The Quest to Tame ‘Superbugs’

A new antibiotic has been discovered and mankind is on an urgent quest to discover more but the inconvenient truth is it is we humans who are responsible for the creation of the monster Superbugs.

Super bugs in India

While the discovery of the new antibiotic fills us with hope against the battle with the superbugs, cases of the superbug’s emergence in India have started trickling in, which is worrisome.

Colistin the last antibiotic in the arsenal of the medical fraternity is also no longer invincible. It is used when all or almost all other drugs fail. Here it should be noted that Colistin was used in the 1960s but its use was stopped owing to its toxicity four decades ago. Since 2005 Colistin is being used to treat severe multidrug-resistant gram negative bacterial infections, particularly among intensive care patients.

Though it is not a preferred antibiotic, in India doctors are left with little choice and are using it against Carbapenem-resistant infections. Carbapenem is a third generation antibiotic and belongs to the strongest class of antibiotics. It is used to treat cases resistant to lower drugs. Hospitals in our country are now recording cases of infections that are incurable even by administering Colistin, which happens to be the last antibiotic available in the world.

The first ever evidence of pan-drug resistant cases has now been recorded by three Chennai-based doctors. Their paper titled Emergence of pan-drug resistance among gram-negative bacteria! The first case series from India was published in the December 2014 issue of Journal of Microbiology and Infectious Diseases.

The paper maps 13 cases recorded over 18 months and informs that tertiary care hospitals across the country are recording cases of infections that even Colistin is not able to treat. In Delhi hospitals the resistance was detected at 4 to 5%. In Pune’s state-run Sassoon General Hospital, of the 799 drug-resistant bacteria tested between January and July of 2014, 36 were found to be Colistin-resistant. Stray cases have been reported at Ruby Hall clinic in Pune and doctors at Tata Memorial Hospital in Mumbai recall one case in the last three to four years.
A New Antibiotic

Penicillin, the first antibiotic was discovered by Alexander Fleming in 1928. But since 1987, no new class of antibiotics has been discovered. The use of antibiotics gained massive popularity in the years following the Second World War. The most frightening diseases like syphilis, pneumonia, tuberculosis, bacterial meningitis, etc. started getting cured. This led to complacency in researches to find more new classes of antibiotics.

In the 1960s, researches into infectious diseases started getting less popular. In the 1970s, medical researchers were even claiming that humanity's victory over infectious diseases was just a matter of time. But this sweet dream came crashing down with the emergence of superbugs and human beings had to swallow the bitter truth that bacteria are cleverer than men.

Now, after a gap of around 28 years scientists have succeeded in creating a new class of antibiotics which if approved for use in humans, promises to deal with pathogens that are becoming resistant to the present lot of antibiotics in use.

The credit for the discovery of the new antibiotic goes to Professors Kim Lewis and Slava Epstein of North-Eastern University, Boston, USA and their colleagues from the University of Bonn in Germany, Novo Biotic Pharmaceuticals and Selcia Ltd in the UK. The findings of the researchers have been published in the journal Nature.

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The superbugs have taught us humans a very important lesson of not being careless, complacent and ignorant which we humans will do well to remember.

Experiments with teixobactin on mice have shown that it can successfully tackle pathogens such as the superbug MRSA (methicillin-resistant Staphylococcus aureus) as well as other bacterial infections such as tuberculosis, sepsis, and Clostridium difficile colitis without having any side effects. Most importantly it eliminates pathogens without encountering any detectable resistance. According to the scientists, as most antibiotics target bacterial proteins the pathogens can become resistant to the drugs by evolving new kinds of proteins. The fact that sets the new found antibiotic apart from the rest is that it launches a double attack on the building blocks of bacterial cell walls.

It will be tested on humans soon and there are high hopes that the new antibiotic may be available for use in the next five years.

Quest to Put a Leash on Superbugs

Looking at nature for new antibiotics: Scientists are turning to nature in the quest to find out new antibiotics. They are looking at the depths of oceans or the driest of deserts or the insides of insects to come up with chemical novelties that may lead to discovery of new antibiotics.

Researchers at the John Innes Centre in Norway are working on the bacteria extracted from the stomachs of stick insects and Cinnabar caterpillar, which is known to have a liking for highly toxic plants. They are also researching on the protective coats of the leaf-eater ants.

Scientists say that the guts of the stick insects or the protective coat of leaf-eater ants is a storehouse of endemic species of microbes that have developed unique ways to deal with the stresses of life including attacks from rival bugs.

Scientists from Lund University in Sweden have found that the lactic acid bacteria found in Honey bees could be an alternative to antibiotics. The group of bacteria counteracted MRSA in lab experiments. The bacteria blend has already been tested on horses and healed persistent wounds. Researchers have identified a unique group of 13 lactic acid bacteria found in fresh honey from the stomach of bees. The bacteria produce a myriad of active antimicrobial compounds. The bacteria were mixed with honey and applied to ten horses whose owners had tried several other methods to heal the wounds of the horses to no avail. All the wounds were healed by the mixture.

