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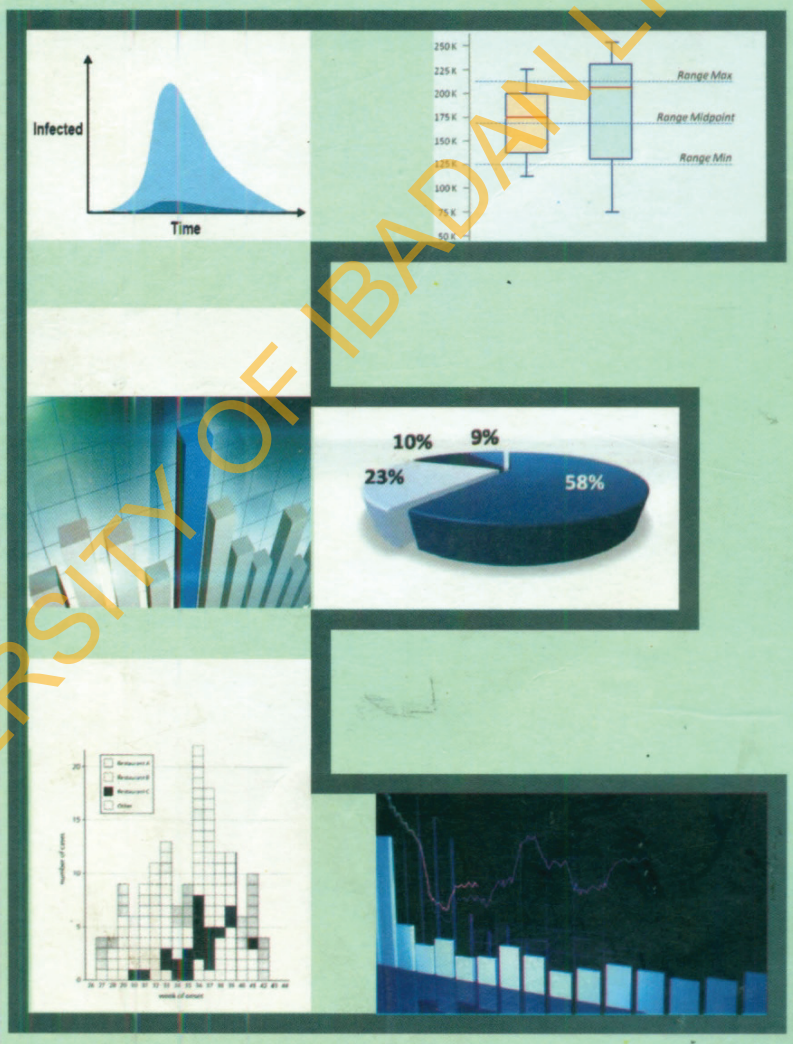

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Epizootiology in Contemporary Global Health: making a difference in the health of people in West Africa

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Abstract

Global health in contemporary times has thrown up challenges that demand innovative and pragmatic approaches and one of such is the concept of One Health. Towards this end, a holistic approach of tackling human and animal health problems is being explored in order to bring about poverty alleviation, health and food security particularly in developing countries. To achieve this, there is an increasing role and importance of epizootiology in planning and evaluation of projects for control and prevention of pandemic from animal diseases in West Africa. Since there is a critical shortage of available manpower in this area, filling this gap requires training of public and private personnel that are focused on diseases at human-animal health interface. Therefore, under the flagship of epizootiology, we propose an initiative that brings together teachers that have worked in this area and have similar and complementary skills and expertise that trainees would be able to assimilate. This program which has received support at the University of Ibadan, Nigeria, will work along with a consortium of Universities to increase graduate training in the surveillance of human-animal diseases from 2012. It is anticipated that this platform will produce a critical mass of highly trained personnel within West Africa that will make a difference in tackling the ever challenging health needs of the people in the sub-region.

