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Can Artificial Intelligence Control Antimicrobial Resistance?

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Abstract: ***The branch of science and machinery which is concerned with computational understanding of an intelligent human behaviour is called Artificial Intelligence. This blend of science and machinery has proven to be of great benefit to human activities and medical science. Our aim is to accentuate that can antimicrobial resistance be fought by Artificial Intelligence. The various studies indicate that Artificial Intelligence can be a solution to the issue of antimicrobial resistance which is rising at a great pace throughout the world.***

Keywords: ***The various studies indicate that Artificial Intelligence.***

I. INTRODUCTION

What is Antibiotic Resistance?

The contemporary epoch of antibiotics began with a serendipitous discovery of Penicillin by Fleming in 1928. Since then, antibiotics have saved millions of lives from infections. However, the excessive clinical application of antibiotics is leading us to the issue of drug resistance.

The event through which a microorganism (bacterium, virus, or fungi) resist an antimicrobial agent from acting against it is called Antimicrobial resistance (AMR).

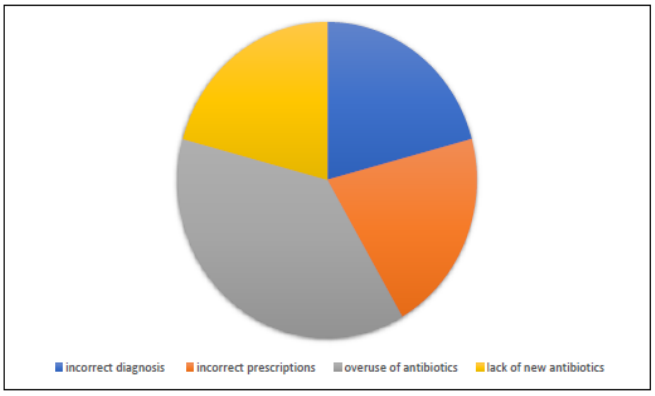

Figure 1: The key factors behind the rise of antimicrobial resistance

The history of Artificial Intelligence and Antimicrobial resistance:

The dynamics of AI and Antimicrobial Resistance changed in the 1960s, when the researchers at Stanford University developed the initial problem-solving program, "Dendral", whose purpose was to gauge hypotheses.

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It was to be operated by pioneers in organic chemistry to recognize unknown samples through their mass spectra

This primary system was used to diagnose the bacteria causing serious blood infections and to propose the appropriate antibiotic therapies. The use of AI in healthcare gained acceptance in 2016, when AI software integrated into the IBM Watson platform diagnosed a rare form of leukemia in a 60-year-old woman and recommended an effective treatment. In concern to the pediatric field, in 1984, one of the first articles on the use of AI was published: it presented a computer-assisted medical decision-making system called SHELP, whose objective was to diagnose inborn errors of metabolism. Approximately 30 years later, to provide valuable help in the diagnosis and treatment of rare pediatric diseases IBM Watson platform was successfully used at Boston Children Hospital.

II. OBJECTIVE

Many decades after the invention of antibiotics, bacterial infections have again become a threat. These crises are seeing new horizons because of overuse and misuse of drugs for a long run and also because of the desuetude behaviour of pharmaceutical in the process of developing new drugs. The involvement of Artificial Intelligence in Antibiotic Resistance has paved a path of hope for combatting the global antimicrobial crisis.

III. METHODOLOGY

To control the spread of Antibiotic Resistance, the use of Artificial Intelligence was first considered in 1984. Till then numerous inventions with the blend of machinery and human intelligence have been done throughout the world. But Artificial Intelligence works under a set methodology to detect and diagnose the infectious issue.

Policies of Artificial Intelligence Against Antibiotic Resistance

- **Predicting Infectious Pathology**

Early diagnosis of infectious pathology is very important when fighting against antibiotic resistance and Artificial Intelligence proves to be a potentially powerful weapon in doing so.

The trials which lead to the proposal of Artificial Intelligence in Antibiotic Resistance are –

Table:1

YEAR	INVENTION	BENEFIT
2017	Komorowski et.al offered a machine based on set of rules from trial-and-error systems with an aim to treat sepsis by considering decisions by clinicians.	The tool presents customized sepsis treatment which has resulted in the lower mortality rate.

