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A retrospective audit of antibiotic prescriptions in a Lebanese Hospital

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Abstract

Despite the frequent alarms that have been published about the adverse effects of antibiotic use and misuse, physicians prescribe to patients approximately 50% of unnecessary antimicrobials. In an attempt to decrease the emergence of antimicrobial resistance and increase awareness, a team approach is required to address this prescribing phenomenon in a feasible manner.

A retrospective study was done at a 140-bed hospital with a representative sample size of 368 patients. Patient data were collected and analyzed by a stewardship team. The overall proportion of patients receiving inappropriate therapy (defined as receiving one or more inappropriate antibiotics) was 45.8%, which is relatively high and consistent with the findings of other studies mentioned in the literature.

This study aimed to provide baseline epidemiological data on the use of antibiotics in a Lebanese hospital and has revealed several notable patterns of antibiotic prescribing practices among Lebanese physicians, such as the consistently high use of antimicrobial drugs (e.g. penicillin). Strong correlations were identified between the type of attending physician and antibiotic appropriateness. These findings will be important in constructing an antimicrobial stewardship program to reduce antibiotic misuse.

Keywords: hospital, prescriptions, antibiotics, antimicrobial stewardship, Lebanon

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Introduction

According to several reports and studies released by the Centers for Disease Control and Prevention,[1] approximately 50% of physician prescriptions for antibiotics are unnecessary, despite the frequent alarms that have been published about their adverse effects on health,[2] medical services costs,[3] and threatening antimicrobial resistance.[4] This phenomenon, which has become the focus of talks in both the healthcare setting[4,5] and among schools and communities,[6] has led to serious medical problems, mainly the development of antibiotic resistance. Studies show that many physicians felt like they had the obligation to prescribe antibiotics solely to satisfy the patients, regardless of whether or not they were confident that this was the best treatment method.[7] Furthermore, when studying the reasons for irrational antibiotic prescribing, 54% was due to patient pressure.[8] As a result of antibiotic use and misuse, bacteria are becoming resistant to different antimicrobial agents, with deaths due to superbug infections. More specifically, several studies found that over 22% of hospitalized patients received an inadequate amount of antibiotics during their stay.[9,10] Additionally, reports have shown an extremely high load of antibiotic use in intensive care unit patients and physicians claim that this is attributable to the complicated medical conditions of these patients and their increased risk for healthcare-associated infections.[11,12] Pharmacies are no exception to this practice, as antibiotics constitute a fair amount of total pharmacy drug spending.[13]

Antimicrobial chemotherapy has been found to be ineffective because it doesn't decrease the duration of the illness[14] nor have they been found to successfully treat upper respiratory infections.[15] The negative consequences of antibiotic use and misuse can be further assessed when studying the increase in bacterial resistance towards antimicrobial agents, allergic reactions due to their use and mortalities due to related super-infections. Based on an antibiotic resistance study in the U.S., over two million illnesses and infections and over 23,000 deaths occurred in 2013 as a result of antimicrobial resistance.[17]

The process to prescribe an antibiotic appropriately consists of three major steps:

1. Deciding if an antibiotic is necessary, judging by the patient history and examination, the clinician's knowledge and suspicion of the presence of an infectious disease.
2. Selecting the right antibiotic based on the likely pathogen, clinical significance, local antibiogram, best-evidence, efficacy, toxicity, adverse events, drug interactions, contra-indications, presence of antibiotic resistance, antibiotic availability and cost.
3. Selecting the right dose, route, interval and duration.[18] Thus such prescribing decisions are an intricate and multi-faceted complex process.

On the other hand, an antimicrobial agent is inappropriate if:

1. It is more costly than a similar agent,
2. Its spectrum is too broad, too narrow or otherwise inappropriate,
3. It is not indicated,
4. The route of administration is inappropriate.

Inappropriate antibiotic prescribing can result in a rise in mortality and morbidity, costly treatment,[19] increased length of stay (LOS), and acquiring antibiotic resistant organisms.

Educating the public and patients about the adequate use of antibiotics is one method to decrease the emergence of antimicrobial resistance.[8] Nonetheless, the role of physicians in addressing this issue is vital as they can control the misuse among patients.[20] Ultimately, the best method to approach this phenomenon is to involve all stakeholders while integrating policies and infection control programs.[21] This study aimed to evaluate antibiotic prescribing in one Lebanese hospital.

