



**The Libyan International Medical University
Faculty of Basic Medical Science**



Antibiotic misuse leads to the emergence of antibiotic resistance

Norelhuda Idris Founas

2269

Supervised by: Dr. Khadija Mansour

Assisted by: Dr. Sara Magrhi

Report Submitted to fulfill the requirements for Scientific Research Activity

Date of Submission: 12 / 3 / 2020

Abstract

The rapid emergence of resistant bacteria is occurring worldwide, endangering the efficacy of antibiotics, which have transformed medicine and saved millions of lives. Many decades after the first patients were treated with antibiotics, bacterial infections have again become a threat. The antibiotic resistance crisis has been attributed to the overuse and misuse of these medications, as well as a lack of new drug development by the pharmaceutical industry due to reduced economic incentives and challenging regulatory requirements. The Centers for Disease Control and Prevention (CDC) has classified a number of bacteria as presenting urgent, serious, and concerning threats, many of which are already responsible for placing a substantial clinical and financial burden on the U.S. health care system, patients, and their families. Coordinated efforts to implement new policies, renew research efforts, and pursue steps to manage the crisis are greatly needed. ⁽¹⁾ ⁽²⁾ ⁽³⁾ ⁽⁴⁾

Introduction

Antibiotics are a vital addition to modern medicine. Their effect on certain infections have been revolutionary, increasing human life expectancy by a drastic eight years. Since their discovery between 1945 and 1972, antibiotics have aided in the treatment of many infections that would have previously been left untreated. If not for these crucial drugs, modern medicine would be set back by decades, minor surgeries such as appendectomies would become possibly fatal.

Antibiotics effectively carry out their function in two ways; either by inhibiting the growth and replication of a bacterium (bacteriostatic) or by outright eradicating the microbes by interrupting the mechanism of their cell wall formation (bactericidal). Their targets are clear; bacterial infections within or on the body. The majority of these drugs are created and produced in laboratories, but are based off natural components. Some antibiotics are highly specialised, effective only against certain types of bacteria.

There are four major mechanisms that mediate bacterial resistance to drugs. (1) Bacteria produce enzymes that inactivate the drug. (2) Bacteria synthesize modified targets against which the drug has a reduced effect. (3) Bacteria reduce permeability to the drug such that an effective intracellular concentration of the drug is not achieved (4) Bacteria actively export drugs using a “multidrug-resistance pump” (MDR pump, or “efflux” pump). The MDR pump imports protons and, in an exchange-type reaction, exports a variety of foreign molecules including certain antibiotics, such as tetracyclines.

The overuse of antibiotics especially taking antibiotics even when they're not the appropriate treatment promotes antibiotic resistance. According to the Centres for Disease Control and Prevention, up to one-third to one-half of antibiotic use in humans is unnecessary or inappropriate.

Antibiotics treat bacterial infections but not viral infections. For example, an antibiotic is an appropriate treatment for strep throat, which is caused by the bacterium *Streptococcus pyogenes*. But it's not the right treatment for most sore throats, which are caused by viruses.

If you take an antibiotic when you actually have a viral infection, the antibiotic attacks bacteria in your body – bacteria that are either beneficial or at least not causing disease. This misdirected treatment can then promote antibiotic resistant properties in harmless bacteria that can be shared with other bacteria, or create an opportunity for potentially harmful bacteria to replace the harmless ones. ⁽⁴⁾⁽⁵⁾

Methods and materials

A prospective cross-sectional survey was conducted during March to July 2018, and was approved by the research committee of faculty of Medical technology, Tripoli University, Libya. Data was collected using a pretested self-administered questionnaire with both open and closed ended questions. The questionnaire was written in English (Translated verbally to the local language) and was pre-validated on a sample of 5 students and comments were taken into consideration. A total of 305 questionnaires were randomly distributed to students of faculty of pharmacy (163 questioners) and faculty of Medical technology (142 questioners), Tripoli University, Libya. The questionnaire contained three open and closed questions that was clarified to all students participated in this study. The first section documented the socio-demographic aspect of students such as age, gender, and year of study. The second section consisted of eight closed questions to deliver facts on the exercise of using antibiotics. The third section consisted of four questions intended to assess the perception of respondents toward antibiotics. A high level of confidentiality was kept throughout the study with written informed consent obtained prior data collection. Students were asked to report antibiotic use with or without prescription in the year 2017. The data entry and analyses were done in SPSS version 22 (SPSS, Inc., Chicago, IL, USA). The data were summarized as percentages and frequencies. ⁽³⁾

