

# Antibiotic consumption in secondary and tertiary hospitals in Colombia: national surveillance from 2018–2020

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## ABSTRACT

**Objective.** To assess the compliance in secondary and tertiary level hospitals with monthly reporting of antibiotic consumption to the Colombian National Public Health Surveillance System (SIVIGILA-INS), and to describe reported antibiotic consumption during 2018–2020.

**Methods.** This study involved a secondary analysis of antibiotic consumption data reported to SIVIGILA-INS. Frequency of hospital reporting was assessed and compared against expected reports, disaggregated by intensive care units (ICU)/non-ICU wards and geographical regions. Consumption was expressed as defined daily dose (DDD) per 100 occupied beds for seven antibiotics.

**Results.** More than 70% of hospitals reported antibiotic consumption at least once in each of the three years (79% in ICU and 71% in non-ICU wards). Of these, ICU monthly reporting was complete (12 monthly reports per year) for 59% in the period 2018–2019 but only 4% in 2020. Non-ICU reporting was complete for 52% in 2019 and for 2% in 2020. Most regions had an overall decrease in reporting in 2020. Analysis of antibiotic consumption showed an increase for piperacillin/tazobactam, ertapenem, and cefepime from 2019 to 2020.

**Conclusions.** There were gaps in the consistency and frequency of reporting. Efforts are needed to improve compliance with monthly reporting, which declined in 2020, possibly due to the COVID-19 pandemic. Non-compliance on reporting and data quality issues should be addressed with the hospitals to enable valid interpretation of antibiotic consumption trends.

## Keywords

Anti-bacterial agents; prescription drug monitoring programs; patients' rooms; intensive care units; operations research, Colombia.

Surveillance of antibiotic consumption for human health is a key element in the global fight against antimicrobial resistance (AMR) (1). High-quality consumption data are required to monitor antibiotic stewardship, evaluate progress, and tailor policy at the local and national levels. Antimicrobial consumption monitoring is a relatively new activity in Colombia. A study in 2009 describing 10 Colombian high complexity

hospitals showed a decrease in the prescription of ciprofloxacin, the disuse of ceftazidime, and an increasing trend in the prescription of ampicillin/sulbactam, ceftriaxone, meropenem, piperacillin/tazobactam, and vancomycin (2).

In 2012, the Ministry of Health and Social Protection of Colombia launched a national pharmaceutical policy stressing the importance of containing antibacterial resistance and

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antimicrobial consumption. At that time, it was agreed that there should be gradual and sustained progress by 2021 in the implementation of the prevention and control program for healthcare-associated infections, in controlling AMR, and in reporting antibiotic consumption in 90% of tertiary and secondary level hospitals<sup>1</sup> (high and medium complexity institutions) (2, 3).

Consequently, the Ministry, with support from the National Institute of Health (INS), implemented surveillance strategies for healthcare-associated infections, antibiotic consumption, and AMR through the National Public Health Surveillance System (Sistema de Vigilancia en Salud Pública—SIVIGILA). The INS has implemented a monitoring program for the consumption of seven antibiotics in secondary and tertiary hospitals at a national level since 2012 (2). The antibiotic consumption surveillance reports from 2013 to 2017 showed variable consumption frequencies in intensive care units (ICU) and non-ICU services throughout the country. In ICUs, the predominant antibiotics used were meropenem, piperacillin/tazobactam, and vancomycin. In non-ICU settings, the consumption of ciprofloxacin and meropenem increased during this time (4).

Then, aligned with the Global Action Plan on Antimicrobial Resistance,<sup>2</sup> Colombia launched a national policy in 2018 that includes strategic interventions related to implementing antimicrobial consumption monitoring mechanisms and an activity named “strengthening surveillance of antimicrobial use at the hospital level” (5). The reports to SIVIGILA implemented previously meet this objective.

