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Antibiotic Prescribing in the Acute Care in Iraq

Ola A. Nassr, Ali M. Abd Alridha, Rua A. Naser, Rasha S. Abbas

***Abstract*—**Background: Excessive and inappropriate use of antimicrobial agents among hospitalized patients remains an important patient safety and public health issue worldwide. Not only does this behavior incur unnecessary cost but it is also associated with increased morbidity and mortality. The objective of this study is to obtain an insight into the prescribing patterns of antibiotics in surgical and medical wards, to help identify a scope for improvement in service delivery. Method: A simple point prevalence survey included a convenience sample of 200 patients admitted to medical and surgical wards in a government teaching hospital in Baghdad between October 2017 and April 2018. Data were collected by a trained pharmacy intern using a standardized form. Patient's demographics and details of the prescribed antibiotics, including dose, frequency of dosing and route of administration, were reported. Patients were included if they had been admitted at least 24 hours before the survey. Patients under 18 years of age, having a diagnosis of cancer or shock, or being admitted to the intensive care unit, were excluded. Data were checked and entered by the authors into Excel and were subjected to frequency analysis, which was carried out on anonymized data to protect patient confidentiality. Results: Overall, 88.5% of patients (n=177) received 293 antibiotics during their hospital admission, with a small variation between wards (80%-97%). The average number of antibiotics prescribed per patient was 1.65, ranging from 1.3 for medical patients to 1.95 for surgical patients. Parenteral third-generation cephalosporins were the most commonly prescribed at a rate of 54.3% (n=159) followed by nitroimidazole 29.4% (n=86), quinolones 7.5% (n=22) and macrolides 4.4% (n=13), while carbapenems and aminoglycosides were the least prescribed together accounting for only 4.4% (n=13). The intravenous route was the most common route of administration, used for 96.6% of patients (n=171). Indications were reported in only 63.8% of cases. Culture to identify pathogenic organisms was employed in only 0.5% of cases. Conclusion: Broad-spectrum antibiotics are prescribed at an alarming rate. This practice may provoke antibiotic resistance and adversely affect the patient outcome. Implementation of an antibiotic stewardship program is warranted to enhance the efficacy, safety and cost-effectiveness of antimicrobial agents.

***Keywords*—**Acute care, antibiotic misuse, Iraq, prescribing.

I. Introduction

SINCE their introduction in 1940, antibiotics have saved millions of lives worldwide [1]. However, inappropriate use of antimicrobial agents in the inpatients settings has been widely reported in the literature [2]-[4]. According to the World Health Organization (WHO), 50% of antibiotics prescriptions are inappropriate [5] and antibiotics are sometimes prescribed when there is little or no evidence of infection [4], [6].

Examples of inappropriate use include use for suspected or viral infections, unnecessary prescription of broad-spectrum antibiotics, inappropriate selection of antimicrobial agents, suboptimal or inappropriate doses or duration and easy access to broad-spectrum antibiotics [7]. With inappropriate prescribing, not only is the antibiotic efficacy questionable but also a risk of potential complications exists [1]. Inappropriate use is linked to the emergence of antimicrobial resistance [8]. For example, the level of antibacterial resistance is higher in the south compared to the north of Europe because antibiotic utilization is higher in the former territory [9].

Infections caused by resistant pathogens tend to have a poorer prognosis, i.e., increased morbidity and mortality and increased duration of illness and length of stay [1], [6], [8]. Furthermore, they impose a greater economic burden on healthcare institutions, families and society, compared to infections caused by susceptible organisms [1], [8], [10]. For example, a Thai study indicates that the hospitalization cost for patients with infections caused by the extended spectrum beta-lactamase producer Escherichia coli is five times higher than for infections caused by extended spectrum non-beta-lactamase producer pathogens (528 USD vs. 108 USD) [6]. In 2007 in Europe, more than 8,000 patients died of sepsis associated with third-generation cephalosporin-resistant Escherichia coli and methicillin-resistant Staphylococcus aureus (MRSA) [9]. Given the fact that antibiotic resistance is growing and the challenge of a limited pipeline of new agents, responsible prescribing is prudent to promote appropriate use, decrease healthcare costs and avoid a further rise in resistance [8]. Thus, WHO advocated the adoption of an antimicrobial stewardship (AMS) program with the objective of optimizing antibiotic prescribing and combating the global rise in antibiotic resistance [6].