Keywords: Global health; Epizootiology; One Health; West Africa

According to Koplan *et al.*, global health emphasizes transnational health issues, determinants, and solutions, involves many disciplines within and beyond the health sciences, promotes interdisciplinary collaboration, and is a synthesis of population-based prevention with individual-level

clinical care[1]. This definition offers an important elaboration on the oft-cited definition of global health initially advanced by the Institute of Medicine (IOM) in its seminal report on the U.S. Commitment to Global Health (2) and amended in 2008 (3). In order to promote and effectively achieve global health, several approaches can be explored. However, for the purpose of this paper, we have chosen to shed some light on the discipline of epizootiology and the practical approaches to its usefulness in promoting public health within the West African sub-region. Epizootiology can simply be defined as the science dealing with the character, ecology, and causes of diseases in animals, especially epizootic diseases or the sum of the factors controlling the presence of a disease in an animal population (4). Alternatively, it is the equivalent of epidemiology with reference to animal diseases (5). Therefore, it is not out of place to refer to epizootiology as veterinary epidemiology; however, from the simplistic point of view, it can be referred to as the science concerned with the factors involved in the occurrence and spread of animal diseases.

From a more practical point of view, epizootiology can be defined as the study of the factors, events, forces and circumstances that contribute to the occurrence, distribution, control and prevention of diseases, ill-health problems and conditions in animal population (6). While contributions to global health are being received from various fields beyond the medical profession, the veterinary profession makes a unique difference in improving the health of people around the world through mitigation of zoonotic diseases and emergence of pandemics. Since the lives of humans and animals are inextricably connected, particularly through sharing the same environment which is laden with parasites and other microbes, man therefore becomes naturally afflicted with most infections and diseases of animals. Schwabe (7) citing Hans Zinsser provides a very succinct quotation which best describes this relationship: "However secure and well-regulated civilized life may become, bacteria, protozoa, viruses, infected fleas, lice, ticks, mosquitoes, and bedbugs will always lurk in the shadows ready to pounce when neglect, poverty, famine, or war lets down the defences about the only genuine sporting proposition that remains is the war against these

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ferocious fellow creatures, which stalk us in the bodies of rats, mice, and all kinds of domestic animals; which waylay us in our food and drink and even in our love." In recognition of these health problems, the World Health Organization (WHO) sited by Schwabe (7) defined zoonoses as those infections and infestations which are naturally transmitted between man and lower vertebrate animals or simply, as diseases, infections and infestations that are transmitted from lower vertebrate animals to humans under natural conditions. Some of these zoonoses are naturally resident (endemic) in West Africa, while others are being newly introduced (emerging). Little attention is paid to some of these zoonoses which have been classified by the WHO as neglected diseases impacting negatively on human and animal health, national productivity, food security/ safety and socio-economic well being of people in the West African countries.

In contemporary times, as our knowledge of diseases and human afflictions expands, new terminologies and concepts begin to appear in our lexicon. Of particular importance is the "One Health/One World/One Medicine" concept (8). Today, One Health links animal and human health together with the ecosystems in which we live. Curiously, when we take a second look at the definitions of epizootiology given above, one would appreciate the fact that epizootiology right from the onset espouses the concept of One Health. This becomes more visible when we adopt the definition of epizootiology as the science that deals with the character, ecology and causes of animal diseases. If we take humans purely from the scientific point of view, we say they are higher animals; hence, belonging to the animal kingdom. In this respect therefore, our line of thought regarding epizootiology will be focused on the interaction between humans, lower animals and the environment in the transmission and perpetuation of diseases caused by parasites and other microorganisms in nature. The point being made here is that epizootiology is a more embracing terminology than epidemiology when we talk about disease transmission and public health. Therefore, the public health veterinarian can be said to have a more fundamental role to play when issues of zoonoses are discussed; and even more so, when we talk about One Health, a phenomenon regarded as being more effective in solving problems of contemporary global health and diseases (8).