Methods

Data were collected retrospectively from a 140-bed hospital between the 1st of June 2012 and the 30th of April 2013. This hospital provides the highest standards of quality care to patients across Lebanon and the surrounding countries in some instances. The hospital is committed to improving the delivery of healthcare in Lebanon. It offers a variety of services that include: cardiothoracic surgery, paediatrics, surgical units, internal medicine units, obstetrics, oncology, neonatal intensive care unit (ICU), medical ICU, cardiac ICU,

post-open heart surgery ICU, paediatric ICU, cardiac ward, haemodialysis unit, and a rehabilitation centre. All patients admitted during this year (10151) were considered as our population; among them, 6068 patients received at least one dose of antibiotics. The sample size was calculated using the following formula published by the research division of the National Education Association.[22]

$$s = \frac{X^2NP(1-P)}{d^2(N-1) + X^2P(1-P)}$$

The required sample size was 368, thus, a systematic random sample was taken from a list of all patients medical record numbers (MRN).

Each patient file was reviewed and abstracted using an Excel sheet (Microsoft Corporation, Redmond WA) with their MRNs. Collected data included: age, sex, admission site, history of infection, co-morbid illnesses, admission date, duration of hospitalization, ward, surgical procedures, ICU stay during hospitalization, current immunosuppression, infectious diseases specialist consultation during hospitalization, antibiotics used (choice, dose, duration, route and whether the drugs were given for prophylactic or therapeutic purpose).

Prescriptions were classified as "empirical" when the pathogen was unknown at the time of prescription, and as "targeted" when a pathogen was identified. "Prophylactic" antibiotics were related to patients undergoing surgeries only.[23] Results were further reviewed to assess appropriateness of prescriptions of antimicrobials by a stewardship team, which consisted of the infection control expert as the chairman, infectious disease specialist, clinical pharmacist and a floor medical resident.

Analysis

The appropriateness of antimicrobial prescription was evaluated according to the international evidence-based guidelines, taking into consideration the local epidemiology, microbiological findings and co-morbidity. Appropriateness was then classified using the algorithm reported by "Société Suisse d'Hygiène Hospitalière Gyssens",[24] which uses the following classifications: correct indication, correct dose, correct choice, correct route and correct duration. Appropriateness of the antimicrobial treatment (AMT) was further determined by using the local AMT guidelines. If all the antimicrobial agents that a patient received were considered correct, the treatment

Table I. Appropriateness of antibiotic therapy among patients

		APPROPRIATENESS				
		Appropriate		Inappropriate		
		N	%	N	%	P-value
Gender	Male	95	51.4%	90	48.6%	p>0.05
	Female	105	57.1%	79	42.9%	
Age	< 12 years	11	68.8%	5	31.3%	p>0.05
	> 12 years	189	53.5%	164	46.5%	
Mortality	No	179	53.1%	158	46.9%	p>0.05
	Yes	21	65.6%	11	34.4%	
Unit	ICU	39	57.4%	29	42.6%	p>0.05
	Other	161	53.5%	140	46.5%	
Specialist	Surgeon	76	52.4%	69	47.6%	p>0.05
	Medicine	124	55.4%	100	44.6%	
ATB	≤ 2 ATB	162	58.7%	114	41.3%	P<0.01
	> 2 ATB	38	40.9%	55	59.1%	

was considered appropriate. If one or more of the antimicrobial agents was considered incorrect or it was not possible to decide on a particular agent, the treatment was considered inappropriate.

After collecting all the necessary information related to the patients' demographic data, body temperature, antibiotic prescriptions, length of stay, blood and laboratory tests, admitting physician and admission diagnosis, the researcher used statistical methods to generate frequency counts, percentages, means and medians, standard deviations and a T-test for further analysis .

Patient data were collected and analyzed by comparing the patients' characteristics, conditions and antibiotic prescription behaviours for all types of infections based on the Infectious Diseases Society of America (IDSA) guidelines. Each type of antibiotic was assessed independently in terms of indication, choice, dose, frequency, duration and route. The appropriateness/ inappropriateness and the statistical significance were calculated.

