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The pattern of antibiotics prescription and consumption: A cross–sectional study

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Abstract

Objective: To investigate the antibiotic utilization and prescription patterns as well as define its convenience to the norm in four North-Sinai hospitals, Egypt. Antimicrobial resistance is a universal health threat. The golden era of miracle antibiotics has ended and we have faced the challenge of being troubled by infectious diseases with no discovery of new antibiotics found since 1987. Antibiotic pressure, overuse, and misuse are important risk factors for antimicrobial resistance and hospital cross-infection. To combat antimicrobial resistance, Egypt started its National Action Plan (2018-2022) aiming to optimize the usage and consumption of antibiotics.

Method: This multicenter descriptive cross-sectional study was designed to describe the pattern of antibiotic prescription and consumption at four North Sinai Hospitals related to the Ministry of Health and Population. We reviewed 309 medical records of the inpatient department; the samples were selected through a stratified random sampling technique. Data were collected retrospectively from the medical records of the hospitalized patients in October, November, and December of 2020 by a paper-based method. Data were analyzed using descriptive statistics.

Result: The prevalence of antibiotic consumption is near 68.9% in the four hospitals indicating that two-thirds of admitted patients receive antibiotics. Approximately 52.1% administered antibiotics for no reason. Most of the admitted patients took antibiotics on the same day of admission, regardless of the different types of hospital departments. Furthermore, 98.7% of antibiotics were prescribed without culture or order for culture and microbiological tests. Broad-spectrum antibiotics were 90% of all antibiotics prescribed. A total of 18 types of antibiotics were prescribed, cefotaxime was the most commonly prescribed antibiotic representing 26.5%.

Conclusion: Judicious antibiotic prescribing behavior slows down the nature of antibiotic resistance. To guarantee the best antimicrobial use in the hospitals, standard treatment guidelines, and the Essential Medicines List for infectious diseases should be carried out and revised at least every 2 years to be a clinical reference for clinicians. Continuous education and training of clinicians and healthcare workers can contribute to optimizing the rational use of antibiotics, which in return reduces the progress of antibiotic resistance. There is an urgent need for antibiotic stewardship and surveillance and their application in all hospitals.

KEYWORDS: Antimicrobial resistance, Antibiotic resistance, Antibiotics prescribing pattern, Antibiotic irrational use

1. Introduction

Antimicrobial resistance (AMR) including antibiotic resistance (AR), is a global health threat in the 21st century. AR is considered one of the universal top 10 health threats, defined by WHO[1,2]. It is a natural phenomenon, as organisms would gradually discover a new way to resist antibiotics designed to kill them by a defense mechanism[3]. Fortunately, the discovery of antibiotics controls infectious diseases, raises life expectancy, and minimizes infection-associated morbidity and mortality[3,4]. Unfortunately, it is no longer the golden era of antibiotics when miracle antibiotics succeed

Significance

This study focuses on historic factors associated with the emergence of antimicrobial resistance which should be addressed to end this crisis. Further, it presents a real image of the antibiotic prescription process and clinicians' behavior in prescribing in such low-middle-income hospitals as a model since few studies in Egypt hospitals address this issue. Accordingly, it aids in developing and enforcing suitable plans after pinpointing the problem source.

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to treat life-threatening infections, and we are living in the post-antibiotic era of multidrug resistance, pan drug resistance, and superbug[5]. Accordingly, deaths will arise in different modern health care aspects[6]. Excessive use of antibiotics introduces more resistance to germs. The resistant germ can multiply and transfer between germs by mobile genetic element[3]. This phenomenon has been accelerated by the irrational and inappropriate use of antibiotics in humans, animals, agriculture, and the environment as a whole[6].

