

# Man versus Microbe - Pre-Apocalyptic Phase Failed?

Pradeep Selvaraj<sup>1</sup>, I Selvaraj<sup>2</sup>, S Preethi<sup>3</sup>

<sup>1</sup>Post-graduate, Department of Community Medicine, SRM Medical College Hospital and Research Centre, SRM University, Kattankulathur, Kancheepuram, Tamil Nadu, India, <sup>2</sup>Senior Associate Professor, Department of Community Medicine, Yenepoya Medical College, Yenepoya University, Mangalore, Karnataka, India, <sup>3</sup>Post-graduate, Department of Community Medicine, Yenepoya Medical College, Yenepoya University, Mangalore, Karnataka, India

## ABSTRACT

We are in the era of emerging pristine microbes and antibiotics with changing trends of urbanization and industrialization that could be both boons, as well as bane. The best exemplification of growing microbial resistance could be quantified to the thousands of new cases of multi-drug resistant tuberculosis emerging every year. Another concern is the incompletion of patients in taking the antibiotics for the prescribed time which again makes the antibiotics to act ineffectively in the subsequent visit. Biological warfare can be at a small scale where members of family getting hospitalized because of food poisoning to the whole nation being killed due to biological warfare. Modern techniques of bio-war attacks include a car could roam around the city emitting a contaminated aerosol through a fake tailpipe. Man-made biological warfare and battle of drug resistance is on-going threat globally. Stringent usage of multi-drug antibiotics against microbial defensive strategies and development of a coherent strategy to defend against bioterrorism are needed to be effectuated to prevent "apocalypse."

**Keywords:** Biological warfare, Bio-terrorism, Bio-war, Black biology, Humans, Microbes, Microbial resistance, Multi-drug resistance, Poly-antibiotics

**Corresponding Author:** Dr. Pradeep Selvaraj, Department of Community Medicine, SRM Medical College Hospital and Research Centre, SRM University, Kattankulathur, Kancheepuram, Tamil Nadu, India. Phone: +91-9884864468. E-mail: spradeepmbbs@yahoo.co.in

## INTRODUCTION

We are in the era of emerging pristine microbes and antibiotics with changing trends of urbanization and industrialization that could be both boons, as well as bane. In the last, 100 years with contemporary medical facilities and with knowledge regarding current standard operating procedures, many pestilences have been brought down to comfortable management. The best exemplification of growing microbial resistance could be quantified to the thousands of new cases of multi-drug resistant tuberculosis (MDR-TB) emerging every year. Methicillin-resistant *Staphylococcus aureus* is the common source of infection in the community and in hospitals. It is estimated that 64% are more likely to die than other people with a non-resistant form of infection.<sup>1</sup> Similarly the new TB cases are on the rise where universally, 3.5% of new TB cases and 20.5% of previously treated TB cases are estimated to have MDR-TB.<sup>1</sup> This is possibly a double edge sword because both patients and doctors may be responsible for this present condition which ranges from the incompletion of patients in not taking the

antibiotics for the prescribed period, to the indiscriminate prescription of more than one antibiotic by the doctors at a time. On one hand, all this are happening knowingly, but there is something which is happening without the knowledge of common man. Numerous lives of people are getting exterminated because of biological warfare. This can be at a small scale where members of family getting hospitalized because of food poisoning, to the whole nation being killed due to biological warfare. In the present era very little importance is being given to such issues. Starting from the famous pneumonic plague attack at Surat, Gujarat in India in the year 1994 to the present Ebola outbreak there is continuous threat of bio-warfare and in due instances thousands of people have suffered from these diseases and lost their lives.<sup>2</sup> The role of epidemiologist and family physicians are tremendous with regards to finding the source of infection. Anti-microbial resistance and bioterrorism are now a global threat. Unremittingly, the battle between man and microbe are being fought, and these organisms have been consistently showing their potency and creating havoc among everyone.

## BLACK BIOLOGY OF BIOTECHNOLOGY

Biological warfare is deliberate use of pathogenic strains of microorganisms or its toxins to spread life-threatening disease on a mass scale to destroy the day to day activities of human life. This “black biology” of biotechnology will be the gravest threats we will ever face. Biological agents that can be used as biological weapons (BWs) could be spread through the air, water, or in food and even robotic delivery is possible. Another technique, a nightmare for biological warfare experts, is the use of “suicide coughers.”<sup>3</sup> The new inventions generated in the field of genetic engineering and biotechnology has forged man-made biological warfare not afar. Life-threatening infectious agents can be easily spread throughout the entire population in less than no time. Artificial virus technology created for medical purposes could be used to create a viral bio-weapon that rivals the horrors of fiction. The United States Centers for Disease Control and Prevention has developed a classification system for biological terror agents. In this era also no one had thought Ebola outbreak might have been an incidence of biological warfare.<sup>4</sup> About 100 years ago smallpox was a major disease killing millions of people throughout the world. The first severe new disease of this century - severe acute respiratory syndrome - Generated by bioterrorism threat confirmed fears and this unfamiliar pathogen might have profound national and international implications for public health and economic security.<sup>5</sup> World Health Assembly meeting held in 2002 stated that the member states supported our longstanding policy to reinforce the surveillance and response activities of diseases which are occurring naturally or by accident. International Network of Food Safety Authorities links national authorities in member states in managing food safety events to protect from food bioterrorism.<sup>6</sup>

