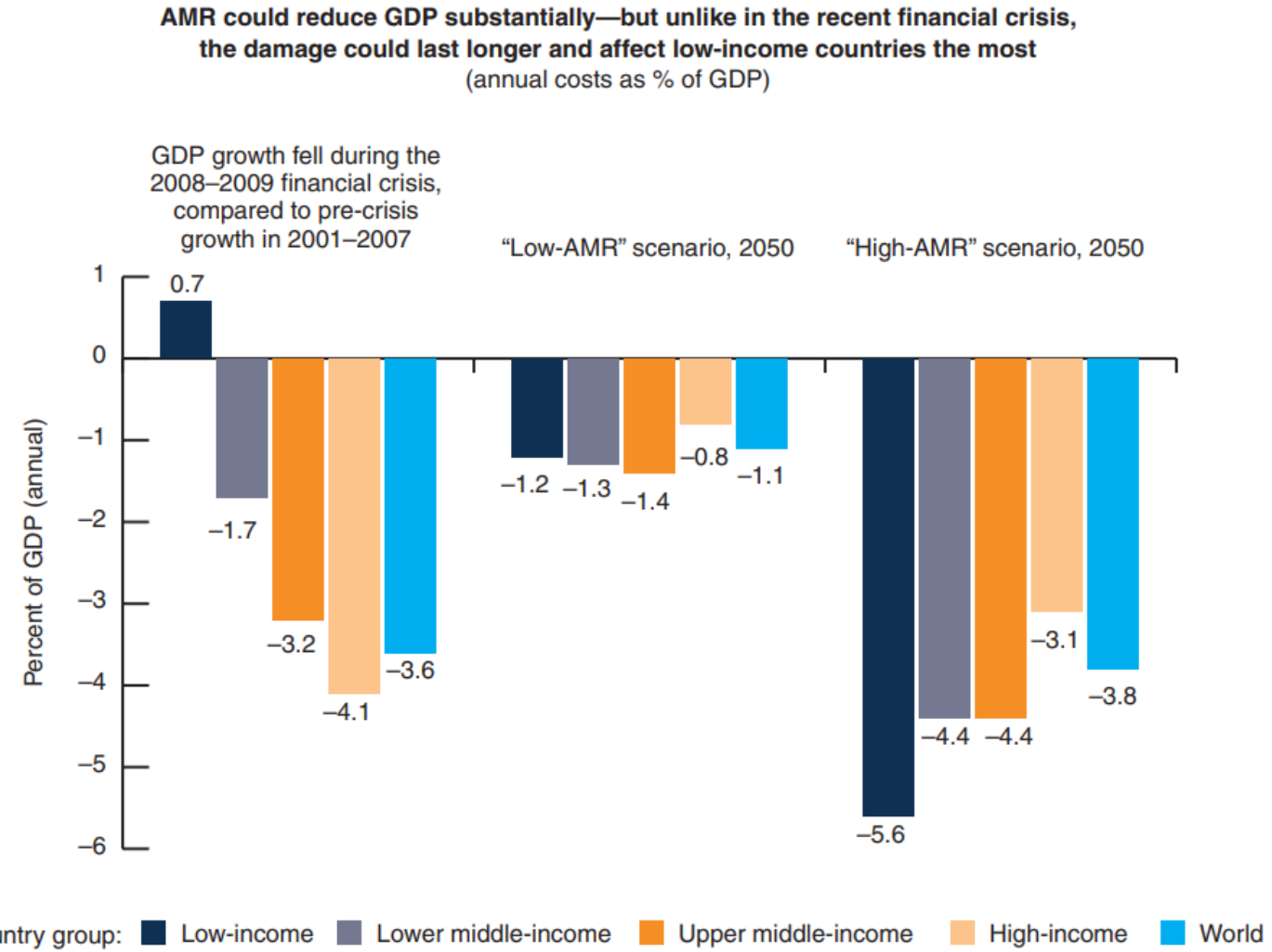


Figure: World Bank, 2017

Evolution of Antimicrobial Regulations in Chile

- **National Plan against AMR (2017)**
  - Promoted research in infection prevention
  - Developed public policies to address AMR
- **Second National Plan (2021-2025)**
  - Multi-ministerial approach (Education, Environment, Science)
- **Antimicrobial Stewardship Programs (AMS)**
  - Coordinated interventions for optimizing antimicrobial use

