

## Health security and the concept of new, emerging and re-emerging infectious diseases in Nigeria: Understanding health strategic management

---

**Joseph Kum Asan**

Department of psychology  
Nigerian Army University, Biu  
Borno State Nigeria.

### Abstract

*Emerging and Reemerging Infectious Disease is a Global Challenge and danger to the stability of nations and the world. Governments, international organizations and individual health professions have renewed their focus on current health care policies in an effort to reduce the threat of emerging infectious diseases, the purpose of this study was to analyze the concept of New emerging and Re-emerging infectious diseases and craft various strategies of managing them in Nigeria. Research publications by the World Health organization(WHO),center for Disease control and prevention(CDC) and other Health institutions were used ,the following findings were brought to bear that Re-emerging infectious diseases were linked to humans activities influenced by urbanization, domestic animals and wildlife also responsible for the spread with strong recommendations of managing them through inter-sectoral surveillance, environmental control measures, behavioral modifications and political will of the Governments as well as public awareness and Education in Nigeria.*

**Key words:** Inter-Sectoral Collaboration, infectious diseases, Re-emerging infectious diseases, globalization and urbanization.

### Introduction

Emerging infectious disease as global burden: Examples of emerging infectious diseases include: Ebola virus (first outbreaks in 1976 and the discovery of the virus in 1977). The 2014–2016



West Africa Ebola virus epidemics, unparalleled in spread for this disease, quickly overwhelmed the health systems of the 3 most affected countries. Ebola virus disease (EVD) can be difficult to initially identify even in a well-functioning health system because its early symptoms can closely mimic those of other common illnesses, such as malaria, typhoid, viral illness, and gastroenteritis<sup>1</sup>. Thus, in an already weakened health system, the task of quickly but correctly identifying and isolating Ebola patients before laboratory test results are available is particularly challenging. This fact can result in missed opportunities to isolate infectious patients (through incomplete screening sensitivity) and expose non-Ebola patients to nosocomial infection (through incomplete specificity).

HIV/AIDS (virus first isolated in 1983), Migration to cities and travels; after introduction, sexual transmission, vertical spread from infected mother to child, contaminated hypodermic apparatus (including during intravenous drug use), transfusions, organ transplants this lead to the re-emergence of HIV/AIDS.

Mycoplasma genitalium Infection In Adults reporting sexual contacts with infected partners, Australia, 2008-2016; Mycoplasma genitalium is an established sexually transmitted pathogen that causes none gonococcal urethritis, and recent evidence indicates that it increases the risk for cervicitis, pelvic inflammatory disease, preterm delivery, and spontaneous abortion. The estimated prevalence of M. genitalium infection is 1%–3% in men and women, according to community-based studies from the United Kingdom, United States, Australia, and Scandinavia. Early diagnosis and effective treatment are

---

<sup>1</sup>Ahmed S.M, Hall A.J, Robinson A.E, Verhoef L, Premkumar P, Parashar U.D, et al. (2014). *Global prevalence of norovirus in cases of gastroenteritis*: a systematic review and meta-analysis. *Lancet Infectious Diseases*; 14:725–30.

Ao Y, Wang J, Ling H, He Y, Dong X, Wang X, et al. (2016). *Norovirus GII.P16/GII.2-associated gastroenteritis*, China, 2016. *Emerg Infect Dis.* 2017; 23:1172–5.

*Centers for Disease Control and Prevention.* (2007). Surveillance for travel-associated Legionnaires disease—United States, 2005–2006.

*MMWR Morb Mortal Wkly Rep.* 2007; 56:1261–3.

therefore important in preventing sequelae and ongoing transmission, particularly the transmission of drug-resistant strains to sex partners. Data on the likelihood of Mycoplasma genitalium infection in sexual contacts, particularly for men who have sex with men (MSM), are needed to form an evidence base for guidelines. We conducted a cross-sectional analysis of patients attending a sexual health clinic in Melbourne, Victoria, Australia, during 2008–2016. We calculated the proportion of contacts with M. genitalium infection and determined factors associated with infection. Among those patients reporting sexual contact with an M. genitalium-infected person, 48.2% of women, 31.0% of heterosexual men, and 41.7% of MSM were infected. Among heterosexual contacts, women were twice as likely to be infected; among MSM, rectal infection was more common than urethral infection; and among persons in heterosexual partnerships, concordance of infection was high. High positivity among female and MSM contacts and high concordance within heterosexual partnerships provide some justification for presumptive treatment; however, clinicians should consider antimicrobial drug resistance and toxicity of quinolones.