According to Schwabe (7), "interdisciplinary contacts have become commonplace in science. The interaction between veterinary medicine and human medicine grows daily. Physicians involved in many aspects of medical research have discovered through their ever greater dependence upon work with lower animals that their field of activity and interest is, in fact, comparative medicine. At the same time, veterinarians have grown increasingly appreciative of some of the overall contributions and consequences of veterinary medicine to human health and welfare". In real terms therefore, this paper attempts at espousing the essential elements involved in epizootiology as it concerns animals, humans, the environment and pathogens, in relation to global health. In doing this, we are reminded that epizootiology is a multidisciplinary science that is best studied through the systems approach[6].

Components of Epizootiology

In their seminal contribution, Esuruoso et al. (6) defined epizootiology as the comprehensive (holistic and peripheral) study of the variable factors, events and forces that contribute to the occurrence, distribution, control and prevention of ill-health, diseases and other problems in animal populations as well as the valuation and quantification of the variable factors and their contribution to identified problems in each instance. These factors, they explained, often include those of hosts, those of agents/parasites, and those of the environment. Furthermore, they stated that epizootiology is a science of natural relationships between biological animal populations, the plant populations on which they depend (in the food and energy chain), and their external environment and its contents which they share inevitably with other living things. Epizootiology also deals essentially and by default, with the problems associated with their nature, their mass and volume, the dynamics of their lives' activities, causal factors leading to rises and falls in their fortunes, the types and shapes of their biorhythms and the temporal and spatial coefficients pertaining to the patterns and effects of their problems. From a critical assessment therefore, epizootiology can be divided into three major components as enunciated by Esuruoso *et al.* (6) namely: (i) the biomedical component, (ii) biostatistical component and (iii) socio-economic component. These three components are therefore regarded as the tripod of epizootioology. They are the pillars of knowledge on which the study of epizootiology as basis for preventive measures are best founded. Therefore, a modern veterinarian according to Esuruoso et al. (6) must be biomedically literate, biostatistically numerate and socio-economically cost-conscious.

Biomedical component: This essentially concerns the biology (i.e. forms, functions, life cycles and the habitat) of the hosts and the agents, as well as the study of the medical/disease implications of the relationships (or interactions) between the host and the agents/parasites, the parasites, the parasites and its vector, and their common external environment/habitat.

Biostatistical component: Since epizootiology is a study of problems of animal populations within ecological communities, it is imperative to examine samples from the identified population when investigating a disease. Therefore, to make right inferences, representative samples have to be taken following accurate statistical methods. Thus, sample statistics have to be referable to population parameters.

Socio-economic component: In carrying out epizootiological investigations in relation to both human and animal health,

and not forgetting ecological implications, it is only reasonable that we take into consideration the cost-benefit analysis of the total processes and methods involved. For example, human rabies in developing countries can be prevented through interventions directed at dogs. Therefore, assessments of potential cost-savings for the public health sector of interventions aimed at animal-host reservoirs are needed. Here, we present the results of two studies conducted to advise on reduction of human rabies from dogs. First, the cost-effectiveness of mass dog vaccination was compared to post-exposure prophylaxis (PEP). Result obtained showed that PEP does not reduce future human exposure. Its cost-effectiveness was estimated at US $46 per disability adjusted life-years averted. Cost-effectiveness for PEP, together with a dog-vaccination campaign, breaks even with cost-effectiveness of PEP alone after almost 5 years. Beyond a time-frame of 7 years, it appeared to be more cost-effective to combine parenteral dog vaccination campaigns with human PEP compared to human PEP alone (9). The second study conducted by Zhang et al. (10) in China, showed that: (i) reducing dog birth rate and increasing dog immunization coverage rate are the most effective methods for controlling rabies in China; (ii) large scale culling of susceptible dogs should be replaced by immunization of the dogs.

Phases of epizootiology: These include: (i) descriptive phase, (ii) analytical phase and (iii) experimental phase.

