Journal of Epidemiology and Global Health (2016) 6, 125–129

HOSTED BY

ELSEVIER

http:// www.elsevier.com/locate/jegh

REVIEW ARTICLE

Bradford Hill's criteria, emerging zoonoses, and One Health

G.V. Asokan [a,*], Vanitha Asokan [b]

[a] College of Health Sciences, University of Bahrain, P.O. Box-32038, Bahrain
[b] Pediatrics Department, American Mission Hospital, Manama, P.O. Box-1, Bahrain

Received 1 September 2015; accepted 19 October 2015
Available online 14 November 2015

KEYWORDS
Disease causation;
Emerging zoonoses;
One Health

Abstract Zoonoses constitute more than 60% of infectious diseases and 75% of emerging infectious diseases. Inappropriate overemphasis of specialization of disciplines has ignored public health. Identifying the causes of disease and determining how exposures are related to outcomes in ''emerging zoonoses" affecting multiple species are considered to be the hallmarks of public health research and practice that compels the adoption of ''One Health". The interactions within and among populations of vertebrates in the causation and transmissions of emerging zoonotic diseases are inherently dynamic, interdependent, and systems based. Disease causality theories have moved from one or several agents causing disease in a single species, to one infectious agent causing disease in multiple species-emerging zoonoses. Identification of the causative pathogen components or structures, elucidating the mechanisms of species specificity, and understanding the natural conditions of emergence would facilitate better derivation of the causal mechanism. Good quality evidence on causation in emerging zoonoses affecting multiple species makes a strong recommendation under the One Health approach for disease prevention and control from diagnostic tests, treatment, antimicrobial resistance, preventive vaccines, and evidence informed health policies. In the tenets of One Health, alliances work best when the legitimate interests of the different partners combine to prevent and control emerging zoonoses.

* Corresponding author at: Head, Public Health Program, College of Health Sciences, University of Bahrain, P.O. Box-32038, Bahrain.
E-mail address: agvaithinathan@uob.edu.bh (G.V. Asokan).

http://dx.doi.org/10.1016/j.jegh.2015.10.002

Contents

1. Introduction

Humans are members of the animal kingdom. Genetically, the human genome shows 99% similarity to great apes and 95% similarity to pigs. Therefore, humans can be considered as remodeled chimpanzee-like apes [1]. Although there is taxonomic relatedness among the species and other common features exist within the vertebrates of the animal kingdom, the crucial drivers of disease invasion and disease causal mechanisms of the infectious agents (zoonoses) are considered to be not straightforward.

A catalog reports that zoonoses constitute >60% of all known infectious diseases and 75% of emerging infectious diseases. Approximately 40% of fungi, 50% of bacteria, 70% of protozoa, 80% of viruses, and 95% of helminths that infect human beings are zoonotic. More than 50% of the recognized pathogens of human beings can infect other vertebrate hosts [2]. Only 100 of the 400 or so known emerging pathogens occur only as human pathogens [3]. Among the marine mammal pathogens, at least 49% are zoonotic, and 28% are emerging zoonoses [4].

This review neither attempts to reignite the debate between realism and pragmatism in causal theories, nor identifies deficiencies in Koch—Henle postulates or Sir Austin Bradford Hill's criteria, but aims to interpret the causation of emerging zoonoses in the fundamentals of One Health. Briefly, a cause of a disease is a factor, event, characteristic, or condition that affects its incidence; elimination of the cause would result in a change in disease incidence [5]. It has been continuously proven that inappropriate overemphasis of specialization of disciplines has ignored the large scale approaches to public health; identifying the causes of disease and determining how exposures are related to outcomes in ''emerging zoonoses''-assumed to be an established understanding of causal mechanisms in ''known zoonoses''-affecting multiple species are considered the hallmarks of public health research and practice. We believe that revisiting Bradford Hill's criteria on causation under One Health would strengthen public health research and policy for prevention and control of emerging zoonoses.

1.1. One Health and disease causal context in emerging zoonoses

People and animals have been in close contact since the domestication of animals, which has assisted in the swapping of diseases and their spread. The shared risks between humans and animals concerning zoonoses, compels the adoption of One Health among human and animal health professionals to identify and reduce such risks [6]. By definition, One Health is a multidisciplinary concept based on a systems approach, which amalgamates the ''collaborative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals and our environment'' [7]. Further, the One Health concept is a worldwide strategy that is expected to help protect and save millions of lives in our present and future generations [8].

In an integrated system, with regard to emerging zoonoses, One Health has the potential to result in improved effectiveness and efficiency of health-associated outcomes. Because disease causation is context dependent, the interactions within and among populations of vertebrates in the causation and transmission of emerging zoonotic diseases is inherently dynamic, interdependent, and systems based. Beyond the population dynamics, feedback among exposures and outcomes are integral to wider causal webs of the natural environment, and that generates context-dependent effects. Further, causal effects on individual and population levels are impacted by herd immunity and the threshold density of the cause. At an individual level, causal effects depend on the distribution of