- Hepatitis C (first identified in 1989, now known to be the most common cause of post-transfusion hepatitis worldwide),
- Emergent Recombinant Norovirus GII.2 strains in young Adults, Hong Kong, china, 2016-2017; a new recombinant norovirus GII.P16-GII.2 outnumbered pandemic GII.4 as the predominant GII genotype in the winter of 2016–2017 in Hong Kong, China. Half of hospitalized case-patients were older children and adults, including 13 young adults. This emergent norovirus targets a wider age population compared with circulating pandemic GII.4 strains<sup>2</sup>.

---

<sup>2</sup>Bhopal R.S, Fallon R.J, Buist E.C, Black R.J, Urquhart J.D. (1991). Proximity of the home to a cooling tower and risk of non-outbreak Legionnaires' disease. *BMJ*; 302:378–83.  
*Centers for Disease Control and Prevention*. (1994). Addressing emerging infectious disease threats: a prevention strategy for the United States. Atlanta: U.S. Department of Health and Human Services, Public Health Service.

- Noroviruses are leading causes of acute gastroenteritis (1). In the winter of 2016–2017, increased circulation of an uncommon recombinant norovirus genotype called GII. P16-GII.2 was reported in parts of Asia, including China (2) and Japan (3). Concurrently, winter norovirus cases peaked at an abnormally high level in Germany (4) and France (5) because of this emergent genotype. We report an increased detection of norovirus GII.P16-GII.2 infections in hospitalized case-patients beginning in August 2016 in Hong Kong, China. We also provide early evidence that this emergent GII.2 variant might target a wider age population than that targeted by circulating pandemic GII.4 strains
- Influenza A (H5N1) virus (well known pathogen in birds but first isolated from humans in 1997), Since 2003, approximately 850 human cases of Eurasian A/goose/Guangdong/1/1996 (GS/GD) lineage H5N1 virus infection have been reported; case-fatality rate is 53% (1–3). Most human infections with highly pathogenic avian influenza (HPAI) subtype H5N1 virus have occurred following direct or indirect exposure to infected poultry in live-poultry markets (LPM) in developing countries (1–3). The main risk factors associated with human infections include visiting an LPM or performing activities with intensive contact with infected poultry, like slaughtering, defeathering, or preparing poultry for cooking (3,4). Poultry-to-human avian influenza (AI) virus transmission can occur from 3 types of exposure: fomite-contact transmission, including contact with contaminated surfaces; droplet transmission, in which large (>5 µm) particles contact a person's conjunctiva or respiratory mucosa; and droplet nuclei transmission (or aerosol transmission), in which a person inhales

---

*European Centre for Disease Prevention and Control.* (2016).

Legionnaires' disease in Europe, 2013 [cited 2016 Aug 1].

<http://ecdc.europa.eu/en/publications/Publications/legionnaires-disease-2015>.

*New York City Rules.* (2016). Cooling towers: new Chapter 8 in Title 24 of the Rules of the City of New York to establish rules for maintenance of cooling towers [cited 2016 Aug 1].

<http://rules.cityofnewyork.us/content/cooling-towers-new-chapter-8-title-24-rules-city-new-york-establish-rules-maintenance>

small droplets (<5 microns) particles suspended in the air. Exposure to infected poultry is a suspected cause of avian influenza (H5N1) virus infections in humans. We detected infectious droplets and aerosols during laboratory-simulated processing of asymptomatic chickens infected with human- (clades 1 and 2.2.1) and avian- (clades 1.1, 2.2, and 2.1) origin H5N1 viruses. We detected fewer airborne infectious particles in simulated processing of infected ducks. Influenza virus-naïve chickens and ferrets exposed to the air space in which virus-infected chickens were processed became infected and died, suggesting that the slaughter of infected chickens is an efficient source of airborne virus that can infect birds and mammals. We did not detect consistent infections in ducks and ferrets exposed to the air space in which virus-infected ducks were processed. Our results support the hypothesis that airborne transmission of HPAI viruses can occur among poultry and from poultry to humans during home or live-poultry market slaughter of infected poultry.<sup>3</sup>