Antimicrobial Stewardship Programs (AMS)

- **AMS (Antimicrobial Stewardship) / PROA (Programas de Optimización de Antimicrobianos)**:
  - WHO-driven systematic approach to optimize antimicrobial use worldwide
  - Part of the Global Action Plan on Antimicrobial Resistance
  - Implemented across healthcare systems internationally
  - Established through Technical Standard No. 210 (December 2020)
  - Mandatory for medium and high-complexity hospitals

Core Components

- **Multidisciplinary Team**
  - Clinical Microbiologists
  - Infectious Disease Specialists
  - Clinical Pharmacists
- **Key Functions**
  - Antimicrobial use optimization
  - Resistance monitoring
  - Treatment guidance
  - Continuous education
- **Primary Goals**
  - Optimize antimicrobial prescribing practices
  - Reduce antimicrobial resistance
  - Improve patient outcomes
  - Ensure cost-effective treatment

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Study Aims

- Primary objectives:
  - Characterize AMS implementation in Chilean hospitals
- Secondary objectives:
  - Identify successful program implementation by developing a quality score
  - Analyze implementation barriers and facilitators

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Study Design

- National mixed-methods cross-sectional study (2023-2024)
  - 153 hospitals nationwide
  - 8 in-depth interviews with AMS leaders
- Methods:
  - Quality scoring system for program evaluation

