

Reducing the health impact of infectious agents: the significance of preventive strategies

Reduktion des Einflusses infektiöser Wirkstoffe: die Bedeutung von Prophylaxe-Strategien

Abstract

Each year almost 15 million people die of infectious diseases and in all probability this figure is much higher, because in many cases infection is not at all recognized as being the cause of death or its contributory role is not known. There is an increase in the risks posed by infections; the belief in the omnipotence of drugs has not stood the test of time; rather, by adopting a counterstance we risk losing all that we accomplished during the last decades. After all, over the past 40 years we witnessed progress in the development of reliable and affordable anti-infectives and vaccines. As a result of this, today parents have their children vaccinated less often since they are no longer aware of the risks posed by lack of vaccination. This will give rise to the sudden re-emergence of certain infectious diseases. And we overlook the fact that by observing basic rules of hygiene (hand hygiene; water decontamination; etc), we could save many lives on this earth. It is becoming increasingly more difficult to treat with antibiotics patients harboring resistant bacterial strains on their skin. Hospitals need surface disinfection to prevent microbes such as *Clostridium difficile* or norovirus. The institutional use of alcohol-based hand disinfectants has by now become an accepted practice in North America. But some of these substances have dangerous side effects where humans and the environment are concerned. Our test methods are not always able to evaluate the actual extent of the risks posed.

Prevention is accorded greater importance in view of the declining number of therapeutic measures available. But combating pathogenic microorganisms could, in turn, give rise to problems whose nature we cannot at all predict today. We need far greater knowledge of the pathogens and should be less naïve when embracing new technologies, which only seem to solve problems. What will be the long-term implications if the increasing selective pressure exerted on these bacteria induces them to become more resistant?

We need an effective combination of treatment and vaccination strategies, together with a consistent prevention policy. Unlike drugs and vaccinations, disinfectants can be used in a consistent manner; they can simultaneously eliminate a vast range of pathogenic microorganisms, without having any major side effects.

Zusammenfassung

Beinahe 15 Millionen Menschen sterben pro Jahr an Infektionen und wahrscheinlich sind es in Wirklichkeit weit mehr, weil man bei vielen die Infektion als Todesursache gar nicht erkannt hat oder uns die Zusammenhänge nicht bekannt sind. Die Gefährdung durch Infektionen nimmt zu, der Glaube an die Allmacht der Pharmazie hat uns nicht weiter gebracht, sondern wir sind in Gefahr, in einer Art Gegenreaktion zu verlieren, was wir in den letzten Dekaden erreicht haben.

Immerhin sehen wir in den letzten 40 Jahren einen Fortschritt bei der Entwicklung sicherer und bezahlbarer Anti-Infektiva und Impfstoffe. Als

Syed A. Sattar¹

¹ Centre for Research on Environmental Microbiology (CREM), Faculty of Medicine, University of Ottawa, Canada

Effekt lassen die Eltern ihre Kinder heute seltener impfen, weil ihnen die Risiken, die sie damit eingehen, nicht mehr bewusst sind. Das wird dazu führen, dass so manche Infektionskrankheit plötzlich wieder da sein wird. Und wir übersehen, dass man mit der Einhaltung einfacher hygienischer Regeln (Händehygiene, Wasseraufbereitung etc.) auf dieser Welt viele Leben retten könnte. Immer mehr Patienten mit resistenten Bakterienstämmen auf ihrer Haut können nicht mehr mit Antibiotika behandelt werden. Krankenhäuser brauchen Flächendesinfektion, um Infektionen mit Keimen wie z.B. Clostridium difficile oder Norovirus zu verhindern. Der institutionelle Gebrauch alkoholischer Händedesinfektionsmittel ist mittlerweile in Nordamerika akzeptiert. Aber manche dieser Substanzen haben wiederum schädliche Nebenwirkungen für Mensch und Umwelt. Unsere Prüfmethode erfassen die Risiken nicht immer in ihrem tatsächlichen Ausmaß.

Dabei wird die Prävention immer wichtiger durch die abnehmende Zahl der zur Verfügung stehenden Therapien. Aber die Bekämpfung der pathogenen Mikroorganismen könnte ihrerseits wieder Probleme auslösen, die wir heute gar nicht absehen können. Wir brauchen ein viel profunderes Wissen über die Krankheitserreger und weniger Naivität in der Anwendung neuer Technologien, die nur auf den ersten Blick die Probleme lösen. Was lösen wir aus, indem wir diese Keime durch immer selektiveren Druck zu immer größerer Anpassung zwingen?

Wir brauchen eine effektivere Mischung aus Behandlungs- und Impfstrategien, zusammen mit einer konsequenten Präventionsstrategie. Anders als Medikation oder Impfstoffe können Desinfektionsmittel, konsequent angewandt, eine breite Zahl von pathogenen Mikroorganismen gleichzeitig unschädlich machen, und das ohne große Nebenwirkungen.

Text

Health impact of infectious agents

Even today, infections claim nearly 15 million lives per year around the globe [8]. This is most likely a gross underestimation because the true cause of death remains undetermined in many cases. Moreover, we now know that infectious agents can be important primary or co-factors in many chronic and acute causes of death [1]. In addition, we continue to discover new pathogens [6] whose combined contribution to human fatalities remains unknown. Therefore, the true burden of microbial pathogens on our health and economy is certainly far greater than currently realized. Why should this be so in today's world? Quite paradoxically, 'modernization' has increased our exposure and vulnerability to many infectious agents [5]. In general terms, the heavy reliance on chemotherapy has not served us well; instead, its backlash could seriously undermine much of the progress of the past several decades.