SIVIGILA-INS applies the World Health Organization (WHO) methodology to measure the consumption of antimicrobials. This methodology has two key components: i) a common metric to express consumption through a defined daily dose (DDD), and ii) the Anatomical Therapeutic Chemical (ATC) system as a global standard for classifying active ingredients for medical use. This standardized methodology facilitates comparisons between countries or regions. It also allows documentation of the impact of regulatory policies and interventions aimed at preventing excess antimicrobial use. Finally, the DDD consumption indicator can be interpreted as an approximation of the appropriate use of various medicines (6).

The same methodology is applied to calculate annual national consumption data. These annual reports include aggregated data on national drug sales for essential antimicrobials. This information is sent to the Ministry of Health and Social Protection by pharmaceutical laboratories and wholesale distributors throughout the country. Colombia began sharing its national consumption data in 2021 based on data collected in 2019. The country reported a total antimicrobial consumption of 18 DDD/1 000 inhabitants per day, corresponding to three ATC codes described as essential antimicrobial medicines: J01 (antibacterials for systemic use), P01AB (nitroimidazole derivatives, for diseases caused by protozoa), and A07AA (intestinal antibacterials). The predominant antibiotics were beta-lactams/

penicillin (6%–35%), macrolides/lincosamides (3%–17%), and quinolones (2%–13%) (7).

While the national DDD indicator was comparable to other Latin American countries (Argentina, Chile, Costa Rica, Paraguay, and Peru), the share of macrolides and quinolones was notably higher in Colombia than elsewhere. The intake of these last two antibiotic classes was the highest among the countries involved in the study (7). When analyzed using the WHO AWaRe<sup>3</sup> antimicrobial classification, 70% of the antimicrobials consumed belonged to the “Access” category, 29% to the “Watch” category, and 0.12% were “Reserve” antimicrobials. Antibiotics for hospital monitoring are included in the Watch category of this classification. These results by themselves do not place the country at an advantage or disadvantage, as the country-specific epidemiological context and its consumption history must be considered.

While this first report was able to provide national health authorities with a general overview of the country’s antimicrobial consumption profile, the National Response Plan to Antimicrobial Resistance emphasizes the need to complement it with high-quality data from different contexts such as private and public hospitals and the community (2, 5). The antibiotic consumption data provided by hospitals in the current SIVIGILA system can play a crucial role in this regard, since the use of antimicrobials in healthcare facilities contributes significantly to AMR (8, 9).

The analysis of antibiotic consumption at national and hospital levels should be used as additional information to propose strategies to optimize antimicrobial use in the country or specific regions. However, the usefulness of these data depends on the robustness of the monitoring system and the quality and consistency of the data that are submitted by the hospitals.

This study aimed to assess the compliance in secondary and tertiary level hospitals with monthly reporting of antibiotic consumption over a three-year period. The study also describes reported antibiotic consumption (in DDD/100 occupied beds) according to type of patient service and geographical region.

## MATERIALS AND METHODS

### Study design

This study was a descriptive secondary analysis of consumption data on seven antibiotics, from secondary and tertiary level Colombian hospitals, submitted via SIVIGILA-INS, from 2018 to 2020, for ICU and non-ICU wards. The database was shared by the Directorate of Epidemiology and Demography of the Ministry of Health and Social Protection of Colombia.<sup>4</sup>

### Study setting

At present, in the Colombian health system there are approximately 400 hospitals working at the tertiary level of complexity,

<sup>1</sup> Health services in Colombia are classified according to their complexity, which is defined based on the resources available, composition, organization, and structural and functional elements. According to the degree of complexity, the services are classified as: low (primary) complexity, medium (secondary) complexity, high (tertiary) complexity and combinations of these.

<sup>2</sup> The Global Action Plan provides the framework for national action plans to combat antimicrobial resistance. It sets out the key actions that the various actors involved should take, using an incremental approach over the next 5–10 years.

<sup>3</sup> WHO updated its Model List of Essential Medicines in 2017 and grouped antibiotics into Access, Watch, and Reserve (AWaRe) categories based on treatment profile and potential for development of resistance. Access: Indicates the antibiotic of choice for each of the 25 most common infections. These antibiotics should be available at all times, affordable, and quality-assured. Watch: Includes most of the “highest-priority critically important antimicrobials” for human medicine and veterinary use. These antibiotics are recommended only for specific, limited indications. Reserve: Antibiotics that should only be used as a last resort when all other antibiotics have failed.