AMS Questionnaire Overview

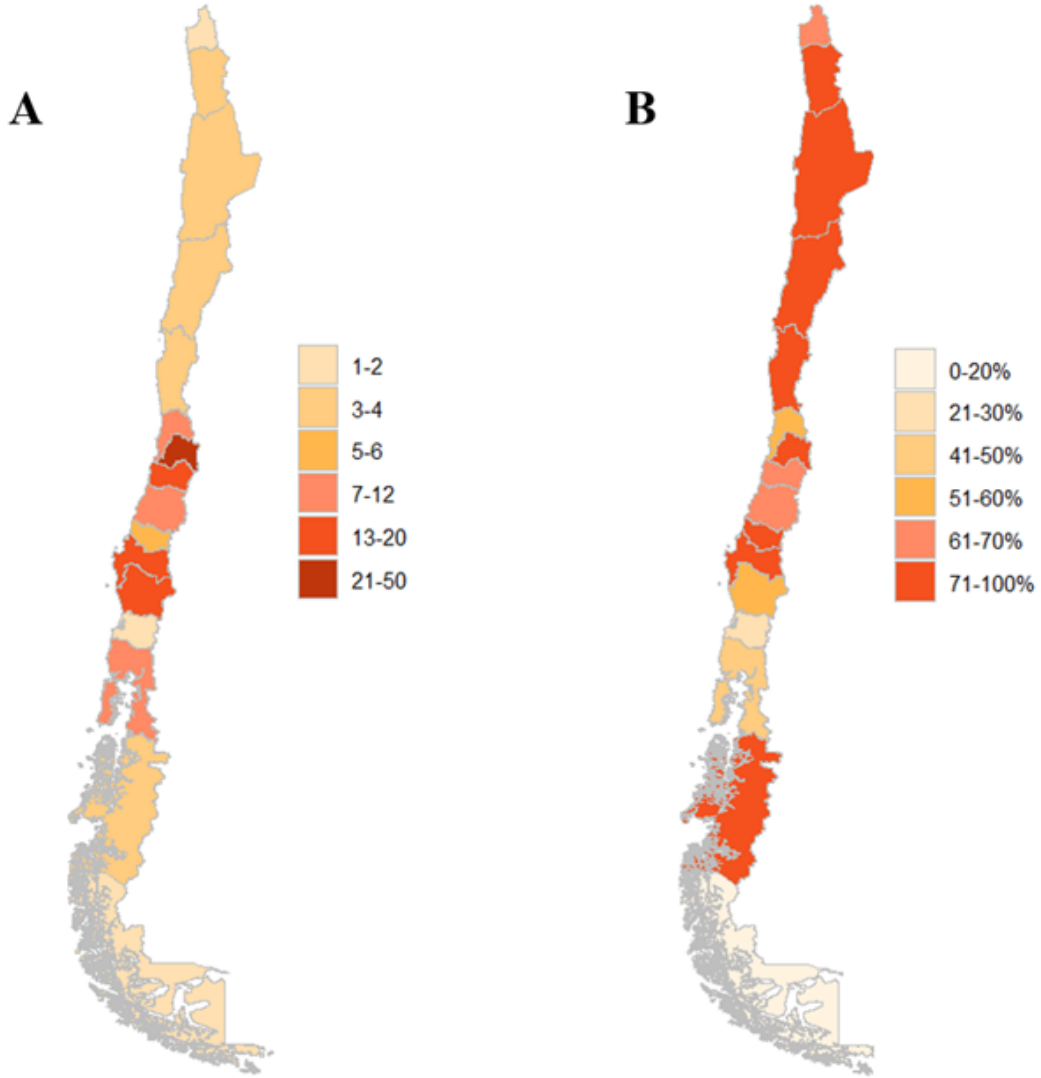
March 2023 - January 2024

- Comprehensive 10-domain questionnaire
- Based on AMS guidelines in collaboration with DESUC
- Piloted with Infectious Diseases (ID) physicians
- Web and phone survey with regular monitoring

Sample Characteristics

Category	With PROA	Without PROA	Total
Total	99 (64.7%)	54 (35.3%)	153 (100%)
Administration			
Public	80 (80.8%)	37 (68.5%)	117 (76.5%)
Private	19 (19.2%)	17 (31.5%)	36 (23.5%)
Complexity			
High	64 (64.6%)	6 (11.1%)	70 (45.8%)
Medium	23 (23.2%)	10 (18.5%)	33 (21.6%)
Low	12 (12.1%)	38 (70.4%)	50 (32.7%)

Geographic distribution of the participant hospitals



Analysis Methods

- Statistical analyses:
  - Multivariable regression (OLS)
  - Logit and probit models
- Qualitative analysis:
  - Thematic analysis

ASP Quality Score Components

- **Overview**
  - 30 binary questions across key domains
  - Raw score: 0-45 points (normalized to 0-100 scale)
- **Domain Weightings**
  - Leadership Support and Accountability (25%)
  - Policies to Improve Antimicrobial Prescribing (20%)
  - Pharmacist-Driven Interventions (15%)
  - Monitoring and Surveillance (15%)
  - Information and Feedback (15%)
  - Education on Antimicrobial Prescribing (10%)