Over and above, no new antibiotic classes have been discovered since 1987. AMR hurts human health and impacts the economy. Annually, an estimation of 30% of antibiotics prescribed in US clinics and emergency departments were prescribed with no need which represents about 47 million courses of antibiotics, said the Centers for Disease Control and Prevention[4]. In developing countries, unnecessary, inappropriate, and useless antibiotic prescriptions are the driver for AR and are common in our hospitals[8]. Above 2.8 million AR infections happen in the USA per year, and around 35 000 people die due to AR. Moreover, around 223 900 people need hospital care for *Clostridioides difficile*, and 12 800 people died in 2017[4]. Hereafter, by the year 2050, it is estimated that the massive infection will affect 444 million people worldwide, and a decline in birthrate will rise[5]. By 2030, AMR could force about 24 million people into extreme poverty[9]. Further, by 2050, drug resistance infection is estimated to threaten 10 million deaths annually worldwide[6,10]. Recent studies predicted a 200% rise in universal antibiotic consumption by 2030[11]. Currently, AMR causes about 700 000 death worldwide[12]. Low-middle income countries show a high occurrence of infectious disease, but data on AMR are limited due to a lack of facilities for making surveillance[13,14].

In May 2015 World Health Assembly evolved the global action plan to combat AMR, and many countries started to develop their national action plan. Recently, the Ministry of Health and Population (MoHP) in Egypt developed a national action plan for 2018-2022 aimed to optimize antimicrobial usage and improve health[12]. Therefore, our study purposed to describe the current situation of antibiotic prescription and consumption in four hospitals to explicit the AR burden. Otherwise, few studies describe the pattern of antibiotic prescription in Egyptian hospitals but relatively more studies on inappropriate prescriptions and self-medication were conducted in the community[7,15–18].

2. Methods

2.1 Study design

It's a multicenter descriptive cross-sectional study designed to describe the pattern of antibiotic prescription and consumption at four North Sinai Hospitals. We collected the data from the medical records of the included patients who were admitted to the four North Sinai Hospitals. Actually, four hospitals related to MoHP in North Sinai: Al-Arish general hospital (AGH), Bir-Abd hospital (BAH), El-Sheikh Zwayed Central Hospital (SCH), and Nekhel Central Hospital (NCH). The capacity and bed numbers of the four hospitals are 250, 90, 23, and 25 for AGH, BCH, SCH, and NCH respectively. Data were taken from medical records of admitted patients in the included departments over October, November, and December, the last three months of 2020, by paper-based method, as the four hospitals didn't have an electronic medical record system. To note, this paper-based data collection form consisted of the study variables. We composed a paper for every patient which contained: hospital data (date of survey, hospital name, ward type, capacity of wards), patient data (patient demographic age, gender), antibiotic data (antibiotic name, strength, frequency, date of start, date of ending, duration, route of administration, antibiotic category, spectrum, number of courses, and associated costs), diagnosis data (indication, reason for antibiotic use, surgical prophylaxis, and culture availability).

The antibiotic role is broken down into treatment, and prophylaxis. Indicators of antibiotic need are divided into a clinical presentation, laboratory findings, radiologic picture, or a combination of two or three pillars of those. Evidence for bacterial infection is culture test, microbiologic test, and sensitivity. No reason for antibiotic prescription defined as no sign and symptoms, no indication, no laboratory finding or radiological test indicated that there is a potential need for antibiotics. Recording the data of the infectious organism if bacterial culture test was done. Further, the time of hospital admission and date of starting the antibiotic were recorded. Before the beginning of the process of data collection, the participating medical staff in this study were trained on how to collect the data from the medical records and the research methodology.

2.2 Population

The object of the study is all patients admitted to the four hospitals' inpatient departments except the Pediatric ward, Pediatric Intensive Care Unit, Neonates Intensive Care Unit, Pediatric Department, and Covid-19 Isolation Unit.

2.3 Inclusion criteria

Patients of ages $\geqslant$18 years old were included, and patients with any chronic illness were accepted.