Briefly, experimental epizootiology is essentially a prospective study involving the descriptive and the analytical phases. In carrying out epizootiological investigations, several diagnostic tools and procedures are explored. One of the diagnostic tools used frequently in epizootiological investigations is "serology" and when applied for this purpose, it is termed "sero-epizootiology". By definition, serology is the scientific study or diagnostic examination of blood serum. It is a process, designed to detect a sign, substance, tissue change or response by the interaction of antigen and its specific antibody. The combination of antigen and antibody is the fundamental reaction in serology. Serological tests are performed through various techniques such as enzyme-linked immunosorbent assay (ELISA) or polymerase chain reactions (PCR). Generally, a serological test is classified as surrogate because it detects secondary changes which are considered to predict the presence or absence of a disease or the disease agent. For example, testing a cow's serum for antibodies of *Brucella abortus* is a surrogate test.

Interdisciplinary contacts in West Africa

Several interdisciplinary contacts have occurred in West Africa, where agricultural and commercial activities have continued to bring people and pigs into regular close contact to spread influenza. The first report of interspecies transmission of influenza viruses involving pigs dates back to the 1930s when Shope presented serological evidence for the transmission of a human influenza virus to pigs (11). Since then, other reports have described the transmission of human influenza viruses to pigs (12-14). In 1998, H3N2 viruses from humans were introduced into the pig population and caused widespread disease among pigs (15). Evidence for this interspecies transmission has been reported in West Africa (16). Serological surveillance studies revealed that prevailing human H1N1 strains are readily transmitted to pigs (17). Human influenza A-like (H3N2) viruses have also been isolated from pigs (18,19) but are not usually maintained in pigs independently of the human population (20). In Nigeria, influenza occurs most often during the harmattan period (November to January) and from early (April to May) to the peak of the rainy season (21, 22). Previous studies have shown that the prevalence of HI antibodies to different influenza viruses is generally high in humans, swine and poultry in Nigeria (23-25).

Moreover, in a recent study, a communal risk pattern associated with clinical human rabies in Ilorin, a transit city in Nigeria, indicated high exposure among children who had to commute to schools from their homes in low-income residential areas. Bites from infected dogs were more common in non-residential areas, especially around a beef market, where waste foods, including condemned meat and other abattoir waste and wastewater were available (26, 27) to sustain free-roaming and stray dogs. With the constant influx of people and animals into this transit city, it is possible that an outbreak of rabies in this city can easily spread to other parts of Nigeria. Thus, environmental health is highlighted as a major risk factor for rabies in this community.

Consortium of Universities

In tackling the problem of endemic, emerging and neglected diseases in West Africa, there is a need to entrench a policy whereby every local government authority in the sub-region should have an epizootiologist in its health service for optimum performance. However, this is currently not available. Towards achieving the goal of implementing the One Health agenda in West Africa therefore, a consortium comprising five of the oldest Universities in the sub-region (University of Sierra Leone, Njala University-Sierra Leone, University of Ghana, Cuttington University, Liberia and University of Ibadan, Nigeria) was established to, among other mandates, provide hands-on training for graduates in the detection, prevention and containment of zoonoses using selected hotspots of endemic and neglected zoonoses in these West African countries (Fig. 1). The graduate program focuses on training of manpower that will be effective in zoonoses detection, prevention, and containment systems and be able to utilize the system efficiently in Nigeria and in West Africa. The following ten areas of emphasis will thus be covered in teaching and research activities:

