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THE INDISCRIMINED CONSUMPTION OF ANTIBIOTICS AND THE EMERGENCE OF SUPERBACTERIA

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Abstract: This article will address a topic of scientific development, which aims to relate the excessive use of antibiotics and the emergence of superbugs. From 1928 onwards, with the discovery of penicillin by Alexander Fleming, a new series of medicines began to gain prominence, antibiotics. From that point on, several studies began to be carried out, resulting in the need to subdivide these drugs according to their purpose and agents of action. However, there was no controlled use, and the population had unrestricted access to them. Antibiotics could be purchased by any individual, and used to treat diseases for which they had no proven efficacy. The search methods used were scientific articles published in Revista ``Unimontes Científica``, and in Research, Society and Development. The results of the research showed that antibiotics, used incorrectly, caused bacteria to create super natural resistance, becoming immune to the effects of this medicine, thus creating a worldwide problem. To conclude, it is necessary that the agents responsible for bacteriological control seek ways to raise awareness among the population regarding the indiscriminate use of antibiotics and the risks they may be causing, unconsciously, to themselves.
Keywords: Agents; Antibiotics; Drugs; Indiscriminate; Superbugs

INTRODUCTION

Since the discovery of penicillin in the 20th century by Alexander Fleming, antibiotics have been used as a treatment for bacterial infections, reducing morbidity and mortality rates from infections, revolutionizing the pharmaceutical industry and improving the health of society. From studies of antibiotics, there is a need to subdivide them according to their purpose, so antibiotics can be natural or synthetic and have the function of causing the death of bacteria or inhibiting bacterial development.

Also, they are known and classified as bactericides when they cause the death of bacteria, or as bacteriostatics, when they inhibit bacterial development. However, due to society's ease of access to antibiotics such as β-lactams, they end up being described for their effectiveness. And over time, microorganisms became naturally more resistant, as a result of the indiscriminate use of antibiotics without necessary evaluation, such as self-medication and medical prescriptions not followed correctly, thus making the antibiotic ineffective, as its concentration will not be the same. sufficient to destroy the bacterial population, but the irregular use of this class of medication, where, through improper use, it serves as a competition tool in the microbial population, which only the most resistant microorganisms survive, being a mechanism along with the bacterial adaptive ability, having bacterial resistance as a result.

Due to the event that arises from mutations, transduction or selection. As a result, the speed at which bacteria adapt is faster than drugs are developed to destroy them, creating a need to develop new, more effective drugs, with the risk of there being no more effective antibiotics for bacterial treatment in the future. Thus, knowing that it is necessary to raise awareness among the population about the incorrect use of antibiotics, as it can cause the drug to become ineffective, resulting in bacterial adaptation, causing it to become super-resistant.

ANTIBIOTICS AND MECHANISMS OF ACTION

Antibiotics are natural or synthetic compound substances, discovered in 1928, capable of eliminating or inhibiting the growth of bacteria. The discovery of these antibiotics occurred after the culture medium was forgotten when exposed to the environment, this culture medium was

for the purpose of studying the bacteria *Staphylococcus aureus*. Contact with the environment caused contamination by fungi of the Penicillium type and thus realized that the environment did not grow near these microorganisms, being a means of preventing the growth of these bacteria under study. Thus, these antibiotics began to have more and more medical prescriptions, and over time the bacteria began to generate adaptation capacity, which is associated with the genomic structure, where there is an exchange of genes between bacteria, carried out through non-specific structures. chromosomal, such as plasmids. Therefore, they become resistant, as genetic changes and chromosomal mutations alter the action of the antibiotic, destroying it. (DUARTE et.al 2019)

As a result, we have several classifications of antibiotics with different mechanisms of action.

BETA-LACTAM ANTIBIOTICS

They are antibiotics that have a beta-lactam ring in their chemical structure, which has a bactericidal function, acting to inhibit the synthesis of the bacterial cell wall. It is worth remembering that the cell wall differentiates between gram-negative and gram-positive bacteria, which involves the peptidoglycan layer. Here we have a very valid concept of penicillins, which bind and activate Penicillin Binding Proteins present in peptidoglycan, which in turn are found in greater quantities in gram-positive bacteria. (SANTANA, 2019)

In this class of antibiotics, we also have cephalosporins, from the first to fourth generation, where the first generation is used against gram-positive inhibition when penicillin must be avoided in allergic cases, for example. The third and fourth generation are more effective, that is, they have greater potency and spectrum of action against gram-negative bacteria. (NOGUEIRA et. al, 2016).