2.4 Exclusion criteria

Patients $<$18 years old and Covid-19 isolated patients and all

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patients admitted to neonatal, pediatrics, and Covid-19 isolation departments were excluded.

We excluded pediatrics because they had a specific concern over infectious diseases. As well, we excluded patients who were isolated in the Covid-19 isolation department because of the significant burden of inappropriate and overuse of antibiotics that can't reflect the usual usage in the everyday time that was preferable to conduct a study specifically for each population separately.

2.5 Sample size and type

Approximately 4 000 patients were admitted to the included departments of the four hospitals over three months. There were variabilities between the mentioned hospital in resources, number of departments, capacity and bed numbers, and locations in North Sinai. Thus, the study samples were collected using a stratified random sampling technique.

The total sample size was calculated to be 270 with a 5% margin of error and a 95% confidence interval, and we raise it to 309, which was divided into the hospital's department (strata) according to the population of each department to cover all. The sample were randomly collected from each hospital departments.

2.6 Statistical analysis

Data were analyzed by using Statistical Package for the Social Sciences (SPSS) version 22. Frequency and percentage described the categorical variables. Categorical variables were presented graphically by Bar Chart. Regarding continuous variables, the mean measures the central tendency for normally distributed data, and the Standard deviation measures dispersion. Median and IQR measure central tendency and dispersion, respectively for continuous skewed data.

2.7 Ethical Approval

This study met ethical considerations and was conducted with ethical approval from the Egyptian MoHP Research Ethics Committee (REC) (Com.No/Dec.No 18-2021/9).

3. Results

We revised a number of 309 medical records of admitted patients in the four hospitals. AGH represents 49.2%(n=152) of the total sample size while BAH, SCH, and NCH represent 28.8%(n=89), 20.7% (n=64) and 1.3%(n=4) respectively. Patients' distributions in the wards over the four hospitals were 31.4% Gastroenterology department, 27.5% Gynecology and Obstetrics department, 13.3% Surgery department, 12% Intensive care unit, 6.1% Orthopedic Surgery, 2.3% Ophthalmology department, 1.9% Ear-Nose-Throat department, 1.3% Diabetes Mellitus department and 3.9% others (Neurology, Urology, and Vascular Department). Approximately, 81.2% (n=251) of hospitalized patients were aged between 18 and 60 years old, while 18.8% (n=58) were more than 60 years old. Mean age (years) ± standard deviation is 45.9 ± 18.6. About 53.7% of the patients were female while 46.3% were male.

Overall, 68.9% of hospital patient records contain antibiotics. About 52.1% of antibiotic prescriptions were prescribed for no reason, 29.6% for surgical prophylaxis and operations, and only 18.3% for treatment. In case of treatment, indicators of antibiotics prescription need are also classified to 74.4% based on the weak indicator for antibiotic need by the meaning of a week tool for diagnosis of bacterial infection like either clinical presentation, laboratory finding, or radiographic finding and 25.6% by a combination that represents a stronger indicator for antibiotic need.

Significantly, 98.7% of antibiotics prescriptions were prescribed without a bacterial culture test and the majority with no recorded evidence of the need. About 63.4% of prescriptions involve one antibiotic, 28.6% involve two antibiotics while 14 prescriptions contain three antibiotics, and three prescriptions have more than three antibiotics. This added about 20448 EGP as an additional cost to the four hospitals, as shown in Table 1.

Cefotaxime is the most commonly prescribed antibiotic followed by ampicillin-sulbactam and ceftriaxone with 26.5%, 25.8%, and 24.6% respectively. Cefepime, ceftazidime, and cefoperazone are the least prescribed antibiotics. Consequently, a high proportion of 51.7% of the prescribed antibiotic was of third-generation cephalosporins antibiotic class and 27.8% of penicillin-beta lactamase inhibitor. Significantly broad-spectrum antibiotics were the most commonly prescribed by 90.1% in contrast to narrow-spectrum of 9.1%. Regarding the route of administration, the majority of prescriptions 96.5% were in the intravenous route, while 2.9% of the oral route, as shown in Table 2.