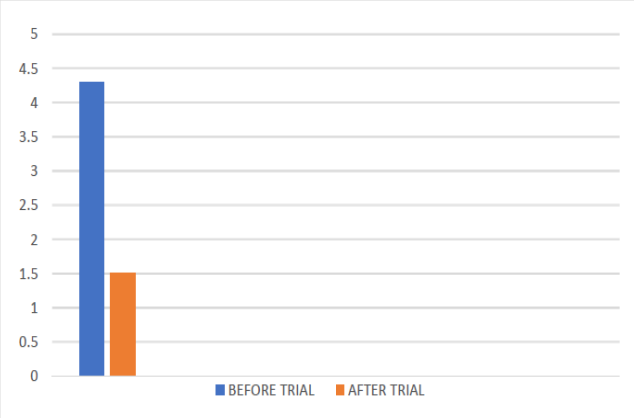

Figure 2: The decrease in the use of antibiotics after the successful trial

The model allowed early analysis of all sepsis cases and therefore a probable decrease of 30% in the use of antibiotics of non-infectious patients was calculated. Therefore, it was concluded that the diagnoses made by AI machines was more accurate than the initial diagnoses done by medical examiners.

- **Appropriate Prescription of Antibiotics**

After the correct diagnosis of the microbial infection, appropriate prescription of antibiotics is very important and simultaneously it is a very complex challenge because it involves selecting the proper therapy for the alleged pathogen, regulating the antimicrobial agent concentration and frequency of administration, and providing the appropriate route to ensure that the actual drug levels reach the site of infection.

The difficulties in the process of prescribing appropriate antibiotics and how AI shows up as the ultimate solution are listed as-

Table 2

S.NO.	PROBLEM	DISCOVERY	BENEFIT
1	Management of large amount of clinical data generated from patients which prevents appropriate prescriptions.	In 2014 an Antimicrobial monitoring system was developed which was combined with user feedback supervision.	Helped in identifying inappropriate prescriptions and prevented potential adverse effects.
2	The menace heath care costing and staff shortage in developing countries.	In 2018 automated surveillance system were approached to collect patient data.	Increase in number of patients receiving effective antibiotic treatment.

- **Prediction of Antibiotic Resistance**

Artificial Intelligence has been very useful in case of predicting Antibiotic Resistance.

With a motive to predict antibiotic resistance using algorithms based on genomic information to predict the bacterial phenotype Variant Mapping and Prediction of antibiotic resistance, a bioinformatics tool was developed with techniques that could sequence data from 3393 bacterial isolates of 9 species which contained antibiotic resistance phenotypes for 29 antibiotics.

- **Effect on Pharmaceutical Industry**
  - ➢ Antimicrobial Peptides

Antimicrobial peptides (AMPs) are natural biopolymers that help to cope up with bacterial invasion and infection. It plays a fundamental role in the non-specific innate defence system that provides resistance to infection without prior exposure to foreign pathogens.

The use of AMP is a promising possibility because of the ease to synthesise, mechanism of action and broad spectrum of activity. According to studies on a model of AMP which seeks to identify peptides with higher or lower microbial activity through modification of amino acid positions, by changing the interactions between amino acids which therefore affects the 3D conformation of peptide. On the other hand, AI models can monitor and change the interactions between amino acids just by the means of graph-based architectures.

Due to lack of synthesis of new antibiotics and the risk of resistance in the earlier discovered ones have led to the gradual decrease in the usage. Since 1980's the number of FDA approved antibiotics has gradually decreased.

And this makes antimicrobial peptides (AMPs) and drug combinations more effective strategies for treating infectious diseases.