Antibiotic resistance surveillance and control in a Mediterranean region study included antibiotic prescription for inpatients from seven Middle East countries indicated an increase in the use of broad-spectrum antibacterial agents accompanied by an increase in the level of resistance in pathogenic organisms [11]. Clinical practice in Iraq lacks a policy for proper auditing, guidelines to optimize antibiotic treatment and restrictions on the purchase of prescription-only medicines, including antibiotics [12], [13].

O. A. Nassr is an Assistant Lecturer at College of Pharmacy, Department of Clinical Pharmacy, University of Al-Mustansiriyah, Baghdad, Iraq. (e-mail: ola.nassr2014@yahoo.com).

A. M. Abd Alridha is an Assistant Lecturer at College of Pharmacy, Department of Clinical Pharmacy, University of Kufa, Najaf, Iraq.

R. A. Naser is a Lecturer at College of Pharmacy, University of Al-Mustansiriyah, Baghdad, Iraq.

R. S. Abbas is an Assistant Lecturer at College of Pharmacy, Department of Clinical Pharmacy, University of Al-Mustansiriyah, Baghdad, Iraq.

Regular surveillance strategies to examine the prescribing patterns are relevant to identify gaps in service delivery that require intervention [6]. Studies that describe the prescribing patterns in Iraq are scarce. There is only one study that examined the prescribing patterns of antibiotics in surgical patients in 2011 and concluded that prescribing is optional, demonstrating an alarming overprescribing of broad-spectrum antibiotics, especially third-generation cephalosporins [12]. The aim of this study is to obtain an insight into the prescribing patterns for antibiotics in surgical and medical wards in a large government teaching hospital in Baghdad.

II. Methods

This point prevalence survey was conducted in surgical and medical wards of government teaching hospital in Baghdad between October 2017 and April 2018. The hospital is known to have an average of 30,000 admissions annually in all departments. All adult patients admitted 24 hours before the survey were included. Exclusion was applied to cancer patients as well as patients diagnosed with shock or admitted to the intensive care unit. Data were collected by trained pharmacy students, who were blinded regarding the study objective, under the supervision of university tutors. As part of their clinical training practice, each final year pharmacy student was asked to submit 1 case sheet using standard form including the following information: age, gender, past medical history, surgical history, inpatient medication information and diagnosis using medical records. Repeated cases were excluded leaving 200 cases eligible for inclusion (100 patients from each ward).

The primary outcome measure was the number of patients receiving antimicrobial therapy during hospital admission. Secondary outcome measure was to get an insight into the prescription pattern including name of antimicrobial agent prescribed, indication, dose, frequency of dosing and route of administration. In addition, we calculate number of patients for whom culture to identify pathogens was performed. Data were reviewed and entered by authors into excel 2013 as anonymous to protect patients confidentiality and were subjected to descriptive statistics analysis. Approval to conduct the study was obtained from Al-Mustansiriyah University, committee of scientific affairs and permission to use the medical records of the patients was obtained from the hospital in which the study was conducted.

III. Results

There were 67 male patients and 133 female patients. The average age of the sample was 48.8 years, (range 18-91 years). Overall, 88.5% of patients (n=177) received 293 antibiotics during their hospital admission with a small variation between wards (80%-97%) (Table I). With regard to the surgical ward, there were 77 surgical patients (Table II) and 23 patients with diabetic foot ulcers treated with debridement and antibiotics. The average number of antibiotics prescribed per patient was 1.65, ranging from 1.3 for medical patients to 1.95 for surgical patients. Parenteral third-generation cephalosporins were the most commonly prescribed at 54.3% (n=159), followed by nitroimidazole at 29.4% (n=86), quinolones at 7.5% (n=22) and macrolides at 4.4% (n=13), while carbapenem and aminoglycoside were the least prescribed, together accounting for only 4.4% (n=13). Among third-generation cephalosporin, ceftriaxone achieved the highest prescription rate at (n=138) followed by metronidazole at (n=86) at a mean total daily dose of 1.7 mg (range 1-3 mg) and 1.5 mg (1-1.5 mg) respectively (Table 3).