To note, AGH is the highest antibiotic consumption at 26.5% followed by BAH at 22.7% then SCH at 18.4% while NCH is the least antibiotic consumption at 1.3%.

3.1 Description of hospitals and their departments

3.1.1 Al–Arish General hospital

AGH was the highest hospital in the antibiotic consumption rate (26.5%). Out of 17 departments, 13 departments met the study inclusion criteria. A total of 53.9% of hospitalized patients received antibiotics. The reason for antibiotic prescription is classified as 59.8% no reason for antibiotic needs, 31.7% for surgical prophylaxis, and 8.5% for treatment which were based on weak indications either clinical or laboratory findings.

At the level of AGH department and patients' records that involve antibiotics, ICU is the highest antibiotic utilization with a percent of

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Table 1. Bio-demographics, prescription patterns, and antibiotics data for 309 hospitalized patients in the 4 hospitals in North-Sinai Egypt

Factor		AGH		BAH		SCH		NCH		Total	
		N	%	N	%	N	%	N	%	N	%
Bio-demographic data	Age in years										
	18 to 60 years old	113	36.6	77	24.9	57	18.4	4	1.3	251	81.2
	More than 60 years old	39	12.6	12	3.9	7	2.3	0	0	58	18.8
Mean age (years) ±standard deviation						45.9 ±18.6					
Sex	Females	88	28.5	49	15.9	27	8.7	2	0.6	166	53.7
	Males	64	20.7	40	12.9	37	12	2	0.6	143	46.3
Patients' distribution in the wards	Gastroenterology Department	24	15.8	15	16.7	56	87.5	2	50	97	31.4
	Gynecology and Obstetrics Department	45	29.6	34	38.2	5	7.8	1	25	85	27.5
	Surgery Department	19	12.5	18	20.2	3	4.7	1	25	41	13.3
	Intensive Care Unit	32	21	5	5.6	0	0	0	0	37	12
	Orthopedic Surgery	12	7.9	7	2.3	0	0	0	0	19	6.1
	Ophthalmology Department	6	3.9	1	0.3	0	0	0	0	7	2.3
	Ear-Nose-Throat Department	2	1.4	4	4.5	0	0	0	0	6	1.9
	Neurology Department	3	1	2	0.6	0	0	0	0	5	1.6
	Diabetes mellitus Department	4	1.3	0	0	0	0	0	0	4	1.3
	Vascular Department	2	0.6	2	0.6	0	0	0	0	4	1.3
	Urology Department	3	1	0	0	0	0	0	0	3	1
	Chest/heart	0	0	1	0.3	0	0	0	0	1	0.3
The location of hospitalization		152	49.2	89	28.8	64	20.7	4	1.3	309	100
Antibiotics in patients' prescriptions	yes	82	26.5	70	22.7	57	18.4	4	1.3	213	68.9
	no	70	22.7	19	6.1	7	2.3	0	0	96	31.1
The number of antibiotics for each patient	One	37	17.4	39	18.3	55	25.8	4	1.9	135	63.4
	Two	30	14.1	29	13.6	2	0.9	0	0	61	28.6
	Three	12	5.6	2	0.9	0	0	0	0	14	6.6
	More than 3	3	1.4	0	0	0	0	0	0	3	1.4
Antibiotics	Cefotaxime	38	12.1	31	9.9	11	3.5	3	1	83	26.5
	Ampicillin-sulbactam	33	10.5	41	13.1	7	2.2	0	0	81	25.8
	Ceftriaxone	19	6.1	20	6.4	38	12.1	0	0	77	24.6
	Metronidazole	16	5.1	0	0	0	0	0	0	16	5.1
	Clindamycin	13	4.2	0	0	0	0	0	0	13	4.2
	Gentamycin	6	1.9	6	1.9	0	0	0	0	12	3.8
	Levofloxacin	5	1.6	1	0.3	0	0	0	0	6	1.9
	Amoxicillin-flucloxacillin	0	0	0	0	3	1	0	0	3	1
	Amoxicillin-clavulanic acid	2	0.6	0	0	0	0	1	0.3	3	1
	Imipenem-cilastatin	3	1	0	0	0	0	0	0	3	1
	Meropenem	2	0.6	1	0.3	0	0	0	0	3	1
	Azithromycin	2	0.6	1	0.3	0	0	0	0	3	1
	Ciprofloxacin	2	0.6	1	0.3	0	0	0	0	3	1
	Amikacin	2	0.6	0	0	0	0	0	0	2	0.6
	Vancomycin	1	0.3	1	0.3	0	0	0	0	2	0.6
	others*	3	1	0	0	0	0	0	0	3	1
	Total	147	47	103	32.9	59	18.8	4	1.3	313	100
Antibiotic classes	Third-generation cephalosporins	59	18.8	51	16.3	49	15.7	3	1	162	51.7
	Penicillin- Beta-lactamase inhibitor	35	11.2	41	13.1	10	3.2	1	0.3	87	27.8
	Nitroimidazoles	16	0	0	0	0	0	0	0	16	5.1
	Lincosamide	13	4.2	0	0	0	0	0	0	13	4.2
	Aminoglycosides	8	2.6	6	1.9	0	0	0	0	14	4.5