The researchers believe the secret to the strong results lie in the broad spectrum of active substances involved. According to Tobias Olofsson, professor of Medical Microbiology, "Antibiotics are mostly one active substance, effective against only a narrow spectrum of bacteria. When used alive, these 13 lactic acid bacteria produce the right kind of antimicrobial compounds as needed. But since store-bought honey doesn’t contain..."
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On the other hand Marcel Jaspars, professor of organic chemistry at Britain’s University of Aberdeen, is heading a 9.5 million Euros or $12.7 million of European Union funding project called Pharmasea in which he and his team of international researchers will haul samples of mud and sediment from deep-sea trenches in the Pacific Ocean, the Arctic waters around Norway, and the Antarctic to search for never before seen bacteria for an answer to the superbugs.

Working on the same line, scientists from the US Rockefeller University have analysed soil from beaches, forests and deserts on five continents to discover the best places in the world to mine untapped antibiotic. The findings provide new insights into the natural world as well as a road map for future drug discovery. The scientists now want to collect more samples from unique environments like caves, hot springs, islands and city parks.

Leading author Zachary Charlop Powers said that the study of the biosynthetic content of these soils shows their potential for drug discovery. According to Sean Brady of the varsity, “Uncultured bacteria from the environment could provide a dazzling array of new molecules, many of which could become new medicines. The unbelievable diversity we found is the first step towards our dream of building a world map of chemicals produced by microbes.” The scientists will continue with their citizen science effort ‘Drugs from Dirt’ inviting the public to submit samples.

Gene editing: Engineers from the Massachusetts Institute of Technology (MIT) have developed a new gene editing system that can selectively kill bacteria carrying harmful genes that confer antibiotic resistance or cause disease. Most antibiotics work by interfering with crucial functions such as cell division or protein synthesis. However, some bacteria including the formidable MRSA (methicillin-resistant staphylococcus) and CRE (Carbapenem-resistant enterobacteriaceae) organisms have evolved to become virtually un treatable with existing drugs.

Timothy Liu, an associate professor at the MIT along with her two students Robert Citronik and Mark Mimene targeted specific genes that allow bacteria to survive antibiotic treatment. The CRISPR genome editing system presented the perfect strategy to go after those genes. The CRISPR involves a set of proteins that bacteria use to defend themselves against bacteriophages.

Software to predict how bacteria react to new drugs: Researchers from the Duke University have developed a unique computer software, which identifies genetic changes that allow bacteria to develop resistance to new experimental drugs. The researchers used the software to predict a constantly evolving bacterium’s countermeasures to one of these new drugs ahead of time, even before the drug is tested on patients.

The team used their programme to identify the genetic changes that will allow MRSA to develop resistance to a class of new experimental drugs that show promise against the deadly bug. When researchers treated live bacteria with the new drug, two of the genetic changes actually arose just as their algorithm predicted. Bruce Donald, professor of computer science and biochemistry at Duke and one of the co-authors of the study emphasises, “This gives us a window into the future to see what bacteria will do to evade drugs that we design before a drug is deployed.”

Engineered cationic antimicrobial peptides: Researchers at the University of Pittsburgh Center for Vaccine Research (CVR) have pioneered a treatment far more effective than traditional antibiotics at inhibiting the growth of superbugs.

Professor at CVR, Ronald C. Montelaro and his colleagues have developed a synthetic version called engineered cationic antimicrobial peptide or ‘eCAP’ that can be synthesised in a lab setting. Cationic is a type of antimicrobial peptide which is a part of innate immune response and found among all classes of life.

The experiments conducted showed that eCAPs worked better than some of the best existing antibiotics including a natural microbial peptide made by nature. The eCAPs worked as effectively at killing Pseudomonas aeruginosa after it became resistant to the traditional drugs. According to Montelaro, “We plan to continue developing the eCAPs with the intention of creating the least toxic and most effective version possible so we can move them to clinical trials and help patients who have exhausted existing antibiotic options.”

A new antibiotic has been discovered and mankind is on an urgent quest to discover more but the inconvenient truth is it is we humans who are responsible for the creation of the monster called Superbug. The over-prescription of antibiotics must be stopped and it should be used only when it is required. The habit of self-treatment by taking antibiotics must be curtailed as well as the sale of over-the-counter antibiotics without a doctor’s prescription must be stopped. Patients who are advised antibiotics must remember to complete the prescribed antibiotic course.

The superbugs have taught us humans a very important lesson of not being careless, complacent and ignorant which we humans will do well to remember. The answer to defeating the superbugs lies in our hands.

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