<sup>4</sup> The dataset used in this article can be made available on request to the corresponding author.

funded through public or private resources (10). Tertiary level hospitals are obliged to report monthly data on beds available, beds occupied, and units dispensed of seven antimicrobials (cefepime, ceftriaxone, ciprofloxacin, ertapenem, meropenem, piperacillin, and vancomycin) to SIVIGILA, for ICU and non-ICU wards (i.e., maternity, general inpatient, surgery, and other wards, excluding emergency rooms) separately. These antibiotics were selected by the INS for consumption surveillance because they are the main antibiotics for clinical use in adult hospitalization services of high complexity health institutions (11). Currently, reporting to SIVIGILA is voluntary for secondary level hospitals and mandatory for tertiary level hospitals.

SIVIGILA is a software tool, developed by the INS, that has allowed the implementation of several epidemiological surveillance programs in the country. It is easy to use, and many hospital staff are familiar with it as a result of training efforts by the INS since the system came into operation in 2006. The reporting of antibiotic consumption through this system began in 2013 (2).

The AWaRe (Access, Watch, Reserve) classification of antimicrobials is a WHO initiative launched in 2017. The tool is primarily aimed at low- and middle-income countries and classifies 37 antibiotics that are frequently used to treat 26 common and severe infections. The classification is based on the antibiotics' potential to induce and propagate resistance, and it also identifies antibiotics that are priorities for monitoring and surveillance (11, 12).

### Source of data and variables

SIVIGILA reports include details of seven antibiotics (cefepime, ceftriaxone, ciprofloxacin, ertapenem, meropenem, piperacillin, and vancomycin) and their consumption in ICU and non-ICU services for adult patient care in secondary and tertiary hospitals across Colombia. Data for this study were obtained from the SIVIGILA-INS database for the years 2018, 2019, and 2020. The study variables for compliance of hospital submissions were year and month of reporting, by type of patient service, and administrative region of the country. In addition, for the consumption trend analysis from 2018 to 2020, DDD per 100 occupied beds reported for each antibiotic were analyzed as a consumption indicator. Due to system drawbacks, it was not possible to retrieve and use the data for non-ICU services in 2018.

### Statistical analysis

Data were provided in a Microsoft Excel spreadsheet. To assess performance of the system, adherence to reporting and data quality were analyzed as parameters of interest. For the reporting parameter, each tertiary level facility was expected to submit one report per month for both ICU and non-ICU services, and each secondary level facility for non-ICU wards only (i.e., 12 reports were expected per facility per service per year). The proportion of reports received was summarized as a percentage. If the same facility had submitted more than one report for a service in a month it was considered a duplicate report, and only the last one was included for the calculation of the number of submitted reports.

For the data quality parameter, the distribution of reported values of monthly DDD/100 occupied beds was summarized

for the different antibiotics using medians and interquartile ranges. Box and whisker plots were developed to identify outliers or implausible values. DDD summary statistics were used to explore the changes in antibiotic consumption profile in ICU and non-ICU services over the three-year period, observing how the two parameters, medians with interquartile ranges, affected the measurement and interpretation of DDD.

### Ethical considerations

Permission to use the antibiotic consumption data was sought and approved from the Ministry of Health and Social Protection, Colombia. National ethics approval was obtained from the Ethics Review Committee of the Research and Extension Center of the National University of Colombia (B.CIEFO-098-2022). International ethics approval was obtained from the PAHO Ethics Review Committee (PAHOERC-0551-01).

## RESULTS

### Compliance with reporting

For the period 2018–2020, an average of 79% of ICU wards reported their antibiotic consumption data at least once a year (Table 1). In the period 2018–2019, 59% of the participating hospitals submitted all 12 monthly reports; in 2020, this percentage decreased to 4%.

There was a decrease in compliance in non-ICU wards: 28% of the hospitals never submitted one antibiotic consumption report in 2019, and 31% in 2020. Non-ICU wards also showed a decrease in complete reporting, from 52% of services submitting all 12 reports in 2019 decreasing to 2% submitting all reports in 2020.