- *Legionella pneumophila* (first outbreak in 1976 as Legionnaire disease and since associated with similar outbreaks linked to poorly maintained air conditioning systems), the incidence of Legionnaires' disease in the United States has been increasing since 2000. Outbreaks and clusters are associated with decorative, recreational, domestic, and industrial water systems, with the largest outbreaks being caused by cooling towers. Since 2006, 6 community-associated Legionnaires' disease outbreaks have occurred in New York City, resulting in 213 cases and 18 deaths. Three outbreaks occurred in 2015,

---

<sup>3</sup>Moreno R, Afonso S, Fevereiro T. (2006). *Incidence of sepsis in hospitalized patients*. Current Infectious Diseases Rep. 2006; 8:346–50.  
 Levin-Rector A, Wilson E.L, Fine A.D, Greene S.K. (2015). Refining historical limits method to improve disease cluster detection, New York City, New York, USA. Emergent Infectious Diseases; 21:265–72.  
 Taylor-Robinson D, Jensen J.S. (2011). *Mycoplasma genitalium*: from Chrysalis to multicolored butterfly. Clinical Microbiology Rev. 2011; 24:498–514.

World Health Organization. (2006). Guidance for national tuberculosis programmes on the management of tuberculosis in children. Geneva: The Organization; WHO/HTM/ TB/2006.371; WHO/FCH/CAH/2006.7.

including the largest on record (138 cases). Three outbreaks were linked to cooling towers by molecular comparison of human and environmental *Legionella* isolates, and the sources for the other three outbreaks were undetermined. The evolution of investigation methods and lessons learned from these outbreaks prompted enactment of a new comprehensive law governing the operation and maintenance of New York City cooling towers. Ongoing surveillance and program evaluation will determine if enforcement of the new cooling tower law reduces Legionnaires' disease incidence in New York City.<sup>4</sup>

- *E. coli* O157:H7 (first detected in 1982, often transmitted through contaminated food, has caused outbreaks of hemolytic uremic syndrome): Mass food processing technology allowing contamination of meat, Globalization of food supplies; changes in food processing and packaging; organ or tissue transplantation; drugs causing immunosuppression; widespread use of antibiotics. Bacteremia caused by gram-negative bacteria is associated with serious illness and death, and emergence of antimicrobial drug resistance in these bacteria is a major concern. Using national microbiology and patient data for 2003–2013 from the US Veterans Health Administration, we characterized non-susceptibility trends of community-acquired, community-onset; healthcare-associated, community-onset; and hospital-onset bacteremia for selected gram-negative bacteria (*Escherichia coli*, *Klebsiella* spp., *Pseudomonas aeruginosa*, and *Acinetobacter* spp.). For 47,746 episodes of bacteremia, the incidence rate was 6.37 episodes/10,000 person-years for community-onset bacteremia and 4.53 episodes/10,000 patient-days for hospital-onset bacteremia. For *Klebsiella* spp., *P. aeruginosa*, and *Acinetobacter* spp., we observed a decreasing proportion of non-susceptibility across nearly all antimicrobial drug classes for patients with healthcare exposure; trends for community-acquired, community-onset isolates were stable or increasing<sup>5</sup>. Despite advances in public health and medical care,

---

<sup>4</sup> World Health Organization. (2014). Guidance for national tuberculosis programmes on the management of tuberculosis in children. 2nd ed. Geneva: The Organization. WHO/HTM/TB/2014.03

<sup>5</sup> Piot P, Muyembe J-J, Edmunds WJ. (2014). *Ebola in West Africa: from disease outbreak to humanitarian crisis*. Lancet Infect Dis; 14:1034–5.

bacteremia is still a major cause of illness and death. Bacteremia caused by gram-negative bacteria is a frequent cause of severe sepsis and septic shock and poses serious therapeutic challenges. Treatment options are limited because of increased infections with multidrug resistant, gram-negative bacteria in community and hospital settings.<sup>6</sup>