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Factor		AGH		BAH		SCH		NCH		Total	
		N	%	N	%	N	%	N	%	N	%
	Fluoroquinolones	7	2.2	2	0.6	0	0	0	0	9	2.9
	Carbapenem	5	1.6	1	0.3	0	0	0	0	6	1.9
	Macrolide	2	0.6	1	0.3	0	0	0	0	3	1
	Glycopeptide	1	0.3	1	0.3	0	0	0	0	2	0.6
	Fourth-generation cephalosporin	1	0.3	0	0	0	0	0	0	1	0.3
Antibiotics prescriptions classification according to their use	No role for antibiotics	49	23	35	16.4	24	11.3	3	1.4	111	52.1
	Surgical prophylaxis	26	12.2	32	15	5	2.3	0	0	63	29.6
	Treatment	7	3.3	3	1.4	28	13.1	1	0.5	39	18.3
Prescriptions classification in case of the treatment use	Clinical presentation of infection only	6	15.4	0	0	12	30.8	1	2.5	19	48.7
	Radiographic findings	0	0	0	0	6	15.4	0	0	6	15.4
	Radiographic findings and clinical findings	0	0	0	0	6	15.4	0	0	6	15.4
	Laboratory finding only	1	2.6	1	2.6	2	5.1	0	0	4	10.3
	Laboratory findings and clinical presentation	0	0	2	5.1	2	5.1	0	0	4	10.3

*Others: Ceftazidime, cefepime, cefaperazone

28%(n=23), indicating that 72% of ICU hospitalized patients were administered antibiotics. Followed by Gynecology and Obstetrics Department with 23.2%(n=19) revealing that 42.2% of patients admitted to Gynecology and Obstetrics department received antibiotics. Posteriorly, the surgery department by 17%(n=14) which reflects a 73.7% proportion of patients hospitalized for surgery receive antibiotics. while the ophthalmology department shows the least antibiotic consumption, and more than 83.3% of patients never receive antibiotics.

3.1.2. Ber Abd hospital

Out of 13 departments in BAH, 10 departments met the inclusion criteria with 78.6% of prescriptions involving antibiotics. Antibiotic was prescribed for no reason amounting to 50%(n=35) while 45.7%(n=32) for surgical prophylaxis and only 4.3%(n=3) for treatment. In Gynecology and Obstetrics department, 85.3%(n=29) of the admitted patients received antibiotics, thus it was the highest antibiotic consumption with 41.4(n=29)%. Followed by the surgery department by 24.3(n=17)% suggests that 94.4% of admitted patients consume antibiotics. Neurology and Ophthalmology departments are of minimal antibiotic utilization with 0%.