Overall, 62.7% (n=111) patients receive combination antibiotic therapy which was prescribed to 89.7% (87/97) of surgical patients compared to 30% (24/80) for medical patients (Table 3). The most frequently prescribed combination was third-generation cephalosporins and metronidazole 63.9% (n=71) followed by third-generation cephalosporins and quinolones 12.6% (n=14), third-generation cephalosporins and azithromycin 9.9% (n=11) and meropenem and metronidazole 9% (n=10). The intravenous route was the most common route of administration, being used for 84.7% of patients (n=150), while 11.9% (n=21) received a combination of IV and oral antibiotics. Only 3.4% of patients (n=6) received only oral treatment. Culture to identify pathogenic organisms was employed in 0.5% of cases. Only 63.8% (n=113/177) gave a reason for prescribing. Reasons included surgical prophylaxis 41.8% (n=74), skin and soft tissue infection including diabetic foot ulcer 13.6% (n=24), chest infection, urinary tract infection 8.5% (n=15) and unknown 36.2 % (n=64).

TABLE I
Proportions and Percentages of Patients Receiving No Therapy, Monotherapy and Combination Therapy

Number of antibiotics	All wards	Surgical ward	Medical ward
0	23 (11.5%)	3 (13.1%)	20 (86.9%)
1	66 (33%)	10 (15.2%)	56 (84.8%)
2	106 (53%)	82 (77.4%)	24 (22.6%)
3	5 (2.5%)	5 (100%)	NA

TABLE II
Types of Surgical Procedures

Surgical ward	Patients (n=77)
Appendectomy	31 (43.7%)
Hernia removal surgery	13 (16.9%)
Cholecystectomy	20 (25.9%)
[a] Anal surgery	7 (9.1%)
[b] Other	6 (7.8%)

[a]Includes hemorrhoidectomy, anal fissurectomy and perianal abscess removal. [b] Includes renal stone, wound operation and fistulectomy

IV. Discussion

The study shows that antibiotics are prescribed at a high rate (88.5%). The average number of antibiotics prescribed per patient is 1.65. Antibiotic exposure was higher in surgical than in medical patients (1.95 vs. 1.3). Parenteral third-generation cephalosporins were the most commonly prescribed accounting for 54.3% of all antibiotics followed by meteronidazole at 29.4% and quinolones at 7.5%. Overall, 62.7% of patients receive combination antibiotic therapy with parenteral third-generation cephalosporins and metronidazole being the most frequently prescribed combination, 63.9%. The parenteral route was employed in 96.6% of patients and only 3.4% received oral antibiotic therapy. Culture to identify pathogenic organisms was employed in 0.5% of cases. Only 63.8% (n=113/177) gave a reason for prescribing.

There is evidence of excessive, perhaps unnecessary, use of antibiotics. Although the average number of antibiotics prescribed per patient (1.65) is within the established WHO range of 1.6-1.8, [5] the rate of antibiotic prescribing is relatively high. The rate of 88.5% is higher than the rates of 32.4%, 33.8% and 31% reported for Australia, Netherlands and Canada, respectively [3], [9], [14]. It is reported that in developing countries, antibiotics are prescribed, usually unnecessarily or inappropriately, to 44%-97% of hospitalized patients [4]. This could be explained by the fact that patients in developing countries are more likely to contract infections due to environmental factors [1], [13]. In addition, prescriber attitudes, knowledge and experience, lack of a clearly defined working diagnosis and perceived expectations from patients are all factors known to affect the proper prescribing of antibiotics [6]. Moreover, poor implementation of effective infection control in hospitals, lack of an antibiotic stewardship program and the unavailability of infection disease specialists and well-trained clinical pharmacists also contribute to a high level of antibiotic use.

TABLE III
MEAN TOTAL DAILY DOSES FOR ANTIBIOTIC PRESCRIPTIONS

Antimicrobial agent Mean daily dose (range) mg.	Prescriptions (n=293)	All wards (n=177)	Surgical ward (n=97)	Medical ward (n=80)
Ceftriaxone	138	1.7 (1-3)	1.95 (1-3)	1.4 (1-3)
Metronidazole	86	1.5 (1-5)	1.5 (1-1.5)	1.25 (1-1.5)
Cefotaxime	15	2.1 (1-3)	2.7 (2-3)	1.8 (1-2)
Azithromycin	13	442.3 (250-500)	NA	442.3 (250-500)
Meropenem	12	2.3 (2-3)	2.3 (2-3)	NA
Moxifloxacin	8	400	NA	400
Ciprofloxacin	7	742.9 (400-800)	800	400
Levofloxacin	7	500	500	500
Ceftazidime	6	2.8 (2-3)	3	2.5 (2-3)

The most commonly prescribed antibiotics are third-generation cephalosporins, metronidazole and quinolones. There is a preference for prescribing ceftriaxone, a third-generation cephalosporin, in both medical and surgical wards. Although all broad-spectrum antibiotics can promote Clostridium difficile infection, third-generation cephalosporins and quinolones are particularly involved [16] and are therefore classified as restricted antibiotics in the UK [16]. A decrease in their use in secondary care in the NHS was reflected in a decrease in the incidence of C. difficile infection [8]. In addition, international guidelines advise against their routine use in surgical prophylaxis as their use promotes resistance [17]. However, studies in Cameroon [5], [6], India [15] and Nigeria [2] show similar prescribing patterns.