Regarding reported beds, a decrease was observed in 2020. On average in 2018 and 2019, 5 375 ICU beds and 33 645 non-ICU beds were reported. In 2020, the number of reported beds dropped to 3 329 in ICU and 4 551 in non-ICU wards.

### Regional antibiotic consumption reporting

In most regions there was an overall decrease in reporting in 2020 (Table 2 and 3). However, some regions improved their reporting from 2019 to 2020; for example, Amazonas (non-ICU: 21% to 50%), Nariño (ICU: 31% to 87%; non-ICU: 30% to 83%), and Caquetá (non-ICU: 78% to 92%). Seven regions did not submit a single antibiotic consumption report during the three-year period (Arauca, Córdoba, Guainía, Guaviare, Putumayo, Vaupés, and Vichada).

### Trends in antibiotics consumption

Variations were observed in the reporting of DDD/100 occupied beds for specific antibiotics over the study period, such as ceftriaxone in ICU wards (2019: 17 584; 2020: 19 857). In addition, the antibiotic consumption showed an increase for piperacillin/tazobactam (91 606 to 94 076), ertapenem (5 793 to 6 051), and cefepime (26 809 to 38 780) from 2019 to 2020 (Table 4).

However, extreme values of the DDD/100 occupied beds indicator limited its usefulness for analysis, including implausible values such as ICU-DDD/100 occupied beds values of

**TABLE 1. Number of SIVIGILA-INS reports from secondary and tertiary hospitals, Colombia, 2018 to 2020**

Intensive care units (ICU)	2018		2019		2020	
	n	%	n	%	n	%
Number of units	413	NA	432	NA	441	NA
Number of units reporting at least once	325	78.6 <sup>a</sup>	335	77.5 <sup>a</sup>	354	80.3 <sup>a</sup>
Number of units reporting all 12 months	200	61.5 <sup>b</sup>	189	56.4 <sup>b</sup>	15	4.2 <sup>b</sup>
Number of expected reports <sup>c</sup>	3 900	NA	4 020	NA	4 248	NA
Number of received reports	3 459	88.7 <sup>d</sup>	3 488	86.7 <sup>d</sup>	3 326	78.2 <sup>d</sup>
Number of beds reported	5 423	NA	5 327	NA	3 329	NA
<b>Other (non-ICU) wards<sup>e</sup></b>						
Number of wards	...	...	673	NA	689	NA
Number of wards reporting at least once	...	...	487	72.3 <sup>a</sup>	475	68.9 <sup>a</sup>
Number of wards reporting all 12 months	...	...	253	51.9 <sup>b</sup>	7	1.5 <sup>b</sup>
Number of expected reports <sup>c</sup>	...	...	5 844	NA	5 700	NA
Number of received reports	...	...	4 945	84.6 <sup>d</sup>	4 564	80.0 <sup>d</sup>
Number of beds reported	34 201	NA	33 090	NA	4 551	NA

NA, not applicable; (...), no data available.

**Notes:**<sup>a</sup>% calculated with total number of units/wards as denominator.<sup>b</sup>% calculated with total number of units/wards reporting at least once in the year as denominator.<sup>c</sup>Number of expected reports = Number of units/wards reporting at least once in each year \* 12.<sup>d</sup>% calculated with number of expected reports as denominator.<sup>e</sup>Non-ICU: Includes all other hospital wards except for ICU and emergency.**Source:** Prepared by the authors based on the study results.**TABLE 2. Submission of monthly reports (received vs expected) on antibiotic use in ICU services, per region and per year**