3.1.3. El Sheikh Zwayed central hospital

The inclusion criteria were applied to three departments out of six departments in SCH. Antibiotics were present in 89.1% of prescriptions. More than 42.2%(n=24) of antibiotics were prescribed for no reason while 8.7% were for surgical prophylaxis, and 49% for treatment which was divided into 71.4%(n=20) weak evidence and 28.6%(n=8) of strong evidence. The gastroenterology department is the highest in SCH concerning antibiotic prescriptions with 87.7%(n=50). Additionally, 89.3% of patients admitted to this department receive antibiotics. As well, the Gynecology and Obstetrics department with 8.8%(n=5) antibiotic prescriptions, with all hospitalized patients in the department receiving antibiotics. While 3.5% of SCH antibiotic prescriptions related to the surgery department represent 66.6% of total department consumption.

3.1.4. Nekhel central hospital

Out of six departments, five departments met the inclusion criteria with 100% of prescriptions contain antibiotics. About 75% of antibiotics were prescribed for no reason, and 25% of weak evidence.

Table 2. Antibiotic route of administration, spectrum and presence of culture test

Factors		N	%
Route of antibiotics administration	IV	302	96.5
	Oral	9	2.9
	IM	2	0.6
Spectrum	Narrow spectrum	31	9.9
	Broad-spectrum	282	90.1
The antibiotics prescribed according to culture	yes	4	1.3
	No	305	98.7

4. Discussion

In this retrospective descriptive multicenter study, we described the pattern of antibiotics prescription in North Sinai hospitals-related to Egyptian MoHP and its departments, determined the appropriateness of the prescribed antibiotics, and calculated the cost; to recognize our current situation appended to the aim of Egyptian national action plan to combat AMR through optimizing its usage. It is a

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study conducted on North Sinai hospitals with too little study in Egyptian hospitals describing the pattern of antibiotic use to date. The literature review states that antimicrobial consumption is an alarming issue and fast-growing in developing countries than in developed ones[19–20].

The prevalence of antibiotic consumption in the four hospitals is 68.9%, higher than the recommended standard by WHO (20%-26.8%) with 36.6% of patients receiving more than one antibiotic[21]. These findings are higher than Pakistan at 35% to 60% of prescriptions involving antibiotics, Egypt at 59%, African countries at 53%, Thailand at 44%, Bangladesh at 25%, and Tanzania at 35.4%[15,22–26].

This overconsumption of antibiotics was not an indication of antibiotic misuse, but our study found that 52.1% of antibiotic prescriptions were prescribed with no reason for need, hence an indicator of inappropriateness. This inappropriateness and haphazard antibiotic prescription elevate antibiotic resistance and increases morbidity and mortality rate. Worldwide, 20%-50% of antibiotics are prescribed haphazardly[27]. Our study found that 29.6% of antibiotics prescriptions were prescribed for surgical prophylaxis, and this finding is higher than a study conducted in French hospitals in which 21% of hospitalized recieved surgical prophylaxis[28].

To bear in mind, only 18.3% of antibiotic prescriptions are for therapeutic purposes, in contrast to the global point prevalence survey[24]. About 74.4% of therapeutic antibiotics prescriptions were dependent on weak indicators for their actual need that raise the esteem of inappropriateness. Right treatment preceded by correct diagnosis through the clinical microbiological test, laboratory test, and clinical presentation in addition to radiographic if needed. Nevertheless, 98.7% of antibiotics are prescribed without culture and sensitivity tests, while only four medical records contain drug sensitivity tests similar to studies in Pakistan and Ethiopia[21,29].