Other countries have different prescribing patterns. For example, in Oman, piperacillin/tazobactam, amoxicillin/clavulanic acid and clarithromycin were the most commonly prescribed antibiotics [10]. In Turkey, amoxicillin/clavulanic acid was the most commonly prescribed in inpatient and outpatient healthcare facilities [7]. The trend towards prescribing broad-spectrum antibiotics could be explained by limited facilities to conduct culture and sensitivity testing to guide antibiotic therapy, as the use of these agents negates the need for pathogen isolation and identification [6].

With regard to surgical prophylaxis, for certain types of clean, clean contaminated and contaminated wounds, the National Institute for Health and Care Excellence (NICE) recommends administration of a single dose of antibiotic 60 minutes before surgical incision, as prophylaxis against potential surgical site infection [8]. A repeat dose is given if the operation is longer than the half-life of the antibiotic [8]. Dirty wounds, such as a perforated appendix, require antibiotic prophylaxis and treatment [8]. All patients receive prophylaxis for more than 24 hours, which is contrary to best-practice recommendations [17]. The practice in Iraq is to prescribe a course of 5-10 days of antibiotics after surgery, as prophylaxis against infection, due to the fear of complications of surgical site infections. This is not peculiar to Iraq; a prolonged duration of prophylaxis has been reported in other studies worldwide [2], [3], [15], [18]. Sometimes antibiotics were administered until discharge and for 5-10 days post discharge to all surgical patients, irrespective of the risk of the procedure to cause surgical site infection and were given to patients without evidence of infection [4].

Antibiotic exposure is higher in surgical than in medical patients. The majority of surgical patients (89.7%) receive combination therapy, compared to only 30% of medical patients. This is in line with other studies that reported overprescribing for surgical patients [4], [15], [18]. The average number of antibiotics prescribed was 1.95 for surgical patients compared to 1.3 for medical patients. In a study conducted in India, the average was 1.7 for a medical ward and 3.02 for a surgical ward [15]. Ceftriaxone and metronidazole were the most common combination. The addition of metronidazole would decrease the incidence of C. difficile infection [19]. This pattern of prescribing has been reported in other studies [2], [5], [6], including pediatric populations [20]. A study in Italy indicated alarming overprescribing of third-generation cephalosporins and metronidazole for surgical prophylaxis in children [20]. Sub-therapeutic concentration contributes to the selection of resistant strains [1]. However, antibiotic doses appear to be within the normal range reported in the British National Formulary [21].

The parenteral route was employed in 96.6% of patients and 3.4% received oral antibiotic therapy. The IV route should ideally be reserved for the critically ill who are unable to absorb drugs, which is only a small proportion of the population [15]. By narrowing down previously started broad-spectrum antibiotics, the likelihood of developing resistance will be reduced [9]. Switching from IV to oral administration is advocated when the patient condition has improved after 48 hours of IV antibiotics, i.e., when the patient is hemodynamically stable (temperature is less than 38°C), the pathogenic organism and or diagnosis is known and there are no contraindications or intolerances affecting oral intake [9]. Similar studies in Nigeria and Kyrgyz Republic show that 74.8% and 75% of patients were receiving antibiotics through a parenteral route respectively [2], [4]. IV/oral switch decreases the cost, the adverse effects and the length of hospital stay, yet provides an equal therapeutic outcome [8]. However, the practice in the hospital is to administer antibiotics via IV to inpatients and orally to outpatients.