1. Study of knowledge, attitude and practices associated with selected zoonotic and high economic consequence

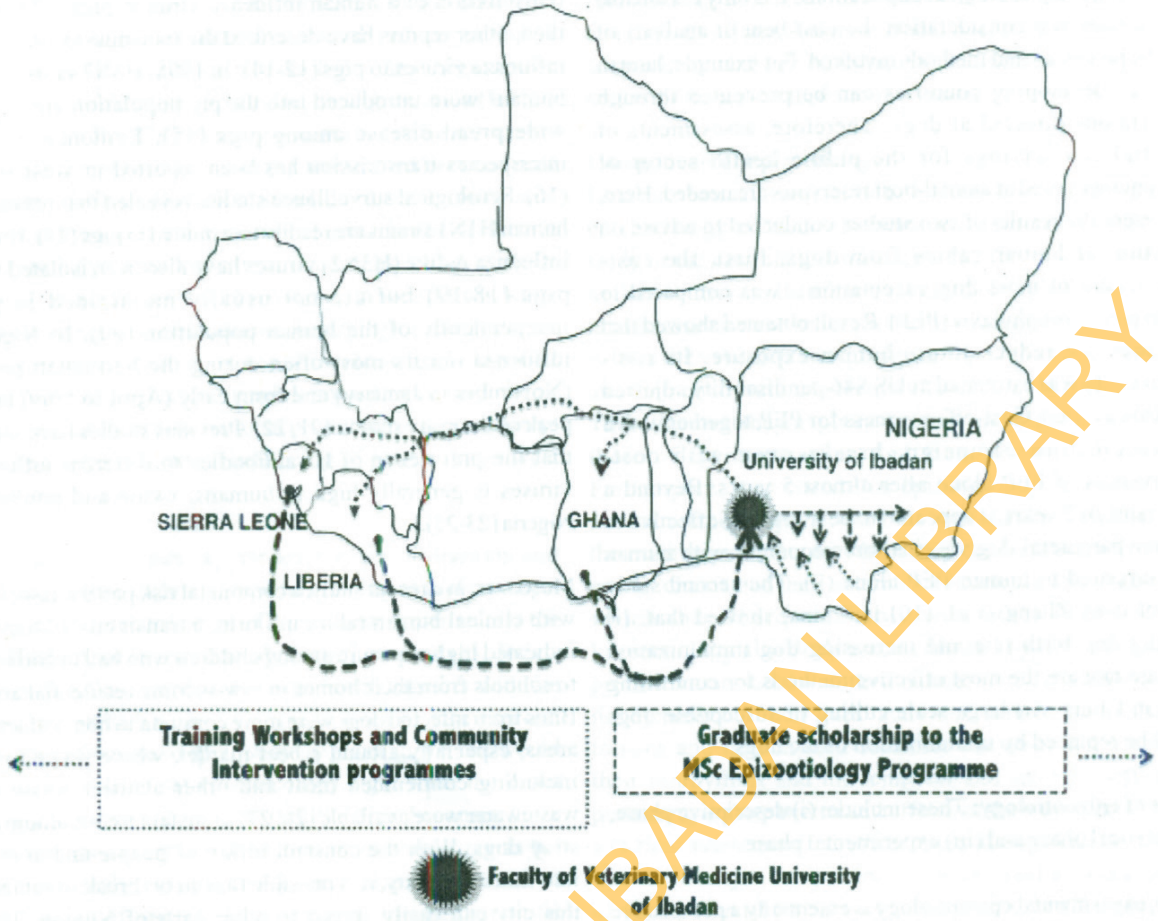

Fig. I: Map of West Africa, indicating the location of partner institutions

transboundary animal diseases (TADs) in selected communities (capturing indigenous knowledge and practices).