Results

Of 305 surveyed students participated in this study, a total of 257 forms were completed and returned (response rate 84.2%). The majority of students (243, 94.5%) were females and the average age was 24.8 years (range 18-25) (Table 1). As shown in Table 2, the prevalence of antibiotic use with and without a prescription was high. Antibiotics were obtained with a medical prescription by 60 (23.3%) and used for self-medication without prescription by 197 (76.6%) of students. The course of antibiotic was completed by the larger number of respondents with or without prescription ([41, 68.3%], [115, 58.3%] respectively). Categories of antibiotics and basis for their use are revealed in (Table 3). The most frequently used antibiotics with or without a prescription were co-amoxiclav, amoxicillin, and cefixime. The most commonly prescribed antibiotics were co-amoxiclav (32, 53.3%), amoxicillin (10, 16.6%), and cefixime (11, 18.3%). For self-medication contributors, the order was the same, the frequently used antibiotics were co-amoxiclav (123, 62.4%), amoxicillin (51, 25.8%) and cefixime (13, 6.6%). The pharmacy was the main source where the majority obtained antibiotics (85% with prescription, 91.8% without prescription). Unexpectedly, large numbers of both groups of students were aware of bacterial resistance associated with misuse of antibiotics. Antibiotics were used with or without a prescription for influenza, upper respiratory tract infection, gastrointestinal disorders, skin conditions and urinary tract infection. Basis for using antibiotics without a prescription include doctor advice on last visit (36.5%), previous experience (27.9%), pharmacist advice (23.3%), and advice of relative (12.1%).⁽³⁾

Discussion

Antibiotic resistance is rising to dangerously high levels in all parts of the world. New resistance mechanisms are emerging and spreading globally, threatening our ability to treat common infectious diseases. A growing list of infections – such as pneumonia, tuberculosis, blood poisoning, gonorrhoea and foodborne diseases – are becoming harder, and sometimes impossible, to treat as antibiotics become less effective.

Where antibiotics can be bought for human or animal use without a prescription, the emergence and spread of resistance is made worse. Similarly, in countries without standard treatment guidelines, antibiotics are often over-prescribed by health workers and veterinarians and over-

used by the public. Without urgent action, we are heading for a post-antibiotic era, in which common infections and minor injuries can once again kill.

Serious outbreaks of diseases caused by gram-negative rods resistant to multiple antibiotics have occurred in many developing countries. In North America, many hospital-acquired infections are caused by multidrug-resistant organisms. Three main points of overuse and misuse of antibiotics increase the likelihood of these problems by enhancing the selection of resistant mutants:

(1) Some physicians use multiple antibiotics when one would be sufficient, prescribe unnecessarily long courses of antibiotic therapy, use antibiotics in self-limited infections for which they are not needed, and overuse antibiotics for prophylaxis before and after surgery.

(2) In many countries, antibiotics are sold over the counter to the general public; this practice encourages inappropriate and indiscriminate use of the drugs.

(3) Antibiotics are used in animal feed to prevent infections and promote growth. This selects for resistant organisms in the animals and may contribute to the pool of resistant organisms in humans. ⁽¹⁾

Antibiotic resistance is one of the biggest threats to global health, food security, and development today. It can affect anyone, of any age, in any country. Antibiotic resistance occurs naturally, but misuse of antibiotics in humans and animals is accelerating the process. A growing number of infections – such as pneumonia, tuberculosis, gonorrhoea, and salmonellosis – are becoming harder to treat as the antibiotics used to treat them become less effective. Antibiotic resistance leads to longer hospital stays, higher medical costs and increased mortality. The world urgently needs to change the way it prescribes and uses antibiotics. Even if new medicines are developed, without behaviour change, antibiotic resistance will remain a major threat. Behaviour changes must also include actions to reduce the spread of infections through vaccination, hand washing, practicing safer sex, and good food hygiene. ⁽¹⁾⁽²⁾⁽⁴⁾

Conclusion

The case study presented revealed important findings confirming the aim of this report, a high incidence of self-medication practice among undergraduate Medical students which constitutes a health problem related to inadequate public knowledge of antibiotics. Influenza, upper respiratory tract infection, gastrointestinal disorders, skin conditions and urinary tract infection were the main reasons for self-medication. Previous experience, doctor advice on last visit, pharmacist advice, and opinion of relative were major criterion for selection of antibiotics. Education programs should be developed, targeting specific public groups identified in this study, with lower antibiotic knowledge and higher self-medication risk. Finally, the attention of health care policy makers should be focused on physicians and pharmacists, as the main information providers of rational antibiotic use, as well as on community pharmacies, identified as the main source of non-prescription antibiotics.

References

1. Ventola, C. L. (2015). The antibiotic resistance crisis: part 1: causes and threats. *Pharmacy and therapeutics*, 40(4), 277.
2. Rather, I. A., Kim, B. C., Bajpai, V. K., & Park, Y. H. (2017). Self-medication and antibiotic resistance: Crisis, current challenges, and prevention. *Saudi journal of biological sciences*, 24(4), 808-812.
3. Atia, A. (2018). Utilization of Antibiotic among University Medical Students from Tripoli, Libya. *J Antibio Res*, 2(2), 201.
4. English, B. K., & Gaur, A. H. (2010). The use and abuse of antibiotics and the development of antibiotic resistance. In *Hot topics in infection and immunity in children VI* (pp. 73-82). Springer, New York, NY.
5. Levy, S. B. (2001). Antibiotic resistance: consequences of inaction. *Clinical Infectious Diseases*, 33(Supplement_3), S124-S129.