Since cephalosporins and their strengths of action were mentioned here, it is worth mentioning that carbapenems, also beta-lactams, are the antibiotics with the broadest spectrum of this class, as they act on greater numbers of bacteria. Imipenem, a carbapenem, is active against many gram-negative and positive, aerobic and anaerobic bacteria, including infections caused by Pseudomonas and Acinetobacter spp. However, it must be reserved for serious hospital infections caused by highly resistant bacteria. (SCHERER et.al, 2016; DUARTE et.al, 2019)

AMINOGLYCOSIDES

They are antibiotics with a chemical structure composed of an amino group and a sugar. Characteristic of an improved pH activity, being slightly more alkaline, around 7.4, which facilitates the action against aerobic gram-negative bacteria. This class of antibiotics interferes with processes considered essential, as they bind to the 30S ribosomal subunit, preventing the movement of this ribosome along the messenger RNA. Thus, having a bactericidal action, it interrupts the synthesis of proteinase if it has an altered sequence of encoded proteins that interferes with membrane permeability, causing electrolyte imbalance and bacterial lysis and for this same reason it must be carefully controlled, as its toxicity is greater and much greater. harmful to the kidneys. Examples of this class: amikacin, streptomycin, gentamicin, neomycin and tobramycin (SCHERER et.al, 2016).

MACROLIDES

Antibiotics are considered bacteriostatic agents, they prevent the proliferation of bacteria when they bind to the 50S ribosomal subunit, inhibiting translocation and transpeptidation steps in the synthesis of bacterial proteins. The most common example

of this class is azithromycin. (SCHERER et.al, 2016)

QUINOLONES

They are considered broad-spectrum antibiotics, due to the range of bacteria that are capable of inhibiting growth, or better said, they inhibit bacterial DNA synthesis, through interaction with the bacterial DNA gyrase and topoisomerase IV enzymes responsible for counteracting DNA supercoiling during replication and allow the segregation of chromosomes by daughter cells. Main drugs in this class: levofloxacin and ciprofloxacin. (GOUVEA,2013).

SULFONAMIDE

It has been an antibiotic widely used against infections due to its low cost and relevant effectiveness. These are drugs that act on the metabolism of folic acid, famous competitive inhibitors of the bacterial enzyme, called dihydropteroatosynthetase, responsible for incorporating para-aminobenzoic acid (PABA), which is a precursor of folic acid. This process is extremely relevant in the biosynthesis of a cofactor that provides carbon for the pyrimidine bases of nucleic acids. (SCHERER et.al, 2016)

BACTERIAL RESISTANCE

Bacterial resistance is a worrying phenomenon that occurs when bacteria develop the ability to resist the effects of antibiotics. This can occur in several ways and can be classified according to different categories. Here are some common classifications related to bacterial resistance in relation to antibiotics. Some bacteria are naturally resistant to certain antibiotics due to their genetic makeup or structural characteristics. For example, many Gram-negative bacteria have outer membranes that make it difficult for antibiotics to enter, making them inherently resistant to certain classes of antibiotics. (NETO et.al, 2023)

Bacteria can acquire antibiotic resistance over time due to random genetic mutations or through the acquisition of resistance genes from other bacteria (through plasmids or transposons, for example). This can happen in response to repeated exposure to antibiotics. (NETO et.al, 2023)

Cross-resistance occurs when a bacterium develops resistance to one antibiotic and, as a result, also becomes resistant to other antibiotics with similar mechanisms of action. This can limit the treatment options available for infections caused by these bacteria. (MARTINS et.al, 2015)

Some types of bacteria develop resistance to multiple classes of antibiotics, becoming "superbugs" that are difficult to treat. This often occurs in healthcare settings where exposure to antibiotics is high. (MARTINS et.al, 2015)

This is a particularly worrying scenario in which bacteria develop resistance to antibiotics that are considered the last resort for treating serious and resistant infections. An example of this is resistance to carbapenems, which are antibiotics of last resort for some infections. (MARTINS et.al, 2015)

Bacterial resistance can occur both in the community and in hospital environments. Bacteria that develop resistance in hospitals are often more resistant and difficult to treat due to constant exposure to antibiotics. (MARTINS et.al, 2015)

Bacteria can develop resistance to specific classes of antibiotics, such as penicillins, cephalosporins, fluoroquinolones, tetracyclines, among others. This may occur due to different resistance mechanisms, such as the production of enzymes that destroy the antibiotic or the modification of targets inside the bacteria. (COSTA et.al, 2017)

Bacterial resistance is a global public

health concern as it makes treating common bacterial infections more difficult. To combat resistance, appropriate antibiotic use practices, continued development of new antibiotics, infection prevention, and infection control measures in hospitals and communities are necessary. (COSTA et.al, 2017).