Region	2018		2019		2020	
	n <sup>a</sup>	% <sup>b</sup>	n	%	n	%
Boyacá	73	76	74	88	92	59
Cundinamarca	131	91	153	85	158	73
Meta	93	97	81	96	70	83
Norte de Santander	99	92	95	88	73	76
Santander	194	95	169	94	161	79
Antioquia	362	97	358	96	333	82
Caldas	87	91	96	89	87	66
Caquetá	13	54	12	100	11	92
Huila	90	94	96	100	87	91
Quindío	54	90	47	98	51	71
Risaralda	103	86	96	89	87	91
Tolima	153	91	159	83	142	79
Bogotá	589	88	574	85	586	79
Cauca	43	72	49	82	43	90
Chocó	10	28	20	56	19	53
Nariño	...	...	37	31	104	87
Valle del Cauca	397	92	376	90	321	79
Atlántico	350	88	326	88	312	79
Bolívar	245	97	244	88	188	78
Cesar	99	75	116	81	101	84
Guajira	53	63	68	94	58	81
Magdalena	111	93	113	86	112	85
Sucre	83	86	102	94	95	72
San Andrés	5	42	12	100	6	50
Casanare	22	92	24	100	29	81

(...): No data available.

**Notes:**<sup>a</sup>Number of reports received in a year.<sup>b</sup>% reports received versus expected = 100 \* submitted reports / (facilities submitting at least one monthly report \* 12).**Source:** Prepared by the authors based on the study results.**TABLE 3. Submission of monthly reports (received vs expected) on antibiotic use in non-ICU services, per region and per year<sup>a</sup>**

Region	2019		2020	
	n <sup>b</sup>	% <sup>c</sup>	n	%
Boyacá	178	82	186	17
Cundinamarca	262	87	232	77
Meta	85	89	82	85
Norte de Santander	103	95	97	90
Santander	205	95	190	83
Antioquia	453	92	429	83
Caldas	68	71	59	70
Caquetá	113	78	99	92
Huila	177	98	160	89
Quindío	46	96	49	68
Risaralda	72	86	71	85
Tolima	161	79	147	82
Bogotá	846	85	809	79
Cauca	48	100	43	90
Chocó	39	81	24	50
Nariño	40	30	100	83
Valle del Cauca	886	92	718	78
Atlántico	334	87	326	80
Bolívar	252	84	202	84
Cesar	115	80	95	79
Guajira	159	70	105	67
Magdalena	119	58	155	76
Sucre	120	91	126	88
San Andrés	23	96	16	67
Amazonas	5	21	12	50
Casanare	36	100	32	89

**Notes:**<sup>a</sup>2018 data for non-ICU services could not be retrieved from the SIVIGILA system.<sup>b</sup>Number of reports received in a year.<sup>c</sup>% reports received versus expected = 100 \* submitted reports / (facilities submitting at least one monthly report \* 12).**Source:** Prepared by the authors based on the study results.

**TABLE 4. Annual antibiotic consumption (DDD/100 beds) in ICU (2018–2020) and non-ICU services (2019–2020)**

Antibiotic	ICU			Non-ICU		Total	
	2018	2019	2020	2019	2020	2019	2020
Ceftriaxone	20 456	17 584	19 857	38 692	35 496	56 277	55 353
Ertapenem	23	2 062	2 693	3 731	3 357	5 793	6 051
Meropenem	136 643	66 214	66 354	23 894	22 014	90 108	88 368
Piperacillin/ tazobactam	76 674	59 264	61 037	32 341	33 039	91 606	94 076
Vancomycin	70 380	43 755	44 617	20 486	18 094	64 242	62 711
Cefepime	243	17 973	26 379	8 836	12 401	26 809	38 780
Ciprofloxacin	...	40	...	34 396	26 674	34 436	26 674
Imipenem	...	25	...	48	...	73	...

DDD, defined daily dose; ICU, intensive care unit; (...), no data available.  
**Source:** Prepared by the authors based on the study results.