In spite of the emergence/re-emergence of pathogens, there is little progress in developing safe and affordable anti-infectives in the past 40 years; the same applies to vaccines as well. Indeed, the rates of childhood vaccinations are falling, partly because many young parents have no memory of the damage infections such as poliomyelitis can cause in children. In addition, there are concerns,

justified or not, with the safety of many childhood vaccines. This continuing decrease in the rate of childhood vaccinations may well see the return of many infectious diseases. Poliomyelitis is a good example here; it was at the verge of eradication then parents succumbed to the rumour that the vaccine rendered girls infertile [3].

Barring a major breakthrough or two, one simply cannot conceive of having safe and effective drugs and/or vaccines available against some 1 500 known human pathogens (Taylor et al. 2003). Even if such a dream were to be realized, it still would not undermine the significance of good environmental and personal hygiene in our daily lives to *prevent* the spread of common infections. For example, simple and inexpensive measures such as hand hygiene and preparing baby's milk formula from clean water could save many lives even in the absence of vaccination against rotaviruses and many other enteric pathogens (Saidi et al. 1997). Women in cholera-endemic areas can reduce the risk of waterborne infection by the simple hygienic practice of passing polluted surface waters through several fold of the *sari* cloth to filter out *Vibrio cholerae*-containing planktons [2].

Microbicides and environmental control of pathogens

Whether we realize it or not, there is heavy reliance on microbicides in many aspects of our daily lives. Indeed, the relative significance of microbicides in infection prevention and control is on the rise with increasing antibiotic

resistance. For example, many patients with MRSA-colonized skin can no longer with treated with antibiotics but must have a microbicidal ointment applied to the body surface several times a week to clear up the colonization. Hospitals must use environmental surface disinfectants to reduce the risk of nosocomial infections with pathogens such as *Clostridium difficile* [4] and norovirus. The use of alcohol-based handrubs in healthcare and other settings is now widely accepted even in North America.

Emerging issues

We cannot ignore the fact that many chemicals used as microbicides can be unsafe for humans as well as the environment. This is leading to a closer scrutiny of formulations containing such ingredients. Flaws have also been identified in common methods to assess the microbicidal activities of chemicals [7].

With the shrinking numbers of therapies at our disposal, there is enhanced reemphasis on preventive strategies, including the use of microbicides in environmental control. But, the increasing reliance on microbicides could precipitate a whole new series of problems if their use is not approached with care. We also need a greater effort to better understand the means of spread of many common pathogens. For examples, we still lack knowledge on the major modes of spread, portals of entry and the relative significance of vehicles such as water, food and air in the spread of pathogens such as rotaviruses and noroviruses. Without this information, any attempt at their environmental control is no more than a 'shot in the dark'.

Quite often, we adopt new technologies without any thought on how they may promote the environmental survival and spread of frank and opportunistic pathogens. For example, many municipalities are switching to chloramination of drinking water to avoid potentially toxic by-products of chlorination (Simmons et al. 2002). There is now evidence suggesting that this change in disinfectants can influence the microbial ecology of biofilms in drinking water distribution systems with increases in environmental mycobacteria (Pryor et al. 2003). Could this measure to improve the chemical quality favour the spread of opportunistic pathogens through municipally treated drinking water?

Concluding remarks

Microbial pathogens will continue to be with us for a long time to come. There are many more of them; their generation time is relatively short and their genomes also much simpler. In this day and age, we subject them to increasing selective pressures, thus forcing them to evolve into forms resistant to antimicrobials and vaccines. This clearly suggests that, for the long term, our current emphasis on treatment and vaccination strategies must be blended better with preventive approaches. Unlike chemotherapy and vaccination, properly designed and applied preventive measures can apply to a much wider variety of pathogens and also be less site-specific.

Curriculum Vitae

Professor Syed A. Sattar, M.Sc., Dip. Bact., M.S. Ph.D.

Figure 1



Figure 1: Syed A. Sattar

Retired Professor of Microbiology.
Director, Centre for Research on Environmental Microbiology (CREM), Faculty of Medicine, University of Ottawa, Canada.

SYED A. SATTAR and his team conduct laboratory-based studies on the fate of human pathogenic bacteria, viruses and protozoa in water, food, air, municipal wastes and on animate and inanimate surfaces. Another focus of his work is to assess physical and chemical agents for interrupting the environmental spread of human pathogens. Microbicide test methods developed at CREM now form the basis for several national and international standards. His Centre also promotes the development and application of chemicals and procedures which are safer for humans as well as the environment.

He has published over 400 research papers, book chapters, commissioned reviews and technical reports, and delivered nearly 225 invited lectures worldwide. He is a Registered Microbiologist of the Canadian College of Microbiologists, and a Fellow of the Amer. Acad. of Microbiol. He is a member of the editorial boards of the *Amer. J. of Infect. Control* and *Infect. Control & Hosp. Epidemiol.* He is an adviser to Canadian and U.S. governments as well as the World Health Organization on various aspects of biosafety and infection control.

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Corresponding author:

Syed A. Sattar
45, Smyth Road, Ottawa, ON K1H 8M5, Canada
ssattar@uottawa.ca

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