The increasing trend of reinvigorated microbes, viruses and bacteria are becoming resistant to the present day developing antibiotics. The antimicrobial resistance due to the bountiful prescription of antibiotic on one hand and non-compliance of the patients on the other hand is making it a man-made deadly weapon. Diseases are worsening as they are becoming resistant to the drugs to thwart them. These microbes are growing and thriving in some bodies in a way that drugs cannot muddle along with it. Medical authorities are finding it difficult to face a major catastrophe with the emerging mutant microbes.<sup>7</sup> Many have reported about new strains of microbes, whether bacteria or viruses. The mutant strains of microbes are immune to various antibiotics which is making the modern diseases difficult to cure.<sup>8</sup> For example, the so-called miracle drugs of the past such as penicillin are unfolding to have no effect on the emerging new variants of modern microbes.

## BIOLOGICAL WARFARE – ITS POTENTIAL

Bioterrorism agents are separated into three categories, depending on the spread and the severity of illness and death. Category A includes organisms or toxins that pose the highest risk to the public and national security such as anthrax, smallpox, plague, botulism, tularemia, and viral hemorrhagic fevers.<sup>9</sup> They can be easily spread or transmitted from person to person, result in high death rates and have the potential for major public health impact. Category B encompass second highest priority because they are moderately easy to spread, result in moderate illness rates and low death rates which includes typhus, brucellosis, cholera, etc.<sup>9</sup> Category C comprises of Nipah virus, Hantavirus, and MDR-TB and emerging pathogens that could be engineered for mass spread in the future because they are easily available are easily produced and spread.<sup>9</sup> Clinical features and its severity depend on the dose exposed, environmental factors, individual’s immune system and the possible route of entry. Health care professionals have a tough time to diagnose the disease because most of the biological warfare agents (BWA) producing diseases mimic each other.

## MODERN BIO-WAR

Numerous lives of people are getting exterminated because of rivalry between two distinct geographical areas. If we look into the various past events on biological warfare which had occurred are like the famous pneumonic plague attack at Surat in 1994, dengue hemorrhagic fever (1996) in Delhi, anthrax (1999) in Midnapore, and mystery “encephalitis” (2001) in Siliguri which are being suspected as an act of bioterrorism.<sup>3</sup> Various such incidents had made US Senate to pass the “Bioterrorism Act of 2002” to monitor analogous activities. We all know the history of anthrax letter attack which took place in the year 2001 in the US which killed five people and during the same year, Deputy Chief Minister of Maharashtra received anthrax culture positive envelope. In 2013, President Obama had received ricin positive letter.<sup>10</sup> Ricin is highly toxic protein; onset of symptoms varies from 2 to 24 h in ricin. Chemicals are used as a medium to kill people which are a part of biological warfare. For most of the disease caused by BWAs doesn’t have a specific antidote. Symptomatic management and supportive therapy is all been established. Recent advancement in a clinical trial of vaccines had given a way in introducing the vaccines for diseases caused by BWAs. Zakowska *et al.* had done study on a new possible treatment for the *Bacillus anthracis* infection.<sup>11</sup> They had reported interesting results were they had used monoclonal antibodies: Raxibacumab, cAb29 or cocktails of antibodies for patients suffering from pulmonary anthrax. The application of CpG

oligodeoxynucleotides to boost the immune response was elicited by anthrax vaccine adsorbed and capillary morphogenesis gene 2 protein complexes which also produced satisfying therapy results.<sup>11</sup>