SUPERBACTERIA IN THE CONTEXT OF THE INDISCRIMINATE USE OF ANTIBIOTICS

"Superbugs" is a term used to describe bacteria that have developed resistance to multiple antibiotics, including those that are considered last resorts for treating serious infections. These bacteria are of particular concern because they can be extremely difficult to treat and can cause infections that are resistant to virtually all available antibiotics. (COSTA, 2019)

MRSA (*Staphylococcus aureus*: methicillin resistant): MRSA is a strain of *Staphylococcus aureus* which has developed resistance to a wide range of antibiotics, including methicillin and other beta-lactams. It is commonly associated with skin, lung and bloodstream infections. (MAIA et.al, 2017).

CRE (Carbapenem-resistant Enterobacteriaceae): Enterobacteria, such as *Escherichia coli* and *Klebsiella pneumoniae*, can develop resistance to carbapenems, which are antibiotics of last resort. These bacteria are known as CRE (Carbapenem-resistant Enterobacteriaceae) and are a major concern in healthcare settings. (MAIA et.al, 2017)

***Acinetobacter baumannii*: multidrug resistant (MDR-AB):** The *Acinetobacter baumannii* is a bacterium that frequently causes hospital infections and has developed resistance to many antibiotics, including carbapenems and aminoglycosides. (ANDRADE, N. A; DARINI, A. L. C., 2020)

***Pseudomonas aeruginosa*: multidrug resistant (MDR-PA):** Pseudomonas aeruginosa is a bacterium that can cause urinary respiratory infections as well as wound infections. Some strains of Pseudomonas aeruginosa have developed resistance to a variety of antibiotics. (ANDRADE, N. A; DARINI, A. L. C., 2020)

***Clostridium difficile*: resistant to fluoroquinolones:** *Clostridium difficile* is a bacterium that can cause infections of the gastrointestinal tract, including antibiotic-associated colitis. Some strains have developed resistance to fluoroquinolones. (ANDRADE, N. A; DARINI, A. L. C., 2020)

Multidrug-resistant tuberculosis (MDR-TB) and extremely resistant tuberculosis (XDR-TB): The *Mycobacterium tuberculosis*, cause of tuberculosis, can develop resistance to multiple antibiotics, making tuberculosis treatment more difficult and prolonged. (ANDRADE, N. A; DARINI, A. L. C., 2020).

Multidrug-resistant gonorrhea: The *Neisseria gonorrhoeae*, which causes gonorrhea, has developed resistance to several antibiotics, including cephalosporins, which are the main drugs used to treat the infection. (ANDRADE, N. A; DARINI, A. L. C., 2020)

These superbugs pose a serious threat to public health as they make treating infections more difficult and can lead to serious complications. Combating bacterial resistance requires a global approach that includes the prudent use of antibiotics, the development of new antimicrobial agents, infection prevention measures, and infection control strategies in healthcare settings. (COSTA, 2019).

FINAL CONSIDERATIONS

The indiscriminate use of antibiotics is a serious problem that contributes to the emergence of superbugs. Superbugs are strains of bacteria that are resistant to multiple antibiotics, making infections more difficult to treat and posing a significant threat to public health.

Key concerns include: Excessive and inappropriate use of antibiotics leads to the development of bacterial resistance, making medications ineffective against infections; The danger of superbugs that are resistant to multiple antibiotics is that they make it difficult to treat serious and potentially fatal infections; self-medication and overprescription of antibiotics contribute to resistance. Antibiotics must not be used for viral infections; the lack of development of new antibiotics exacerbates the problem, limiting available treatment options; antibiotic resistance is a global threat to health, putting medical advances achieved in recent decades at risk; and awareness and responsible use of antibiotics are essential, along with encouraging research into new medicines to combat this threat to public health.

In summary, the indiscriminate use of antibiotics is a considerable concern that is directly linked to the development of superbugs and the threat they pose to public health. Addressing this issue requires a global effort, involving governments, healthcare professionals, the pharmaceutical industry and society at large, in order to preserve the effectiveness of antibiotics and ensure effective treatments for bacterial infections.

REFERENCES

BAPTISTA, Maria Galvão de Figueiredo Mendes. **MECANISMOS DE RESISTÊNCIAS AOS ANTIBIÓTICOS. 2013. 42 f**. Tese de Doutorado. Dissertação (Mestrado)-Curso de Ciências Farmacêuticas, Faculdade de Ciências e Tecnologias da Saúde, Universidade Lusófona de Humanidades e Tecnologias, Lisboa, 2013. Cap. 6.