Culture to identify pathogenic organisms was performed in only 0.5% of cases. In the Oman study, culture and sensitivity testing was employed in 25% of cases [10]. However, modern diagnostic techniques such as polymerase chain reaction (PCR) have allowed the isolation of pathogens in 89.8% of patients with community-acquired pneumonia in Sweden [1], thus allowing the use of antibiotics with a narrower spectrum of activity that can target the known pathogen [1]. In the hospital where the study was conducted, microbiological testing is typically reserved for patients who fail to respond to repeated and various courses of antibiotic therapy. This is in line with a previously published study in Iraq which found that antibiotic prescribing is empirical, and culture and sensitivity testing is absent [12]. This is not related merely to the physician's attitude toward the importance of culture and sensitivity testing but also to poor availability of resources. Empirical prescribing is multifactorial, with factors including limited facilities to conduct culture and sensitivity testing, costly laboratory diagnostic tests and long waits for laboratory tests to return [2].

Poor prescribing practice is further reinforced by the lack of indication in 36.2% of cases. Indication was documented in only 63.1% of prescriptions in Australia [3]. Similarly, in a Nigerian study, indication was reported for 61.8% of cases [2]. This could be due to patient demand and diagnostic uncertainty [6]. Prescribing antibiotics when there is uncertainty about the diagnosis of infection represents evidence of antibiotic misuse, which is implicated in the emergence of resistance in previously sensitive bacteria [6].

Safe and effective antibiotic use involves a delicate balance between adequacy of antibiotic therapy, following standard prescribing practice and avoidance of excessive and inappropriate antibiotic use, thereby preventing a further rise in antibiotic resistance [9]. As resistance is of global significance and has the potential to affect patient treatment and outcome [4], our findings highlight the need to improve prescribing practice through continued education for prescribers, implementation of evidence-based guidelines and improvements in laboratories. The country needs initiatives to regulate and optimize antibiotic use, especially in inpatient settings where broad-spectrum antimicrobials are frequently used [10]. Implementation of antibiotic stewardship has been shown to improve the cost-effectiveness of antibiotic therapy. It decreases the costs incurred by healthcare facilities through optimizing antibiotic use via rapid use of antibiotics in cases of life-threatening infections, switching from IV to oral administration in eligible patients and decreasing excessive and inappropriate use [8]. Thus, this strategy indirectly decreases costs by decreasing the length of stay, decreasing resistance and consequently improving the patient outcome [8]. In addition, the antibiotic name, dose, route, indication, date started, stop/review date and duration should be clearly documented in the medical records**,** to avoid excessive and unnecessary use of antibiotics and treatment failure**.**

The external validity of the study is limited by a relatively small sample size. In addition, prescribing data were collected over a short period, from one hospital in Baghdad. Indication for surgical prophylaxis was not reported and was assumed due to poor documentation of such data. A large multicenter study to reflect antibiotic prescribing practice is warranted.

V. Conclusion

The study provides an insight into antibiotic prescribing in acute care in an Iraqi hospital. It indicates a high level of prescribing which is primarily empirical, augmented by a preference for prescribing restricted antibiotics represented by parenteral third-generation cephalosporins. Implementation of guidelines for antibiotic use, continued professional education of prescribers and regular surveillance to monitor prescribing patterns are important, to enhance prudent use of antibiotics and improve patient outcomes.

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References

[1] C. L. Ventola, "The antibiotic resistance crisis—part 1: causes and threats," Pharmacy and Therapeutics, vol. 40, no. 4, pp. 277– 283, 2015.

[2] OO. Oduyebo, AT. Olayinka, KC. Iregbu, A. Versporten, H. Goossens, PI. Nwajiobi-Princewill, et al., "A point prevalence survey of antimicrobial prescribing in four Nigerian Tertiary Hospitals," Annals of Tropical Pathology, vol. 8, no. 1: pp. 42-46, 2017.

[3] M. O. Cotta, M. S. Robertson, L. M. Upjohn, C. Marshall, D. Liew, K. L. Buising, "Using periodic point-prevalence surveys to assess appropriateness of antimicrobial prescribing in Australian private hospitals," Intern Med J, vol. 44, no. 3: pp. 240-6, 2014.

[4] K. Baktygul, B. Marat, Z. Ashirali, Harun-Or-rashid M, J. Sakamoto, "An assessment of antibiotics prescribed at the secondary health-care level in the Kyrgyz Republic," Nagoya J Med Sci, vol. 73: pp. 157-68, 2011.

[5] L. A. Mbam, G. L. Monekosso, E. A. Asongalem, "Indications and patterns of antibiotic prescription in the Buea Regional Hospital of Cameroon," Health Sci Dis, vol. 16, no. 1, 2015.