Results

Patient-related data

Of the 368 patients, 50.1% were males and 49.9% were females. The mean age was 56 years and 46% were aged more than 64 years while 30.6% were aged between 40 and 64 years. 74.8% of patients received two or fewer antibiotics while 25.2% received more than two antibiotics. The majority of patients were admitted to regular wards (81.6%) and the remaining patients (18.4%) were admitted to ICUs. The mean LOS was 6 days and 91.3% of the patients were discharged alive while 8.7% passed away during their stay.

Inappropriate treatment by antibiotics during their hospital stay was found in 45.8% of our sample. When comparing demographic variables (Table I), appropriate antibiotic therapy was received by 57% and 51% of females and males respectively (Chi-square $p>0.05$), 68.8% of patients aged less than 12 years and 53.5% of patients older than 12. There was no statistically significant correlation between patients' age and appropriateness. The comparison between mortality and appropriateness also showed no statistically significant correlation. There was not any difference in appropriate treatment between those admitted to ICU and those admitted to other wards (57.4% and 53.5% respectively, Chi-square $p>0.05$). There was no significant correlation with respect to physicians' specialty. When comparing the number of antibiotics and appropriateness of treatment, a statistically significant correlation (Chi-square $p<0.01$) was yielded.

The comparison between patients' mean age and appropriateness showed that there was no statistically significant correlation. The comparison between the mean LOS of patients and appropriateness was also not statistically significant (T-test $p>0.05$). The

Table II. Mean, geometric mean and standard deviation of antibiotic appropriateness among patients

		N	Mean	Geo Mean	Std. Deviation	P-Value
Age (Year)	Inappropriate	200	57.51	1.69	23.028	p>0.05
	Appropriate	169	54.38	1.68	21.957	
	Total	369	56.08	1.68	22.568	
LOS (day)	Inappropriate	200	5.36	0.60	6.701	p>0.05
	Appropriate	169	6.09	0.63	6.918	
	Total	369	5.70	0.62	6.802	
Number of antibiotics	Inappropriate	200	1.95	0.23	1.223	P<0.001
	Appropriate	169	2.41	0.32	1.478	
	Total	369	2.16	0.27	1.363	

comparison between the numbers of antibiotics given to patients and appropriateness showed that there was a statistically significant correlation (T-test p<0.001) (Table II).

Antibiotic-related data

The antibiotics given in our study were distributed as follows (Table III): 35.3% were cephalosporins, 14.5% were penicillins, 10.2% were quinolones, 10.8% were glycopeptides, 9.7% were aminoglycosides, 7.8% were macrolides, 6.5% were carbapenem, and other antibiotics such as tetracycline, polymyxin, rifamycin, and metronidazole were used in small percentages. Furthermore, around half of the antibiotics (46.5%) were empirically used, 37.5% were used as prophylactic therapy and 16% were used as targeted therapy (Table III).

The majority of antibiotics prescribed to patients (93.6%) were with "proper indication", 79.5% of which were "proper choice", 76.7% were administered with the "correct dosage", 79% were administered with the "correct frequency and duration", 73.8% in the "correct route", and 9.8% of antibiotics given to patients were de-escalated. Appropriateness of prescribing by antibiotic class is shown in Table IV.

The antibiotics were compared in function of appropriateness. The results show that 74% of aminoglycoside were appropriately prescribed, 50.4% of penicillin were inappropriately prescribed, 85.5% of macrolide were appropriately prescribed, 66.9% of cephalosporin were appropriately prescribed, 70.4% of quinolone were appropriately prescribed, 33.3% of Tetracycline were appropriately prescribed, all the polymyxin (100%) were appropriately prescribed, 77.8% of rifamycin were appropriately prescribed, 80.8% of carbapenem were appropriately prescribed, and 94.2% of Glycopeptides were appropriately prescribed (Table V).

Furthermore, 92.1% of targeted antibiotics were appropriately prescribed, 70.3% of empiric antibiotics were appropriately prescribed, and 62.8% of prophylactic antibiotics were appropriately prescribed.