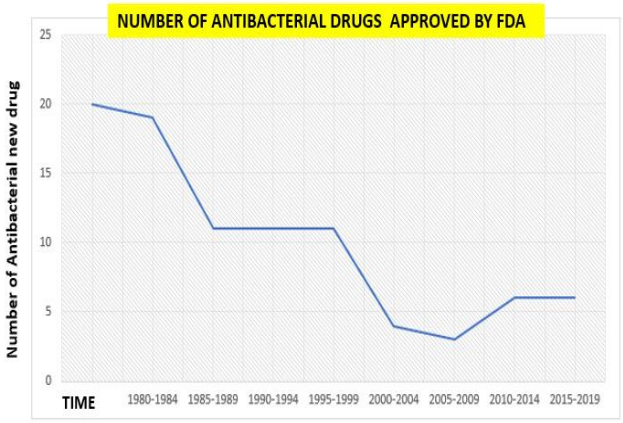

Figure 3: Number of Antibacterial Drugs Approved by FDA

IV. RESULT ANALYSIS

The blend of science and machinery has no doubt proved to be the boon for medical science. The rising issue of Antimicrobial Resistance throughout the world now seems to see its shore with the involvement of Artificial Intelligence. The problems of diagnosing the bacterial infection and providing the correct treatment for the alleged bacteria has now become easy and way faster than it was before.

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It won't be wrong to say that the lack of new antibiotics made was one of the major reasons behind the drastic increase in the issue of antimicrobial resistance. But since Artificial Intelligence has stepped into the matter the dynamics have changed. And therefore, the purpose is solved. The involvement of human intelligence in machinery running on codes and clinical decisions is the perfect solution to the subject of Antimicrobial Resistance.

V. CONCLUSION

Back in the history when in 1928 Fleming changed the direction of medical treatment by the invention of Penicillin, an antibiotic with a hope to save lives. The world was seeing the new era of medicine by then. Hardly anyone could have imagined that this boon will one day turn into bane. Antimicrobial resistance yet another hurdle in the field of medicine. But then in 1960's the idea to use Artificial Intelligence in Antimicrobial Resistance came into picture. And slowly and gradually it changed the complete scenario of medical treatments. No doubt that the benefits of Artificial Intelligence in healthcare are countless but being particular about antimicrobial resistance it has proved itself has the ultimate solution.

Starting from the correct diagnoses of the infection to prescribing the correct the therapy AI has not just made the pathology easy but more accurate. Management of clinical data has now become a task of seconds. In developing countries where healthcare funds are not enough to meet the demands, AI machines stand as ultimate key to low-cost healthcare facilities. The fact that in the process of predicting Antimicrobial Resistance AI models have always succeeded and with mostly accurate results.

Thereby it can be concluded that Artificial Intelligence is an essential key to the rising issue of Antimicrobial Resistance. But of course, there are unexplored paths that need the light of discovery. The era of Artificial Intelligence in the field of medicine has just began.

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AUTHORS PROFILE

Garima Bhardwaj, I am a final year student of Life Sciences department of Kalindi College, University of Delhi. Being of medical student my interest has always been in research and medicines. I always believe that science is an explored book who's each page has thousands of unanswered questions. Reading and exploring the unexplored pages of medical sciences has now become my passion and interest. With an aim to become a zoologist I tend to reach and read all what is in there for me. As far as the paper is concerned, I choose this topic with vision to find how Artificial Intelligence can control the spread of Antibiotics resistance. This vision of medical science blended with technical intelligence can bring drastic and essential changes not only to the field of medical science but also the ideology of pathology.

Neelam Bhardwaj, I am Working as Asst. Professor at Dronacharya Group of Institutions, Greater Noida from July 2009. I have done M.B.A. with dual specialization in Finance and Human Resource Management from IMT Ghaziabad in 2007, completed M. Com from Agra University in 2003 and completed B. Com(H) from Delhi University in 2000. I am Lifetime member of AIMA.

I have attended many workshops /Conferences /Seminars/ FDPs:

- Attended Online Refresher Program on "Use of ICT in Engineering Education" sponsored by AICTE-ISTE during 7th - 13th April 2021.
- Attended a one Week FDP on "Advanced Excel with Data Visualization" organized by E & ICT Academy, IIT Kanpur from 5th – 10th April 2021.
- Attended a Three-Week FDP on Entrepreneurship organized by IIITD Innovation & Incubation Center from 15th March – 6th April 2021.
- Attended AICTE-ISTE approved Refresher Program on "Use of ICT in Engineering Education" organized by MSIT, New Delhi during 24 Feb 2021 to 2 Mar 2021.
- Participated in National Library Conclave on Copyright, 2021, organized by JNU and India International Centre (IIC) and San Rachana – A Policy Think Tank on 21st Jan 2021.
- Attended a workshop on "Combating Fraud Activities using Data Science" organized by Laboratory for Computational Social Systems (LCS2) at IIIT Delhi on 11th Jan 2020.