**TABLE 5. Summary statistics of DDD/100 beds reported from ICU (2018–2020) and non-ICU (2019–2020) services, Colombia**

Antibiotic	Service	2018			2019			2020		
		Monthly median	Inter-quartile range	Range (min–max)	Monthly median	Inter-quartile range	Range (min–max)	Monthly median	Inter-quartile range	Range (min–max)
Ceftriaxone	ICU	2.4	0.3–6.2	0–16 458	2.3	0.2–6.1	0–141.1	2.2	0.1–6.3	0–144.0
	Non-ICU	...	...	...	2.9	0.8–7.7	0–150.0	2.8	0.7–7.7	0–147.8
Cefepime	ICU	0.0	0.0–0.0	0–62.1	1.9	0.0–7.0	0–132.5	3.9	0.3–9.6	0–144.0
	Non-ICU	...	...	...	0.2	0.0–2.2	0–146.9	0.8	0.0–2.9	0–147.4
Piperacillin/ tazobactam	ICU	13.6	5.9–23.1	0–9 752.5	14.2	6.3–23.4	0–146.4	13.8	5.7–24.1	0–231.8
	Non-ICU	...	...	...	4.2	0.6–9.0	0–142.7	4.4	0.7–9.6	0–146.3
Ertapenem	ICU	0.0	0.0–0.0	0–14.5	0.0	0.0–0.0	0–51.6	0.0	0.0–0.0	0–135.5
	Non-ICU	...	...	...	0.0	0.0–0.4	0–128.5	0.0	0.0–0.6	0–137.1
Meropenem	ICU	23.4	11.6–38.3	0–28 167	15.2	7.4–25.7	0–147.6	15.3	7.2–26.4	0–198.2
	Non-ICU	...	...	...	2.7	0.3–5.7	0–149.9	2.8	0.4–5.9	0–147.7
Ciprofloxacin	ICU	...	...	...	0.0	0.0–0.0	0–8.8	...	...	...
	Non-ICU	...	...	...	1.6	0.2–5.1	0–319.3	1.2	0.1–4.2	0–206.9
Vancomycin	ICU	9.8	5.1–16.8	0–57 604	9.4	4.6–16.2	0–148.9	9.2	4.4–16.7	0–148.8
	Non-ICU	...	...	...	2.1	0.2–4.4	0–134.4	2.2	0.3–4.7	0–147.4

DDD, defined daily dose; ICU, intensive care unit; (...), no data available.  
**Source:** Prepared by the authors based on the study results.

57 604 for vancomycin in 2018, or 9 752.5 for piperacillin/tazobactam and 16 458 for ceftriaxone in the same year (Table 5). Variable reporting rates also influenced DDD/100 occupied beds values. Monthly median and interquartile ranges for antibiotic consumption remained unchanged for 2018 and 2019 for ICUs, and for 2019 and 2020 for non-ICU wards (Table 5).

## DISCUSSION

Antibiotic consumption monitoring programs are essential because they provide information and guide the optimization of antimicrobial use in a country. These programs document patients' exposure to antibiotics and the potential development of AMR (13). Thus, in Colombia, the monthly notification of hospital antibiotic consumption through SIVIGILA-INS has been implemented for nine years. This system is flexible and is adjusted annually according to the country's needs as a result of information provided by the hospitals and specific situations such as the identification of new mechanisms of AMR. For example, including an antibiotic of pharmaco-epidemiological interest (ertapenem in 2018) due to inappropriate prescriptions,

or excluding an antibiotic due to disuse (imipenem in 2020). The selection of monitoring antibiotics should be suitable to broadly represent the consumption preferences in hospital care in the country (14).

In addition, INS generates annual reports and discloses hospital consumption of seven antibiotics that are subject to surveillance. This study aimed to evaluate the compliance of hospital consumption reports over a three-year period and identified the need to standardize and monitor the methodology of this reporting system to obtain robust and reliable data.

In this regard, there is room for improvement at the interface; that is, where primary data generated in the hospitals are uploaded into the system. For example, the system allows more than one report to be uploaded for a specific period in any moment and does not have a data validation system. These issues directly affect the DDD/100 occupied beds indicator calculated for each drug.

This study has several limitations. First, as the dataset did not include the hospital level of care (tertiary or secondary) and the source of funding (public or private), it was not possible to assess whether some hospitals had more urgent issues with

monitoring than others. Second, we detected high variability in the data, which may be explained by duplicate reports, suspected typing mistakes, and/or a lack of compliance with monthly reporting. These issues affected the reliability of the reported data.