2. Study and mapping of zoonotic and high economic consequence TAD outbreaks and their pattern of spread (covering both the prospective and 10 years' retrospective studies).
3. Study of geographic risk factors (environmental) associated with zoonotic and high economic consequence TADs, their possible solution options and estimated cost-benefit ratios of their risk management plans.
4. Studies on biotechnology indigenization for surveillance and rapid detection of zoonotic and high economic consequence TADs in countries of West Africa.
5. Study of existing policy initiatives to mitigate zoonotic and high economic consequence TADs in West Africa.
6. Training in techniques for spatio-temporal data capture and information analysis on zoonoses and high economic consequence TADs occurrence in West Africa, using the geographic positioning systems (GPS) (etrex, Magelan 360) kit, aerial photography and geographic information systems (GIS) (TAD-info, EPI-info and ArcView Desktop) facilities.
7. Training in the isolation, characterization and confirmatory diagnosis of selected causal agents of zoonotic diseases (including *Brucella spp., Toxoplasma gondii*, *Cryptosporidium spp.*, Yellow fever, Lassa fever, Rabies and influenza viruses) and high economic consequence TADs.
8. Training in molecular epizootiology techniques and its application in the study of zoonotic and high economic consequence TADs.
9. Training in planning for biological risk management against zoonoses and high economic consequence TADs, with case studies during practicum in selected hotspots.
10. Training on use of indicators in the monitoring and evaluation of zoonoses, and control and containment of high economic consequence TADs.

Harmonious impact in West Africa

The initiative we propose ultimately fits into the One Health concept which is a world-wide strategy for expanding

interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment (8). The synergism achieved will advance health care for the 21st century and beyond by accelerating biomedical research discoveries, enhancing public health efficacy, expeditiously expanding the scientific knowledge base, and improving medical education and clinical care (1, 8). When properly implemented, it will help protect and save millions of lives in the present and future generations. The core areas of emphasis of the programme are:
(i) spatio-temporal data capture and information analysis, (ii) diagnostic techniques and molecular epizootiology, (iii) biological risk management planning, and (iv) use of indicators in the monitoring and evaluation of disease control projects.

Conclusions

In conclusion, a good understanding of the systems approach and of the epizootiological methods involved will go a long way in solving contemporary global health problems especially in West Africa that is still lagging behind in modern human and animal health welfare.

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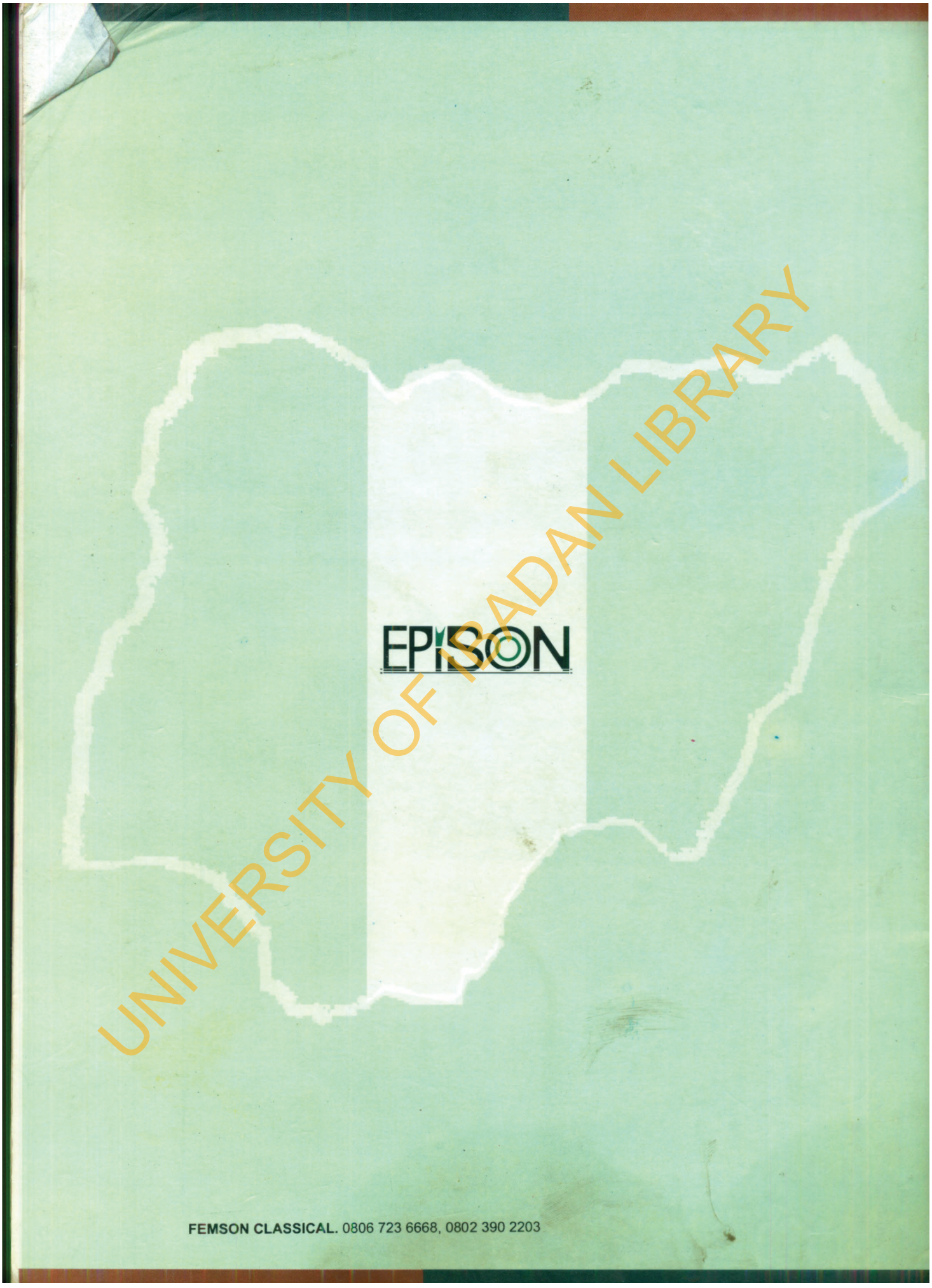
References

