COMBATING EVOLVING PATHOGENS

Introduction

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Pathogens have adapted to a variety of constantly changing environments in order to survive. Doctors, pharmaceutical companies, and scientists are faced with the challenge of learning how to combat these pathogens and protect us before they can infect us.

Several obstacles prevent us from becoming completely immune to various pathogens. First, many bacteria and viruses have evolved resistance to drugs. Second, we still do not know as much as we should about the mechanisms that parasites, bacteria, and viruses use to infect us, how they cause disease, or how our bodies react to infections.

Pharmaceutical companies invest billions of dollars every year in attempt to develop drugs to target these pathogens or lessen their symptoms to help patients live more comfortable lives. Governments and private foundations also invest a lot of money in research to learn more about these evolving pathogens and help find “weak spots” in the parasites, bacteria, and viruses for the pharmaceutical companies to target.

In this special issue of the *Yale Journal of Biology and Medicine*, “Combating Evolving Pathogens,” we take a look at a variety of pathogens known to cause infectious diseases so we can learn about them as well as the current methods available to treat infected patients. The pathogens discussed include parasites (soil transmitted helminths (STHs), *Plasmodium* species), viruses (respiratory syncytial virus, influenza, human metapneumovirus, human bocavirus, and HIV), bacteria (*Mycobacterium tuberculosis, Salmonella*, and methicillin-resistant *Staphylococcus aureus*).

Bath et al. conducted a survey in the Manikganj district in Bangladesh on the community’s understanding and knowledge of treatment and prevention of STHs (more commonly known as intestinal worms). Approximately one billion of the world’s population is infected with STHs. This has led to a number of outreach programs being developed to help educate and treat those with these infections. The results of the survey indicate that although many people within this rural and poorly educated community understood how STHs are transmitted, they took very few steps, if any, to prevent transmission.

Sadanand discusses yet another well-known species of parasite, *Plasmodium*, that causes malaria. She fills us in on what is known about the pathogenesis of malaria,

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as well as how our bodies react to this infection. Finally, she discusses the current methods available for diagnosing malaria and the methods available to reduce infection through either drug treatment or practices that reduce the number of mosquitoes that can pass on this pathogen.

With the technologies we have at hand, scientists have begun uncovering new viruses that cause illnesses previously not believed to be caused by pathogens. Hustedt and Vazquez have focused on pediatric respiratory tract infections caused by many viruses, such as respiratory syncytial virus and influenza, as well as two newly discovered viruses: human metapneumovirus and human bocavirus. They describe a number of methods that can be used to identify the virus causing infection and thus enable doctors to better treat their patients. Stansell and Desrosiers provide a different perspective into human immunodeficiency virus (HIV), which is the causative agent of acquired immune deficiency syndrome (AIDS). They discuss how glycoproteins found on the surface of the HIV virion are used to prevent more important viral epitopes from being attacked by the immune system. Carbohydrates that make up the glycoproteins have evolved to help the virus spread throughout the organism it infects as well as modulate the cytokines made by the host. Further understanding these viral surface glycoproteins allows a novel target for drugs in order to decrease the deleterious effects of HIV infection.

Vaccines help keep patients from becoming infected by various pathogens. Thaiss and Kaufman discuss the current work being done to develop a new vaccine against tuberculosis (TB). TB causes approximately two million deaths each year and mainly affects those in developing regions of the world. Many of us are familiar with the Bacille Calmette-Guérin (BCG) vaccine that has been used for decades to protect against severe childhood TB. However, this does not protect against adult pulmonary disease. Thaiss and Kaufman discuss and describe the current vaccine candidates available as well as explain the many obstacles that a new vaccine will have to overcome.

Carleton provides insight into how we can now manipulate many pathogenic bacteria to use them as vaccine vectors, emphasizing how far we have come in our understanding of bacteria such as Salmonella and how technologies have evolved to help us make use of natural pathogens for our own advantages.

Balkin and Morell discuss the well-known superbug methicillin-resistant Staphylococcus aureus (MRSA), how it came to be, and how it is able to spread throughout hospitals as well as the community. They discuss current efforts to generate new antibiotics against MRSA.

Noblin and Brahme’s interview with Dr. Mark Cockett, Vice President of Infectious Diseases and Applied Genomics at Bristol-Myers Squibb (BMS), completes the issue. Cockett’s department focuses on targeting HIV, hepatitis B, and hepatitis C. Cockett informs us how BMS decides which pathogen to target for drug development, the benefits and downfall of high-throughput screening to identify potential compounds that could be developed into drugs, and the role that academia can play in aiding drug discovery and development.

The aim of this special issue is to learn more about how pathogens are constantly evolving and the battle that we have ahead of us to learn how to overcome these deadly pathogens.