Modern techniques of bio-war attacks include a car could roam around the city emitting a contaminated aerosol through a fake tailpipe. Suitcases, backpacks, books, letters, umbrellas, and remote control devices are some of the delivery methods listed. Small robots looking like rocks or wood could be programmed to act at a given time to release BW agents or even stay underground for a long time. Another technique, a nightmare for bioterror experts, is the use of “suicide coughers” who have got self-inoculated with lethal strains of anthrax and smallpox and go into public gatherings to spread the diseases, causing mass fatalities. Bioterrorism is making a way for agroterrorism where the BWAs could be used against crops including the causative agents of wheat blast, rice blast, rice brown spot disease, and wheat stem rust. Agroterrorism is ultramodern way of spreading fear and causing massive economic loss. Subsequent goals include causing disease and death to humans and animals. Cha *et al.* reported the microbial characterization of a Korean soil with specific suppressiveness to *Fusarium wilt* of strawberry.<sup>12</sup> They also had identified *Streptomyces* genes responsible for the ribosomal synthesis of a novel heat-stable anti-fungal thiopeptide antibiotic inhibitory to *Fusarium oxysporum* and the antibiotic’s mode of action against fungal cell wall biosynthesis.<sup>12</sup> Vargas *et al.* in his article had narrated the review of the general aspects of zebrafish as a biological warfare model in the basic biomedical research had been presented.<sup>13</sup> Biological warfare even includes intentional chemical contamination of food, water, and even crops. The role of epidemiologist and community physicians are inevitable in monitoring and finding out the source of contamination and making them available at the time of clinical care. In India Department of Defense had made efforts to tackle biological warfare through its arm called defense research and development organization. Various laboratories are set up that tackle with such incidences and give an authenticated report on the possible source of biological warfare. In India the bioterrorism should be part of disaster preparedness program and need to be implemented as a part of curriculum to seed the facts about biological warfare and how to tackle such situations as a future primary health care physicians.

## ANTI-MICROBIAL RESISTANCE - PRESENT AND FUTURE

New technology advancement in research by inventing new antibiotics to tackle these MDR microbes is creating havoc indirectly to the public. According to Van Boeckel *et al.* (2015) emerging countries like Russia, Brazil, India,

South Africa, and China present the next big threat for antibiotic resistance due to antimicrobial consumption.<sup>14</sup> The study estimates consumption of antimicrobials in these countries will double by 2030. Imagine the future where no antibiotics for the modern microbes which will again make us switch over to the pre-antibiotic era. As a community physician what is our role in tackling such situations. Are we ready to face the pre-antibiotic era? The burden of modern microbes is unimaginable. The existing microbes are transforming into new variants because of mutation and added on to this the man-made antibiotic resistant microbes are increasing the burden of modern microbes. The most interesting fact is the man-made drug resistant antibiotic microbe can infect a patient who has never ever had taken antibiotics in his lifetime. However, even though our technology is advancing, it is very hard to kill these modern microbes. As a primary care physician, it is our sole responsibility in the safety regulations of prescription of antibiotics. The trend of poly-pharmacy and poly-prescription of antibiotics are doing harm indirectly to the society. With the increasing diabetic population all over the world, it will be very difficult to cure superadded infections on them with the emerging trend of antimicrobial resistance. In developing countries, the adequate infrastructure in the health care sector is lacking. Selective placement of patients who are infectious in preventing the transmission of infections, optimum spacing between the beds to reduce the risk of cross-infection, cohorting the patients in terms of particular infection which can minimize the hospital acquired antibiotic resistance. Singhal *et al.* found in his study that uropathogens displayed a very high level of resistance to fluoroquinolones which necessitates periodic studies of the causative uropathogens and their antibiotic sensitivity pattern.<sup>15</sup> Newfangled way of physician introducing modern microbes is on the rise. The health care physicians and workers are the first point of contact with patients. They can easily transmit infection from one person to another, provided stringent aseptic conditions are being considered. The health care physician-made modern microbes are on the rise due to the cross-infection brought about by equipment’s and gadgets used by physicians while seeing patients such as cell phones, laptops, stethoscope, and sphygmomanometer. We can overcome this by spreading awareness among health care professionals about the burden arising because of their incautious attitude resulting in such misshapen. Health care professionals must be educated to wash their long sleeved aprons every time they use it and wash their hands with astringents after every time they see their patients. They are advised not to avoid use gadgets in the patient seeing room or wards. Health care equipments need to be cleaned and aseptic precautions to be maintained strictly.

Science always improves biodefense but the same is used to create bioterrorism. This could be understood from the significant contributions made in the field of the human genome that is the key factor manipulated by the so-called genetically engineered microbes. Developing more definitive, rapid, and automated detection equipment, regardless of whether or not microbe have been genetically engineered; production of newer vaccines that stimulate humoral immunity; designing newer antibiotics by advancing in microbial genomics.<sup>16</sup> Microbes gain defensive strategies against poly-antibiotics and, therefore, need to be stringent to prevent “nightmare” superbugs and “apocalyptic” scenarios.<sup>17</sup>

## Recommendations

The threat of bioterrorism is growing, but should not be considered inevitable.<sup>18</sup> Coherent strategies need to be implemented to defend against biological warfare both by the central and state government and punishable offence to be given for those who indulge in such activities.<sup>19</sup>

## CONCLUSION

Man-made biological warfare and battle of drug resistance is on-going threat globally. Furtherance toward one bug-one drug historical approach needs to be established come to the mind. The importance of national health security awareness among medical students is very essential. Situations to handle BWA need to be implemented through the disaster preparedness program where BWAs to be included as a part of curriculum enrichment among medical students. Stringent usage of multi-drug antibiotics against microbial defensive strategies and development of a coherent strategy to defend against bioterrorism are needed to be effectuated to prevent “apocalypse.”