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Quantitative Results: QS

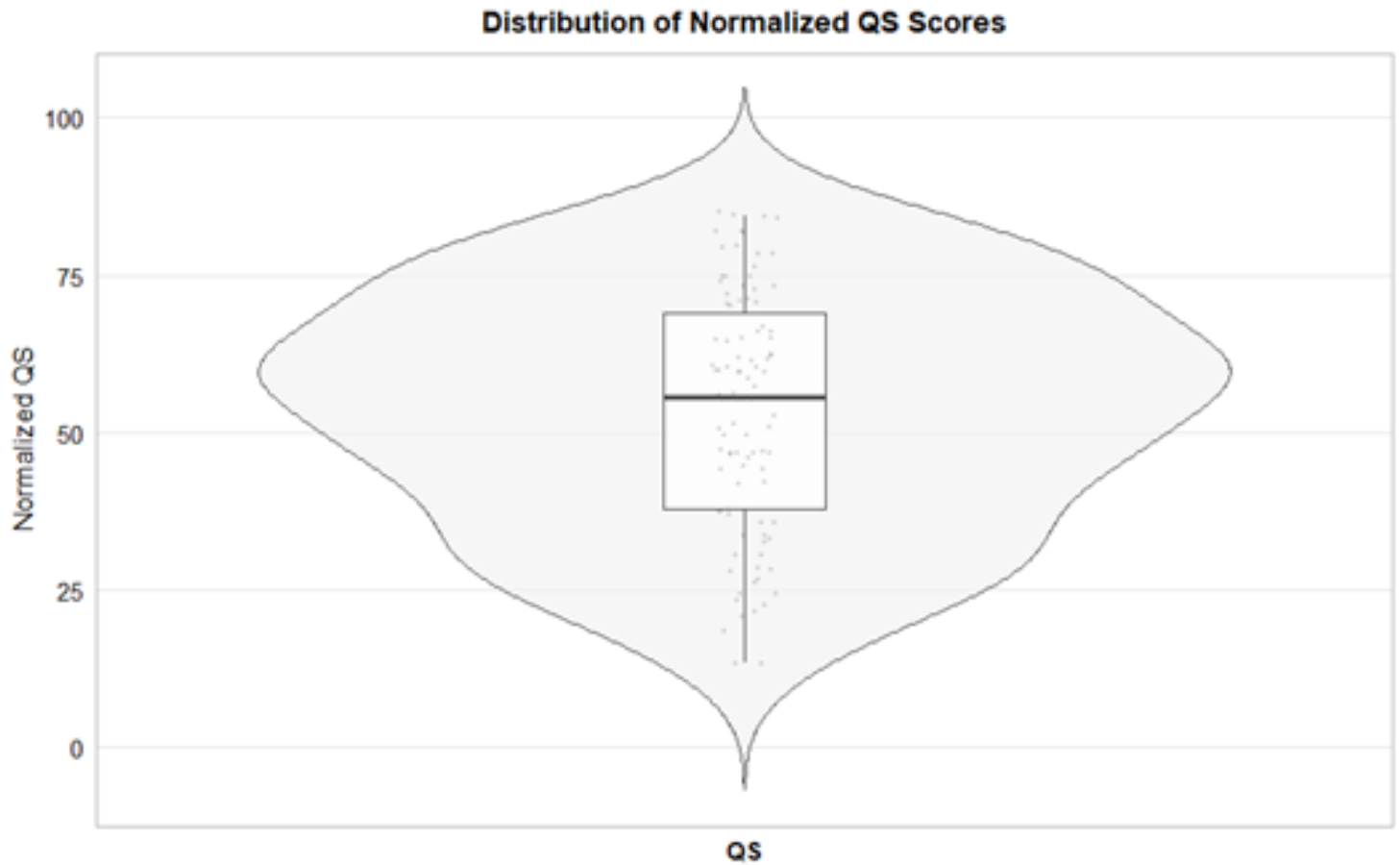

Figure: Violin plot showing the distribution of normalized QS values, with boxplot indicating median and IQR.