CALDAS, Alison Freire; DE OLIVEIRA, Carlos Silva; DA SILVA, Diego Pereira. Resistência bacteriana decorrente do uso indiscriminado de antibióticos. **Scire Salutis**, v. 12, n. 1, p. 1-7, 2022.

CRISTALDO, Yasmim Cabral; IRMÃO, Mariana Ojeda Souza; MATUO, Renata. O uso indiscriminado de antibióticos e sua relação com a resistência bacteriana.

DA SILVA DUARTE, Suzane Meriely et al. Revisão Sistemática da Resistência e Farmacodinâmica de Antibióticos. **Brazilian Journal of Development**, v. 5, n. 10, p. 21476-21489, 2019.

DA SILVA MARTINS, Graziella et al. Uso indiscriminado de antibióticos pela população de São José do Calçado (ES) e o perigo das superbactérias. **Acta Biomedica Brasiliensia**, v. 6, n. 2, p. 84-96, 2015.

DA SILVA MIRANDA, Isabela Carollaynne; VIEIRA, Roberta Michelly Silva; SOUZA, Thamyres Fernanda Moura Pedrosa. Consequências do uso inadequado de antibióticos: uma revisão de literatura. **Research, Society and Development**, v. 11, n. 7, p. e58411730225-e58411730225, 2022.

DE ARAÚJO NETO, Pedro Pereira et al. Resistência bacteriana consecutiva do uso indiscriminado de antibióticos: revisão integrativa. **Arquivos de Ciências da Saúde da UNIPAR**, v. 27, n. 5, p. 3320-3330, 2023.

DE ANDRADE, Leonardo Neves; DA COSTA DARINI, Ana Lúcia. Mecanismos de resistência bacteriana aos antibióticos. 2020.

FITL-AEMS, CURSO DE BIOMEDICINA DAS. SUPERBACTÉRIAS: A EVOLUÇÃO DA ESPÉCIE.

GOUVEA, Ligiane Rios. Complexos metálicos de fluorquinolonas: síntese, atividade biológica e estudos do mecanismo de ação. 2013.

LOUREIRO, Rui João et al. O uso de antibióticos e as resistências bacterianas: breves notas sobre sua evolução. **Revista Portuguesa de saúde pública**, v. 1, pág. 77-84, 2016.

LUNA, Larissa Silva; REBOUÇAS, Bartira Rodrigues; CARMO, Mariana Gabriela Pereira do. Uso indiscriminado de antibióticos como um problema de saúde pública: uma revisão integrativa. 2023.

MAIA, Gabriela; UBERTI, Natanieli; MEOTTI, Juliana Maria. A CRESCENTE AMEAÇA DAS SUPERBACTÉRIAS. **Mostra Interativa da Produção Estudantil em Educação Científica e Tecnológica**, 2017.

MOREIRA, Natallia. O uso de antibióticos e o papel do farmacêutico clínico no combate à resistência bacteriana. **Revista Cereus**, v. 14, n. 3, p. 51-60, 2022.

NOGUEIRA, Hadison Santos et al. Antibacterianos: principais classes, mecanismos de ação e resistência. **Revista unimontes científica**, v. 18, n. 2, p. 96-108, 2016.

OLIVEIRA, Marcelo; PEREIRA, Kedina Damiana Silva Pereira Silva; ZAMBERLAM, Cláudia Raquel. RESISTÊNCIA BACTERIANA PELO USO INDISCRIMINADO DE ANTIBIÓTICOS: UMA QUESTÃO DE SAÚDE PÚBLICA: doi. org/10.29327/4426668. **Revista Ibero-Americana de Humanidades, Ciências e Educação**, v. 6, n. 11, p. 183-201, 2020.

PEREIRA, João Paulo Menezes et al. Klebsiella pneumoniae carbapenemase: o que fez com que uma bactéria se tornasse super. **Revista Brasileira Interdisciplinar de Saúde**, 2020

ROSA, J. L. N. Antibióticos, bases, conceitos e fundamentos essenciais para o profissional de saúde [monografia]. **Criciúma: Unidade Acadêmica da Saúde, Universidade do Extremo Sul Catarinense**, 2011.

SILVA, Inês Matos et al. **Antibióticos beta-lactâmicos e as' superbactérias'**. 2017. Dissertação de Mestrado.

TEIXEIRA[1], Alysson Ribeiro et al. Resistência bacteriana relacionada ao uso indiscriminado de antibióticos. 2019.