1. Koplan, JP, Bond TC, Merson MH, Reddy KS, Rodriguez MH, Sewankambo NK, Wasserheit JN. Towards a common definition of Global Health. Lancet. 2009; 373: 1993–95.
2. Institute of Medicine America's Vital Interest in Global Health. Washington, D.C.: National Academies Press; 1997.
3. Institute of Medicine. The U.S. Commitment to Global Health: Recommendations for the New Administration. Washington, D.C., Institute of Medicine, Committee on the U.S. Commitment to Global Health, National Academies Press; 2008.
4. The American Medical Dictionary. Copyright by Houghton Mifflin Company. Published by Houghton Mifflin Company; 2007, 2004
5. Saunders Comprehensive Veterinary Dictionary, 3 ed. Elsevier, Inc. 2007.
6. Esuruoso, GO, Ijagbone IF, Olugasa BO. Introductory Epizootiology (Second Edition). Published by VetAcademic Resource Publishers and Consultants. Printed by GLJ Press, Ibadan Nigeria; 2005. p. 324.
7. Schwabe CW. Veterinary medicine and human health. The Williams and Wilkins Company, Baltimore, USA; 1969. p. 1-713.
8. Kaplan B, Kahan LH, Monath TM. 'One Health – One Medicine': linking human, animal and environmental health. Veterinaria Italiana 2009; 45 (1):1-208.
9. Zinsstag J, Dürr S, Penny MA, Mindekem R, Roth F, Menendez Gonzalez S, Naissengar S, Hattendorf J. Transmission dynamics and economics of rabies control in dogs and humans in an African city. Proceedings of the National Academy of Sciences. 2009 Sep 1;106(35):14996-5001
10. Zhang J, Jin Z, Sun G-Q, Zhou T, Ruan S. Analysis of rabies in China: Transmission dynamics and control. PLoS ONE. 2011; 6(7): e20891. doi:10.1371/journal.pone.0020891.
11. Shope RE, The influenza viruses of swine and man. Harvey Lecture 1935-1936; 30:183–213.
12. Castrucci MR, Campitelli L, Ruggieri A, Barigazzi G, Sidoli L, Daniels R, Oxford JS, and Donatelli I. Antigenic and sequence analysis of H3 influenza virus haemagglutinins from pigs in Italy. Journal of Virology 1994;75:371-379.
13. Brown I, Harris P, McCauley J, Alexander DJ. Multiple genetic reassortment of avian and human influenza A viruses in European pigs, resulting in the emergence of an H1N2 virus of novel genotype. Journal of Virology. 1998; 79: 2947–2955.
14. World Health Organization. Implications of H5N1 infections in pigs in China. Avian Influenza Update August 25. http://www.who.int/csr/don/2004_08_25/en/print.html (last accessed on 10th April 2009).
15. Centre for Disease Control and Prevention (CDC). Transmission of Influenza A Viruses between animals and people. Avian Influenza (Bird Flu). October 17, 2005. http://www.cdc.gov/flu/avian/gen-info/pdf/transmission.pdf. (last accessed on 10 April 2009).
16. Adeola OA, Adeniji JA, Olugasa BO. Isolation of influenza A viruses from pigs in Ibadan, Nigeria. Veterinaria Italiana. 2009; 45(3):383-390.
17. Adeola OA, Adeniji JA, Olugasa BO. Detection of haemagglutination-inhibiting antibodies against human H1 and H3 strains of influenza A viruses in pigs in Ibadan, Nigeria. Zoonoses and Public Health. 2010; 57 (7-8): e89-94.
18. Brown IH, Chakraverty P, Harris PA, Alexander DJ. Disease outbreaks in pigs in Great Britain due to an influenza A virus of H1N2 subtype. *Veterinary Records.* 1995; (1): 328-329.
19. Schrader C, Süss J. Molecular epidemiology of porcine H3N2 Influenza A viruses isolated in Germany between 1982 and 2001. Intervirology. 2004; 47(2):72-77.
20. Zhou NN, Senne DA, Landgraf JS, Swenson SL, Erickson G, Rossow K, Liu L, Yoon K, Krauss S, Webster RG. Genetic reassortment of avian, swine, and human influenza A viruses in American pigs. *Journal of Virology,* 1999; 73 (10): 8851-8856.