Table III. Percentage distribution of prescribed antibiotics per patients

Antibiotic	
Aminoglycoside	77 (9.7%)
Penicillin	115 (14.5%)
Macrolide	62 (7.8%)
Cephalosporin	281 (35.3%)
Quinolone	81 (10.2%)
Tetracycline	3 (0.4%)
Polymyxin	13 (1.6%)
Carbapenem	52 (6.5%)
Metronidazole	16 (2.0%)
Rifamycin	9 (1.1%)
Glycopeptides	86 (10.8%)
Antibiotic Type	
Prophylactic	298 (37.5%)
Empiric	370 (46.5%)
Targeted	127 (16.0%)
Antibiotic Days	
Antibiotic Days Therapy **	3.84 (3.19)

The majority of well-indicated antibiotics given to patients (75.7%) were appropriately used (p<0.001), 89.1% of which were administered with the correct choice, 91.8% with the correct dosage, 89.5% with the correct frequency, 89.2% with the correct duration, 95.9% by the correct route, and last but not least, all of the antibiotics given to patients with de-escalation were appropriately used (p<0.001) (Table VI).

369 patients have received a total of 795 individual antibiotics during their stay in the hospital in this study. The majority of these antibiotics (71.3%) were appropriately used on these patients (Table VII).

Discussion

This study aimed to provide baseline epidemiological data on the use of antibiotics in a Lebanese hospital and has revealed several notable patterns of antibiotic prescribing practices among Lebanese physicians. Prescribing of antibiotics did not vary dramatically across patient characteristics for both males and females, and different age groups. However, there

Table IV. Percentage distribution of prescribed antibiotics per patients in terms of proper indication, choice, dose, frequency, duration and route

*Representation n (%) / ** Mean (Standard deviation)*

Indication	
No	51 (6.4%)
Yes	744 (93.6%)
Choice	
No	112 (14.1%)
Yes	632 (79.5%)
NA	51 (6.4%)
Dose	
No	21 (2.6%)
Yes	610 (76.7%)
NA	164 (20.6%)
Frequency	
No	3 (.4%)
Yes	628 (79.0%)
NA	164 (20.6%)
Duration	
Yes	631 (79.4%)
NA	164 (20.6%)
Route	
No	43 (5.4%)
Yes	587 (73.8%)
NA	165 (20.8%)
De-escalation	
Yes	78 (9.8%)
NA	717 (90.2%)

Table V. Appropriateness of antibiotic therapy per antibiotic class

		A/I			P-Value
		Appropriate	Inappropriate	Total	
		N %	N %	N %	
Aminoglycoside	Aminoglycoside	57 74.0%	20 26.0%	77 100.0%	p>0.05
	Other Antibiotics	507 70.6%	211 29.4%	718 100.0%	
Penicillin	Penicillin	57 49.6%	58 50.4%	115 100.0%	P<0.05
	Other Antibiotics	507 74.6%	173 25.4%	680 100.0%	
Macrolide	Macrolide	53 85.5%	9 14.5%	62 100.0%	P<0.05
	Other Antibiotics	511 69.7%	222 30.3%	733 100.0%	
Cephalosporin	Cephalosporin	188 66.9%	93 33.1%	281 100.0%	P>0.05
	Other Antibiotics	376 73.2%	138 26.8%	514 100.0%	
Quinolone	Quinolone	57 70.4%	24 29.6%	81 100.0%	p>0.05
	Other Antibiotics	507 71.0%	207 29.0%	714 100.0%	
Tetracycline	Tetracycline	1 33.3%	2 66.7%	3 100.0%	p>0.05
	Other Antibiotics	563 71.1%	229 28.9%	792 100.0%	
Polymyxin	Polymyxin	13 100.0%	0 0.0%	13 100.0%	P<0.05
	Other Antibiotics	551 70.5%	231 29.5%	782 100.0%	
Carbapenem	Carbapenem	42 80.8%	10 19.2%	52 100.0%	p>0.05
	Other Antibiotics	522 70.3%	221 29.7%	743 100.0%	
Metronidazole	Metronidazole	8 50.0%	8 50.0%	16 100.0%	p>0.05
	Other Antibiotics	556 71.4%	223 28.6%	779 100.0%	

Table V. Appropriateness of antibiotic therapy per antibiotic class (continued)

		A/I			P-Value
		Appropriate	Inappropriate	Total	
		N %	N %	N %	
Rifamycin	Rifamycin	7 77.8%	2 22.2%	9 100.0%	p>0.05
	Other Antibiotics	557 70.9%	229 29.1%	786 100.0%	
Glycopeptides	Glycopeptides	81 94.2%	5 5.8%	86 100.0%	P<0.05
	Other Antibiotics	483 68.1%	226 31.9%	709 100.0%	