Relevant to the situation of 'the tragedy of the commons' suspected infection or uncertainty contribute to excessive use of antibiotics, we found that 79.2% of antibiotics were administered on the same day of hospital admission. Moreover, clinicians reported in a study that antibiotic prescription during a hospital stay was a common practice to prevent infections, do suggest lacking infection and control concepts among them which led to the misuse of antibiotics[15,30]. Therefore, prescribing within guidelines is leading to good practice.

In our study, 18 types of antibiotics were prescribed either alone or in combination. Regarding antibiotic classes, half of the prescribed antibiotics were third-generation cephalosporins, divided into 26.5% cefotaxime and 27.8% Penicillin Beta-lactamase inhibitors, followed by 24.6% ceftriaxone. These findings are similar to South Africa and Pakistan's findings[22]. Cefotaxime is the most commonly prescribed antibiotic at 26.5%, in contrast to a study conducted in Tanzania in which amoxicillin/clavulanate was the most commonly prescribed antibiotics[26], which may be due to its broad-spectrum activity and availability in hospital pharmacies and its shortage.

As reported in similar studies, 90% of antibiotics are broad-spectrum[31]. About 63.4% of prescriptions involve a single antibiotic while 36.6% had more than one antibiotic, the finding is nearly similar to a study in Pakistan in which 65% received one antibiotic, Jourdan 34.7%, and higher than Tanzania 19.6%[22,26,32].

We found that 96.5% of antibiotics are injectables similar to a study conducted in Yemen but higher than in Congo 68.2%[33,34]. However, a study conducted on outpatients founds the lowest injectables prescribed antibiotics at 11.2% and 26.5%, which was normal in the case of outpatients[36–38].

Regardless of the different causes of patient hospitalization and different department in hospitals, approximately 50% of combined antibiotics prescriptions were cefotaxime and ampicillin-sulbactam. Around 20% to 40% of a hospital's medicine budget is for antimicrobials with an increase in antimicrobial consumption yearly, which contributes to rising health care costs, therefore, it should be carefully managed[38]. Our study found that the cost of the prescribed antibiotic was 20448 EGP.

We separately describe each hospital department to recognize the area of defect in consumption and appropriateness of the prescription behavior. This will facilitate the development of a plan and implement the regulations and policy robustly in these departments to optimize the usage for possible future intervention. Total Antibiotic consumption of the four hospitals was 68.9% divided to 26.5% AGH, 22.7% BAH, 18.4% SZH and 1.3% NCH. AGH demonstrates the highest proportion of the prescribed antibiotics for no reason at 23% followed by 16.4% for BAH, 11.3% for SCH, and lastly NCH at 1.4%.

In AGH, ICU is the highest consumption of antibiotics similar to Kenya and Global point prevalence survey[24]. Gynecology and Obstetrics Department is the highest in antibiotic prescription by 40.8% in BAH in contrast to Ghana and Kenya[39,40]. While SCH Gastroenterology Department shows the highest antibiotic consumption at 87.7%[41]. Higher than the study done in Nigeria on insured patients by 46.89%[42].

5. Conclusions

Our study demonstrated that two-thirds of hospitalized patients in North Sinai- Egypt Ministry of Health and Population Hospital received antibiotics. More than half of patient received antibiotics for no reason and more than 98% of antibiotics were prescribed with no indicators. Antibiotic prescribing behavior among clinicians participates in the acceleration of the antibiotic resistance phenomenon. Thus, there is an urgent need for the development of antibiotic policy and strengthening regulation with monitoring and stewardship. The significance of our study is that it shed light on understanding clinicians' attitudes toward dealing with antibiotics in each hospital department.

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Conflict of interest statement

The authors declare that there is no conflict of interest.

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Authors' contributions

Shams MMH developed the research idea, wrote the literature review, analyzed the data, and wrote the manuscript. Hamdy EM collected the data, contributed to writing the literature review, and wrote the keywords. Mohamed KA, Qwaider MO, El-Agha B, Elmatary SA collected the data from the four hospitals.

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