Quantitative Results: QS

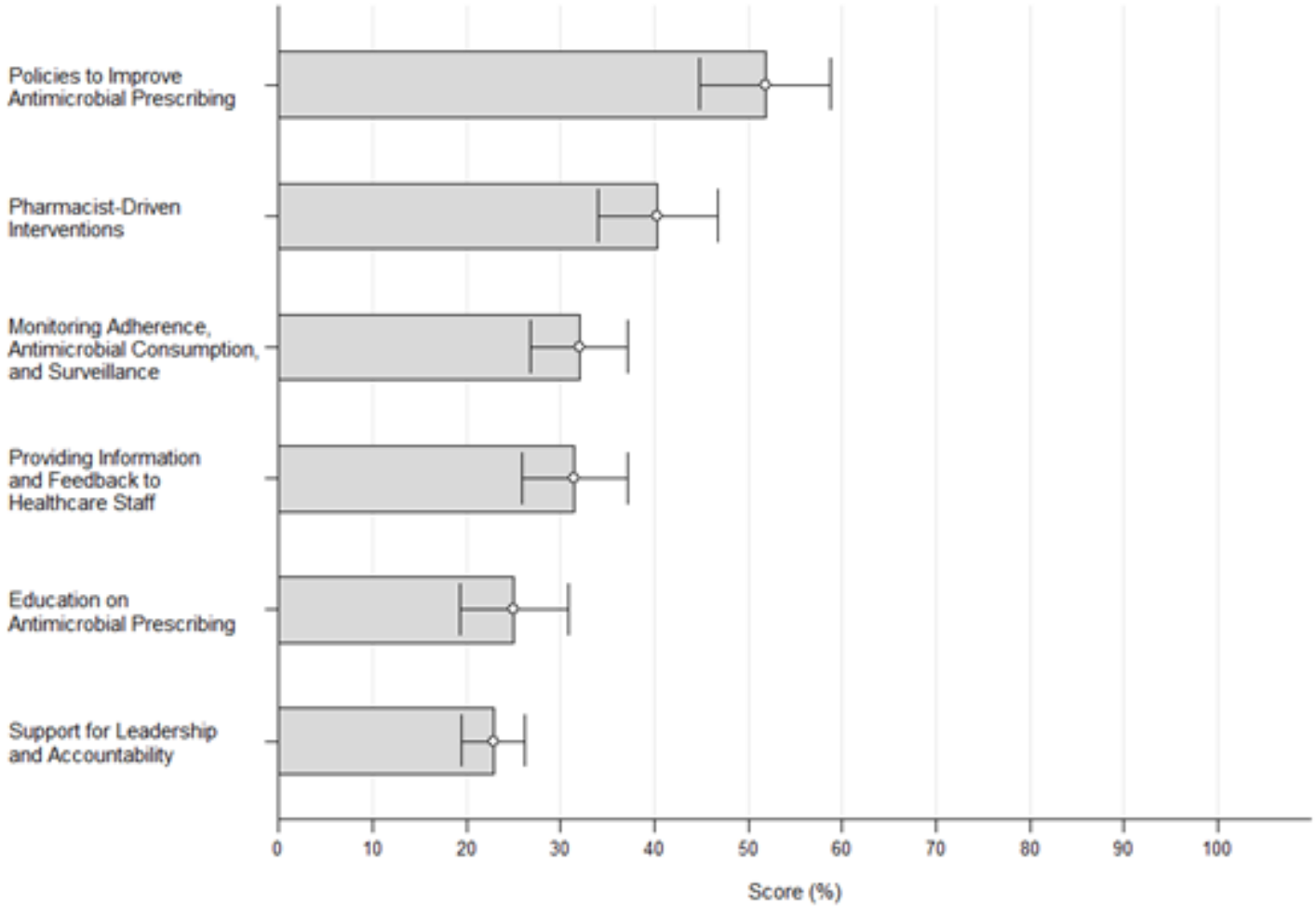

Figure: Mean scores (%) for antimicrobial stewardship strategies with 95% confidence intervals.

Regression Analysis Results (1/2)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Antimicrobials Requiring Authorization	0.32*** (0.058)	0.21*** (0.055)	0.21*** (0.056)	0.17** (0.057)	0.13* (0.057)
Hospital Complexity: Medium	—	-6.10*** (1.75)	-6.21*** (1.78)	-5.39** (1.75)	-5.55** (1.75)
Hospital Complexity: Low	—	-11.30*** (2.65)	-11.52*** (2.72)	-11.00*** (2.64)	-9.83*** (2.68)
Institution Type: Public	—	—	0.70 (1.84)	0.30 (1.79)	-0.22 (1.77)
Total Infections in ICU	—	—	—	0.040* (0.016)	0.038* (0.016)

Note: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05

Regression Analysis Results (2/2)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Years AMS: 1-3	—	—	—	—	2.33
					(1.58)
Years AMS: 3-5	—	—	—	—	3.59
					(3.23)
Years AMS: >5	—	—	—	—	5.17*
					(2.46)
Observations	99	99	99	99	99
Adj. R-squared	0.277	0.441	0.434	0.471	0.510
Residual SE	7.031	6.182	6.217	6.010	5.780
F Statistic	30.8***	21.49***	15.97***	14.91***	10.9***

Note: AMS = Antimicrobial stewardship program. Reference category for Hospital Complexity is High, for Institution Type is Private, and for Years AMS is <1 year. *** p<0.001, ** p<0.01, * p<0.05

Quantitative Results

- Quality Score correlations:
  - Higher with stricter antimicrobial controls
  - Better in high-complexity hospitals
  - Improved with program longevity
- Other findings:
  - No public/private difference
  - Positive correlation with ICU infection rates

