

Excerpts from: Tabrah, F. L. 2011. **Koch's Postulates, Carnivorous Cows, and Tuberculosis Today.** Hawai'i Medical Journal, 20: 144-148.

Abstract

With Koch's announcement in 1882 of his work with the tubercle bacillus, his famous postulates launched the rational world of infectious disease and an abrupt social change—strict patient isolation. The postulates, so successful at their inception, soon began to show some problems, particularly with cholera, which clearly violated some of Koch's requirements. Subsequent studies of other diseases and the discovery of entirely new ones have so altered and expanded the original postulates that they now are little but a precious touch of history. The present additions and replacements of the original concepts are skillful changes that several authors have devised to introduce new order into understanding complex viral and prion diseases. In 1988, this knowledge, with the totally rational response of the British population and its cattle industry, was critical in promptly blocking the threatened epidemic of human prion disease.

In contrast, the recent upsurge of tuberculosis (TB) in the worldwide AIDS epidemic in developing countries, and the sudden increase in metabolic syndrome in wealthy ones, suggests the need for focused sociobiologic research seeking ways to affect the damaging lifestyle behavior of many less educated populations in both settings. The world awaits an equivalent of Koch's Postulates in sociobiology to explain and possibly avert large self-destructive behaviors.

Meticulous isolation of colonies over many weeks, and transfer of the organisms with characteristic resulting disease led to the famous Henle-Koch Postulates which at the time became the gold standard for proof relating a parasitic organism with a specific disease:

1. The organism must be shown to be invariably present in characteristic form and arrangement in the diseased tissue.
2. The organism, which from its relationship to the diseased tissue appears to be responsible for the disease, must be isolated and grown in pure culture.

3. The pure culture must be shown to induce the disease experimentally.

4. The organism should be re-isolated from the experimentally infected subject (this postulate was added after Loeffler).

Although Koch's postulates were of incalculable value in their first application, new knowledge has required major changes. Fredericks and Relman presented a revision in their 1996 review. In Fredericks' and Relman's summary, some of the reasons for these additions to the original postulates are that:

Many viruses do not cause illness in all infected individuals, a requirement of postulate #1. An example is poliovirus, which causes paralytic disease in about 1% of those infected. Further compromising postulate #1 is the fact that infection with the same virus may lead to markedly different diseases, while different viruses may cause the same disease. Postulates #2 and #3 cannot be fulfilled for viruses that do not replicate in cell culture, or for which a suitable animal model has not been identified.

The application of nucleic acid-based methods of microbial identification has made Koch's postulates even less applicable. Polymerase chain reaction and high-throughput sequence analyses have revealed a great deal about microbes that are associated with pathology or disease, but proving causation has become even more difficult as the number of uncultivable viruses rapidly multiplies. Nucleic acid based detection methods are so sensitive that they detect small numbers of viruses that may occur in the absence of disease. The use of these new methods has led to revised versions of Koch's postulates that are fundamentally sound: both hepatitis C virus and human papillomaviruses were convincingly shown to be causative agents of hepatitis and cervical cancer, respectively, long before methods were developed for propagation of the viruses in cell culture.

Conclusions: Optimal Use of Public Health Resources

Koch's postulates, useful as they were when announced in 1882, have had a rough ride intellectually, both at their inception and in their application to the many diseases to which they were applied. After millennia of ignorance, superstition, and abject fear of tuberculosis as inevitable, Koch's sudden explanation and proof of bacterial transmission brought strict patient isolation. Unrelated social changes were occurring at the time, with widespread improvement in housing, crowding, sanitation, and nutrition, all of which were important in subduing the disease. Much later, the most critical development of all, the antibiotics, produced a further remarkable dip in TB mortality—offset since 1985 by the current surge of AIDS/TB and highly resistant TB strains. There are still about five thousand deaths a day worldwide from TB, largely related to associated AIDS infection.

In some countries, while control of TB/AIDS by technological barriers to disease transmission such as viricidal jells, condom use, syringe exchange programs, and anti-HIV drug regimes have been useful, superstition, family structure, sexual practices, and chaotic economic and political forces (ie. in sub-Sahara areas) all negate technical gains. War, rape, genocide, and poverty breed public health disaster.

Rational clinical intervention needs at least some base of education and social stability in a target population. Without security, sanitation, nutrition, birth control, and other major changes in family lifestyle that control the role of women, it is unlikely that the disease patterns in developing countries will greatly improve. Even reasonably successful drugs and vaccines are of little use in a melee of apathy, genocide, rape, and starvation. In many regions, the most vicious problems are

cultural and economic, and until these are realistically addressed, medical interventions offer little hope of success. Today we know far more about the details of epidemiology, molecular biology, and pharmacology than we do about the obtuse human behavior that often prevents their clinical application. To affect world health, religious issues, social structure, political failure, and poverty demand focused attention.

Increased research support of sociobiologic studies of self-destructive populations is needed to teach us how to alter behaviors that block the application of rational health principles. Our need for understanding why people behave as they do lies not only in chaotic third world settings, but in rich nations whose populations approach a sixty percent obesity rate and a metabolic syndrome epidemic.

Informative research results analyzing public health failures would far outweigh their costs in health care expenditures and lives saved. The ultimate laboratory is the village, the town, and the metropolis.

In each, to study why people act as they do in blocking the obvious measures that would enhance their health and lives, would add enormously to human welfare.

Perhaps it is time for a Koch's Postulates equivalent to explain the crippling impedance of human behavior.

The author has no conflict of interest to disclose.

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