[6] E. D. Chem, D. N. Anong, J. K. T. Akoachere, "Prescribing patterns and associated factors of antibiotic prescription in primary health care

facilities of Kumbo East and Kumbo West Health Districts, North West Cameroon," PLoS One, Vol. 13, no. 3: pp: e0193353, 2018.
[7] S. Mollahaliloglu, A. Alkan, B. Donertas, S. Ozgulcu, A. Akici, "Assessment of antibiotic prescribing at different hospitals and primary health care facilities," Saudi Pharmaceutical Journal, vol. 21, no. 3: pp. 281-291, 2013.
[8] D. Ashiru-Oredope, M. Sharland, E. Charani, C. McNulty, J. Cooke, "Improving the quality of antibiotic prescribing in the NHS by developing a new Antimicrobial Stewardship Programme: Start Smart--Then Focus," J Antimicrob Chemother, vol. 67 Suppl 1: pp. i51-63, 2012.
[9] H. Akhloufi, R. H. Streefkerk, D. C. Melles, J. E. de Steenwinkel, C. A. Schurink, R. P. Verkooijen, et al., "Point prevalence of appropriate antimicrobial therapy in a Dutch university hospital," Eur J Clin Microbiol Infect Dis, vol. 34, no. 8: pp. 1631-7, 2015.
[10] A. Al-Yamani, F. Khamis, I. Al-Zakwani, H. Al-Noomani, J. Al-Noomani, S. Al-Abri, "Patterns of Antimicrobial Prescribing in a Tertiary Care Hospital in Oman," Oman Med J, vol. 31, no. 1: pp. 35-9, 2016.
[11] M. A. Borg, P. Zarb, M. Ferecgh, H. Goossens, et al., "Antibiotic consumption in southern and eastern Mediterranean hospitals: results from the ARMed project," J Antimicrob Chemother, vol. 62, no. 4: pp. 830-6, 2008.
[12] K. M. Jumaa, S.A Hussein, A. M. Jaffer, A. S. Abdel Alaziz, Abdel Latif R. A., "Antibiotic Prescription Pattern in Surgery Department in Baquba Teaching Hospital," The New Iraqi Journal of Medicine, vol. 7, no. 2: pp. 33-40, 2011.
[13] T. K. Al Hilfi, R. Lafta, G. Burnham, "Health services in Iraq," Lancet, vol. 381: pp. 939-48, 2013.
[14] C. Lee, S. A. Walker, N. Daneman, M. Elligsen, L. Palmay, B. Coburn, et al., "Point prevalence survey of antimicrobial utilization in a Canadian tertiary-care teaching hospital, " J Epidemiol Glob Health, vol. 5, no. 2: pp. 143-50, 2015.
[15] V. S. Deshmukh, V. V. Khadke, A. W. Patil, P. S. Lohar, "Study of prescribing pattern of antimicrobial agents in indoor patients of a tertiary care hospital," Vol. 2, no. 3, 281-5, 2013.
[16] Clostridium difficile infection: risk with broad spectrum antibiotics. 2015 March 2015; Available from: https://www.nice.org.uk/advice/esmpb1/resources/clostridium-difficile-infection-risk-with-broadspectrum-antibiotics-pdf-1502609568697285.
[17] Bratzler, D. W., E. P. Dellinger, K. M. Olsen, T. M. Perl, P. G. Auwaerter, M. K. Bolon, et al., Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health Syst Pharm, vol. 70, no. 3: p. 195-283, 2013.
[18] E. Charani, C. Tarrant, K. Moorthy, N. Sevdalis, L. Brennan, A. H. Holmes, "Understanding antibiotic decision making in surgery-a qualitative analysis," Clin Microbiol Infect, vol. 23, no. 10, pp. 752-760, 2017.
[19] S. O'Neill, P. Ross, P. McGarry, S. Yalamarthi, "Latest diagnosis and management of diverticulitis," Br J Med Pract, vol. 4, no. 4, pp: a443, 2011.
[20] M. De Luca, D. Dona, C. Montagnani, A. Lo Vecchio, M. Romanengo, C. Tagliabue, et al, "Antibiotic Prescriptions and Prophylaxis in Italian Children. Is It Time to Change? Data from the ARPEC Project," PLoS One, vol. 11, no. 5: pp. e0154662, 2016.
[21] British National Formulary. Edition 69. London: Royal Pharmaceutical Society of Great Britain and British Medical Association; 2015. pp 222-245.