Table VI. Appropriateness of antibiotic therapy per antibiotic type, indication, choice, dose, frequency, duration and route

		Appropriateness				P-Value
		Appropriate		Inappropriate		
		N	%	N	%	
Antibiotic Type	Prophylactic	187	62.8%	111	37.2%	p<0.001
	Empiric	260	70.3%	110	29.7%	
	Targeted	117	92.1%	10	7.9%	
Indication	No	1	2.0%	50	98.0%	p<0.001
	Yes	563	75.7%	181	24.3%	
Choice	No	0	0.0%	112	100.0%	p<0.001
	Yes	563	89.1%	69	10.9%	
	NA	1	2.0%	50	98.0%	
Dose	No	3	14.3%	18	85.7%	p<0.001
	Yes	560	91.8%	50	8.2%	
	NA	1	.6%	163	99.4%	
Frequency	No	1	33.3%	2	66.7%	p<0.001
	Yes	562	89.5%	66	10.5%	
	NA	1	.6%	163	99.4%	
Duration	Yes	563	89.2%	68	10.8%	p<0.001
	NA	1	.6%	163	99.4%	
Route	No	0	0.0%	43	100.0%	p<0.001
	Yes	563	95.9%	24	4.1%	
	NA	1	.6%	164	99.4%	
De-escalation	Yes	78	100.0%	0	0.0%	p<0.001
	NA	486	67.8%	231	32.2%	

Table VII. Percentage of appropriateness of total prescribed antibiotics

Appropriateness	Frequency (N)	Percent (%)
Appropriate	567	71.3
Inappropriate	217	27.3
Total	**795**	**100.0**

was a significant correlation between the type of attending physician and antibiotic appropriateness, where pulmonologists were the highest prescribers with a relatively high inappropriateness. During data collection, 25% of the randomly selected patients were taking more than two antibiotics during their stay in the hospital with a 59.1% inappropriate prescription rate. The overall antibiotic inappropriate rate was 45.8%, which is relatively high and consistent with the findings of other studies mentioned in the literature. The most frequently prescribed antibiotics were cephalosporins and penicillin; empiric antimicrobial therapy was most frequently prescribed. When judged independently, 27.3% of the individual antibiotics were inappropriately used. Moreover, the comparison between mortality and appropriateness showed that there was no statistically significant correlation between the two variables (Chi-square; $p>0.05$), where 53.1% of the patients who were discharged alive and 65.6% of patients who died received appropriate antibiotics.

Many determinants for the rational use of antibiotics are similar whether the antibiotics are prescribed in hospitals or in the community. Nonetheless, physicians working in hospitals encounter different, and mostly more complex, clinical scenarios than those dealt with by colleagues working in the community. In recognition of this fact, the concept of an "antibiotic stewardship program" has been specifically developed for healthcare institutions.

In recognition of the fact that antibiotic resistance has multiple causes and not a single action or measure can eliminate or limit the problem, the new concept of "intervention bundles" has been introduced. The bundles may be seen as sets of locally adjusted and practically designed procedures with the aim to operationalize an antibiotic stewardship program, which is often designed and introduced at a higher administrative level.

The evidence-based implementation and updated antibiotic guidelines, establishing clinical pathways and prescription audits with feedback to prescribing physicians are the main important and basic elements of the antibiotic stewardship program. Furthermore, in the work towards more intellectual antibiotic use in hospitals, the magnitude of antibiotic utilization must be calculated and presented on a regular basis. The main reason for monitoring is the possibility to identify factors that influence antibiotic use and to monitor the effect of implementation strategies.[25]

The findings of these descriptive data were important to judge the need for adopting an antimicrobial stewardship (AMS) intervention in the hospital and to reduce the unnecessary antibiotic used. Optimizing and properly governing antibiotic practices is crucial to control the adverse effects of misuse. All distinctive stakeholders will need to play complementary roles in the AMS agenda.

When trying to shift prescribing behaviour, it is important to ensure opinion leader buy/in and to seek the involvement from senior clinicians and multidisciplinary teams. A significant change is expected to be seen only after the engagement of senior colleagues in the development of the policy and implementation of the intervention. To ensure effective intervention, we established a multidisciplinary team, which consisted of physicians, pharmacists and infection control professionals to move away from the traditional single/disciplinary approach and towards a multidisciplinary team approach.

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