Another limitation of this study is related to the health emergency caused by COVID-19 in 2020. This affected the monitoring of antibiotic consumption in hospitals and other surveillance programs. During the pandemic it was observed that health and administrative staff were forced to redesign care models and processes to be available for ICU, emergency, and inpatient care due to low availability of healthcare professionals (15). In ICUs there was a decrease in monthly reporting from 87% in the period 2018 and 2019 to 78% in 2020. Similarly, in 2019, 52% of non-ICU services reported for the whole year (12 months), but only 1.5% did so in 2020 (Table 1). These results could be related to the fact that this reporting was not a priority in 2020, when healthcare professionals in charge of reporting had to turn their attention to documenting the admission, management, and evolution of COVID-19 patients in each hospital (16). Overall, the COVID-19 pandemic affected reporting compliance in almost all regions of the country, except for a few areas where reporting was maintained or even improved in 2020, such as Nariño and Caquetá.

Variations in antibiotic consumption (DDD/100 occupied beds per day) are sensitive to hospital reporting performance. According to the INS annual report for 2020, while the number of reporting hospitals increased, the total number of beds was considerably lower, especially for non-ICU (13% of total beds reported during 2018 and 2019, as shown in Table 1). Of the ICU beds, only 61% were notified in 2020, compared to the number of beds included in the previous annual reports (17). The 2020 underreporting is even greater considering that in 2020 adult ICU bed capacity increased from 5 346 to 6 149 beds nationwide (18). This finding could be related to the overwork due to the COVID-19 pandemic in 2020.

Regarding the consumption trends observed between 2018 and 2020, the variations in the consumption of piperacillin/tazobactam, ertapenem, ceftriaxone, and cefepime from 2019 to 2020 could be related to an increase in prescriptions for patients with moderate or severe symptoms related to secondary infection and coinfections in response to SARS-CoV-2 virus, in ICU mainly and non-ICU services (19). Regarding the decrease of ciprofloxacin in 2020, although speculative, possible explanations might be adjustments in antibiotic prescriptions through compliance with hospital-specific or national therapeutic guidelines, or a low incidence of infections treated with this antibiotic. This example illustrates the need for each hospital to implement antimicrobial stewardship (AMS) interventions to analyze its consumption data, identify the causes of variation, and improve the use of antibiotics. Such AMS interventions have been shown to reduce treatment costs, resistance rates, and healthcare-associated infections and to improve patient outcomes (20).

A way forward could be to provide technical advice to hospitals and to support the INS in order to gradually improve compliance indicators of monthly reporting with reliable data (i.e., the ratio of reports received by SIVIGILA to the expected reports). For example, automated controls such as range checks and validation tools built into data entry and analysis systems could contribute to data quality by highlighting implausible or

missing values and reports. Alternatively, a sentinel surveillance approach could help in creating a representative sample of hospitals with high-quality consumption data. Furthermore, data reporting could be made mandatory for secondary level hospitals. It would also be useful to collect data on a few additional variables at service/ward level, such as the number of patients attended and the sources of financing. Finally, knowing the total number of patients treated in ICU and non-ICU services in the hospitals that report to SIVIGILA would allow a comparative analysis of national and hospital consumption.

In conclusion, the progress in the number of ICU and non-ICU services in the country providing the data required by the hospital antibiotic consumption surveillance program is noteworthy. However, the quality of DDD data is sensitive to external factors such as the COVID-19 pandemic in 2020, changes in antibiotic prescription practices, and the accuracy of data-entry work. This highlights the critical need to strengthen the SIVIGILA system for antibiotic consumption, to guarantee data quality, to improve data completeness, and to support hospital staff. In this regard, there is room for improvement at the interface and the issues directly affect the DDD/100 occupied beds indicator calculated for each drug.

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## Consumo de antibióticos en hospitales de segundo y tercer nivel en Colombia: vigilancia nacional entre 2018 y 2020

### RESUMEN

**Objetivo.** Evaluar el cumplimiento de los hospitales de segundo y tercer nivel en la presentación mensual de información sobre el consumo de antibióticos en el Sistema Nacional de Vigilancia en Salud Pública de Colombia (SIVIGILA-INS) y describir el consumo de antibióticos reportado en el período 2018-2020.