Probability of Having an AMS Program - Main Effects

Variable	OLS		Logit		Probit	
	Without Controls	With Controls	Without Controls	With Controls	Without Controls	With Controls
HAI Program	0.574*** (0.158)	0.363*** (0.106)	2.858*** (1.076)	3.660*** (1.071)	1.703*** (0.564)	2.038*** (0.593)
Public Institution	—	0.224*** (0.076)	—	2.144** (0.947)	—	1.085** (0.492)
High Complexity	—	-0.229*** (0.083)	—	-1.937** (0.875)	—	-1.080** (0.458)
Medium Complexity	—	-0.611*** (0.082)	—	-4.224*** (0.814)	—	-2.376*** (0.418)

Note: Standard errors in parentheses. Reference categories: Private (Institution), Low (Complexity).

*** p<0.001, ** p<0.01, * p<0.05

Marginal Effects of HAI Program on AMS Implementation

- **Model Comparison**
  - OLS with controls: 0.3600 (36.00%)
- **Logit Model**
  - ME $= \hat{y}(1 - \hat{y})\beta$
  - is 0.3613
- **Probit Model**
  - ME $= \beta \cdot \phi(\beta X)$
  - 0.3726
- **Key Finding**
  - Presence of an HAI program increases probability of AMS implementation by approximately 36-37 percentage points
- **Model Consistency**
  - All three models show similar marginal effects
  - Results robust across different estimation methods

Key Themes from Qualitative Analysis (1/3)

Theme	Key Elements	Representative Quote
Resource Management	• Protected time • Resource allocation • Financial support	"I work 44 hours... these are 'protected' hours in quotation marks, so I feel that it's more about the team's willingness than actual established hours." —Medium complexity, Central region
Training & Development	• Knowledge gaps • Professional growth • Continuous education	"In terms of training, there hasn't been much... despite requesting formal training courses for the team, we haven't been able to obtain them." —Medium complexity, South Region

Key Themes from Qualitative Analysis (2/3)

Theme	Key Elements	Representative Quote
Professional Communication	• Cultural change • Team dynamics • Service coordination	"In the CCU, the AMS program is already well accepted... but there are other departments where the acceptance isn't as strong." —High complexity, North Region
Institutional Context	• Program monitoring • Implementation gaps • Guideline adaptation	"They issued guidelines, but no one is teaching us how we're going to be evaluated... When it comes to concrete details, how are you going to measure this?" —High complexity, Central Region

Key Themes from Qualitative Analysis (3/3)

Theme	Key Elements	Representative Quote
Leadership Commitment	• Team motivation • Strategic vision • Program advocacy	"It's really important that the person leading the team is passionate about the topic and has the motivation to do it, regardless of time constraints." —Medium complexity, Central Region
Stakeholder Engagement	• Administrative buy-in • Network collaboration • Program recognition	"After demonstrating that we had reduced the cost of antimicrobials... we received full support from the administration." —High complexity, Central Region

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Discussion: AMS Implementation Challenges

- **Main Challenges**
  - Limited resources and protected time (Appaneal et al., 2023; Pakyz et al., 2021)
  - Financial constraints: 62.5% of hospitals lack budgeted support (Chang et al., 2022)
  - IT infrastructure limitations affecting monitoring (Houng et al., 2023)
  - Medical staff resistance and communication barriers (Houng et al., 2023)
  - Training deficiencies aligned with Argentina study (Quiros et al., 2021)

Conclusions and Limitations

- **Key Conclusions**
  - Study provides comprehensive assessment of AMS implementation in Chilean hospitals
  - Success factors: leadership commitment, institutional support, standardized practices
  - Programs show potential for improvement with maturity (>5 years implementation)
  - Opportunity to strengthen programs through systematic evaluation and support
- **Study Limitations**
  - Self-reported data subject to social desirability bias
  - Quality score not adapted for low-complexity settings
  - Clinical outcomes not included in evaluation metrics

Acknowledgments

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- Research Team
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Thank you for your attention

Questions?

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