## REFERENCES

1. Antimicrobial resistance. WHO. Available from: <http://www.who.int/mediacentre/factsheets/fs194/en/>. [Last retrieved on 2015 Aug 22].
2. Openness is key in fight against disease outbreaks. Available from: <http://www.who.int/bulletin/volumes/84/10/06-011006/en/>. [Last retrieved on 2015 Aug 22].
3. Bhardwaj P, Srivastava J, Karan J. Bioterrorism: An imminent public health threat. *Internet J Epidemiol* 2008;7:2-2.
4. Bioterrorism Agents/Diseases. Emergency preparedness and response. CDC Home. Available from: <http://www.emergency.cdc.gov/agent/agentlist.asp>. [Last retrieved on 2015 Aug 22].
5. Shurtleff AC. Bioterrorism and emerging infectious disease - Antimicrobials, therapeutics and immune-modulators. *SARS coronavirus. IDrugs* 2004;7:91-5.
6. Baila J. The US Food Safety System. Addressing Foodborne Threats to Health: Policies, Practices, and Global Coordination: Workshop Summary. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK57085/>. [Last retrieved on 2015 Aug 22].
7. Zilinskas RA. Contagion: A movie pandemic versus the reality of public health. James Martin Center for Nonproliferation Studies, 2011. Available from: [http://www.wmdjunction.com/110923\\_contagion.htm](http://www.wmdjunction.com/110923_contagion.htm). [Last retrieved on 2015 Aug 22].
8. Coates AR, Hu Y. Novel approaches to developing new antibiotics for bacterial infections. *Br J Pharmacol* 2007;152:1147-54.
9. Biodefense and Emerging Infectious Diseases. National Institute of Allergy and Infectious Diseases. Available from: <http://www.niaid.nih.gov/topics/biodefense/biodefense/pages/cata.aspx>. [Last retrieved on 2015 Aug 15; Last updated on 2015 Jun 12].
10. Ricin Letters, 2013. Available from: [https://www.en.wikipedia.org/wiki/April\\_2013\\_ricin\\_letters](https://www.en.wikipedia.org/wiki/April_2013_ricin_letters). [Last retrieved on 2015 Aug 22].
11. Zakowska D, Bartoszcz M, Niemcewicz M, Bielawska-Drózd A, Knap J, Cieslik P, et al. *Bacillus anthracis* infections – new possibilities of treatment. *Ann Agric Environ Med* 2015;22:202-7.
12. Cha JY, Han S, Hong HJ, Cho H, Kim D, Kwon Y, et al. Microbial and biochemical basis of a *Fusarium* wilt-suppressive soil. *ISME J* 2015.
13. Vargis RA, Sarmiento K, Vásquez IC. Zebrafish (*Danio rerio*): A potential model for toxinological studies. *Zebrafish* 2015.
14. Van Boeckel TP, Brower C, Gilbert M, Grenfell BT, Levin SA, Robinson TP, et al. Global trends in antimicrobial use in food animals. *Proc Natl Acad Sci U S A* 2015;112:5649-54.
15. Singhal A, Sharma R, Jain M, Vyas L. Hospital and community isolates of uropathogens and their antibiotic sensitivity pattern from a Tertiary Care Hospital in North West India. *Ann Med Health Sci Res* 2014;4:51-6.
16. Superbugs: Why we should fear them, 2013. Available from: [http://www.thestar.com/news/world/2013/04/29/superbugs\\_why\\_we\\_should\\_fear\\_them.html](http://www.thestar.com/news/world/2013/04/29/superbugs_why_we_should_fear_them.html). [Last retrieved on 2015 Aug 22].
17. Ainscough MJ. Next generation bioweapons: Genetic engineering and BW. Available from: <http://www.au.af.mil/au/awc/awcgate/cpc-pubs/biostorm/ainscough.pdf>. [Last retrieved on 2015 Aug 22].
18. Anderson JH. Microbes and mass casualties: Defending America against bioterrorism. Heritage foundation background executive summary. Available from: <http://www.heritage.org/research/reports/1998/05/defending-america-against-bioterrorism>. [Last retrieved on 2015 Aug 22].
19. Volpe P. Towards a coherent strategy for combating biological weapons of mass destruction, 1996. Available from: <http://www.oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html>. [Last retrieved on 2015 Aug 22].

**How to cite this article:** Selvaraj P, Selvaraj I, Preethi S. Man versus Microbe – Pre-Apocalyptic Phase Failed? *Int J Adv Health Sci* 2015;2(4):18-21  
**Source of Support:** Nil, **Conflict of Interest:** None declared.