**Métodos.** Este estudio incluyó un análisis secundario de los datos del consumo de antibióticos reportado en SIVIGILA-INS. Se evaluó la frecuencia de los informes hospitalarios y se comparó con los informes esperados, desglosados por unidad de cuidados intensivos (UCI) y otros servicios distintos a la UCI, y por región geográfica. El consumo se expresó en dosis diaria definida (DDD) por 100 camas ocupadas para siete antibióticos.

**Resultados.** Más del 70% de los hospitales notificaron el consumo de antibióticos al menos una vez en cada uno de los tres años (79% en la UCI y 71% en los servicios distintos a la UCI). De estos, el 59% de las UCI completaron los informes mensuales (12 informes en un año) entre el 2018 y el 2019, pero solo el 4% en el 2020. El 52% de los servicios distintos a la UCI completó los informes en el 2019 y el 2% en el 2020. En la mayoría de las regiones hubo una disminución general de la notificación en el 2020. El análisis del consumo de antibióticos mostró un aumento de piperacilina/tazobactam, ertapenem y cefepima del 2019 al 2020.

**Conclusiones.** Se encontraron disparidades en la coherencia y en la frecuencia de la presentación de informes. Es necesario destinar esfuerzos para mejorar el cumplimiento de la notificación mensual, que disminuyó en el 2020 posiblemente debido a la pandemia de COVID-19. La falta de cumplimiento en la presentación de los reportes y los problemas de calidad de los datos deben abordarse con los hospitales para facilitar la interpretación válida de las tendencias de consumo de antibióticos.

**Palabras clave** Antibacterianos; programas de monitoreo de medicamentos recetados; habitaciones de pacientes; unidades de cuidados intensivos; investigación operativa; Colombia.

## Consumo de antibióticos em hospitais secundários e terciários da Colômbia: vigilância nacional de 2018 a 2020

### RESUMO

**Objetivo.** Avaliar o cumprimento da exigência de notificar mensalmente o consumo de antibióticos em hospitais secundários e terciários ao Sistema Nacional de Vigilância em Saúde Pública da Colômbia (SIVIGILA-INS) e descrever o consumo informado de antibióticos de 2018 a 2020.

**Métodos.** Este estudo envolveu uma análise secundária dos dados de consumo de antibióticos enviados para o SIVIGILA-INS. A frequência de notificação pelos hospitais foi avaliada e comparada com a frequência esperada. Os dados foram desagregados entre unidades de terapia intensiva (UTIs) e enfermarias gerais e por regiões geográficas. O consumo foi expresso como dose diária definida (DDD) por 100 leitos ocupados para sete antibióticos.

**Resultados.** Mais de 70% dos hospitais notificaram consumo de antibióticos pelo menos uma vez em cada um dos três anos (79% na UTI e 71% nas enfermarias gerais). Entre eles, 59% dos hospitais enviaram todas as notificações relativas a UTIs (12 notificações mensais) no período de 2018 a 2019, mas apenas 4% o fizeram em 2020. No caso das enfermarias gerais, 52% dos hospitais enviaram todas as notificações em 2019 e 2% o fizeram em 2020. A maioria das regiões teve uma diminuição geral no número de notificações enviadas em 2020. A análise do consumo de antibióticos revelou um aumento no uso de piperacilina/tazobactam, ertapeném e cefepima de 2019 para 2020.

**Conclusões.** Houve lacunas na uniformidade e frequência das notificações. São necessários esforços para melhorar o cumprimento da exigência de notificações mensais, que, possivelmente devido à pandemia de COVID-19, diminuiu em 2020. Problemas relacionados ao não cumprimento da exigência de notificação e à qualidade dos dados devem ser resolvidos junto aos hospitais para permitir uma interpretação válida das tendências de consumo de antibióticos.

**Palavras-chave** Antibacterianos; programas de monitoramento de prescrição de medicamentos; quartos de pacientes; unidades de terapia intensiva; pesquisa operacional; Colômbia.