21. Katsuda K, Shirahata T, Kida H, Goto H. Antigenic and genetic analyses of the hemagglutinin of influenza viruses isolated from pigs in 1993. *Journal of Veterinary Medical Science*, 1995; 57: 1023-1027.
22. David-West TS, Cooke AR. Laboratory and clinical investigations of the 1974 influenza epidemic in Nigeria. *Bulletin of World Health Organisation*, 1974; 51:103-105.
23. Olaleye OD, Omilabu SA, Baba SS, Fagbami AH. Haemagglutination- inhibition (HI) antibodies against strains of influenza A virus in horse and pig sera in Nigeria. *Journal of Hygiene, Epidemiology, Microbiology, and Immunology*. 1990; 34: 365-370.
24. Adeniji JA, Adu FD, Baba SS, Ayoade GO, Owoade AA, Tomori O. Influenza A and B antibodies in pigs and chicken population in Ibadan metropolis, Nigeria. Tropical Veterinaria 1993; 11: 39-45.
25. Olaleye OD, Omilabu SA, Olabode AO, Fagbami AH. Serological evidence for influenza virus activity in Nigeria (1985-1987). Virologie. 1989; 49 (1):11-17.
26. Olugasa BO, Aiyedun JO, Emikpe BO. Prevalence of antibody against rabies among confined, free-roaming and stray dogs in a transit city of Nigeria. *Veterinaria Italiana*. 2011; 47(4): 453-460.
27. Olugasa BO, Aiyedun JO, Akingbogun AA. Identification of geographic risk factors associated with clinical human rabies in a transit city of Nigeria. *Epizootiology and Animal Health in West Africa*. 2009; 5: 43-52.
28. Olugasa BO, Odeniyi AO, Adeogun AO, Adeola OA. Antibody levels against rabies among occupationally exposed individuals in a Nigerian University. *Veterinaria Italiana*. 2010; 46 (1): 21-28.



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