- Borreliaburgdorferi (first detected in 1982 and identified as the cause of Lyme disease): Reforestation around homes and other conditions favoring tick vector and deer (a secondary reservoir host) led to its re-emergent.
- Emergence of *Bordetella holmesii* as a causative agent of whooping cough, Barcelona Spain; the detection of *Bordetella holmesii* as a cause of whooping cough in Spain. Prevalence was 3.9% in 2015, doubling to 8.8% in 2016. This emergence raises concern regarding the contribution of *B. holmesii* to the reemergence of whooping cough and the effectiveness of the pertussis vaccine. Whooping cough is a highly contagious respiratory disease, primarily caused by *Bordetella pertussis*. Other species, such as *B. Parapertussis* and *B. holmesii*, have been recognized as causes of a syndrome that clinically resembles that of whooping cough. Pertussis is the term used for the disease specifically caused by *B. pertussis*, whereas pertussis-like illness or syndrome is more appropriately used when referring to the other etiologic agents. *B. holmesii*, a poorly studied pathogen, was originally identified in 1995 as a rare

---

Pittet L.F, Posfay-Barbe K.M. (2016). *Bordetella holmesii*: still emerging and elusive 20 years on. *Microbiol Spectr*.

Feldmann H, Geisbert TW. (2011). *Ebola haemorrhagic fever*. *Lancet*; 377:849–62.

Stroup D.F, Williamson G.D, Herndon J.L, Karon J.M. (1989). Detection of aberrations in the occurrence of notifiable diseases surveillance data. *Journal of Medicine*; 8:323–9

<sup>6</sup> World Health Organization. (1995). Communicable disease prevention and control: new, emerging, and re-emerging infectious diseases. WHO Doc. A48/15; Feb. 22, 1995.

World Health Organization. (2016). Global tuberculosis report 2016. Geneva: The Organization; WHO/HTM/TB/2016.13.

World Health Organization. (2016). Legionella and the prevention of legionellosis [cited 2016 Aug 1]. [http://www.who.int/water\\_sanitation\\_health/emerging/legionella.pdf](http://www.who.int/water_sanitation_health/emerging/legionella.pdf)

cause of bacteremia (3). Since then, it has been related to other invasive diseases, especially in asplenic and immunosuppressed patients and in healthy people with pertussis-like symptoms. To date, several cases of *B. holmesii* associated with pertussis-like illness have been reported in North and South America, Asia, Africa, and Europe. Additionally, 2 important outbreaks of *B. holmesii* infection associated with pertussis-like illness were detected in France and Ohio. Recent reports of the detection of positive cases of *B. holmesii* infection in the Netherlands, which previous analysis had failed to identify, reinforce the emergence of this pathogen. To our knowledge, the presence of this microorganism in Spain has not been documented. We report the emergence of *B. holmesii* as a causative agent of whooping cough in the metropolitan area of Barcelona, Spain. *B. holmesii* is an underdiagnosed emerging respiratory pathogen that triggers clinical manifestations similar to those caused by *B. pertussis*

- Drug Resistance Tuberculosis amongst children, china, 2006-2016; Microbial drug resistance has become a major public health concern worldwide. Tuberculosis (TB) is one of the leading causes of death worldwide. The World Health Organization (WHO) estimates that worldwide during 2015, this disease developed in 10.4 million persons and caused the death of 1.8 million. Children prevalence of TB globally, especially drug-resistant (DR) TB among children, is still a major cause of childhood illness and death. Control of TB among children is impeded by the challenges of presentation, diagnosis, reporting, and treatment; the absence of clear targets; and perceptions of low public health importance of TB. Difficulties with sputum collection and the paucibacillary nature of TB in children often make TB diagnosis difficult and drug-susceptibility testing (DST) inaccessible because DST is possible only after bacteriologic confirmation. Children with TB are especially susceptible to severe disease and death; even those with a favorable treatment outcome (cure or completion) or a latent infection could become a reservoir of disease relapse or reactivation. The percentage of DR TB, MDR TB, and overall firstline drug resistance for isoniazid, rifampin, ethambutol, and streptomycin in primary cases of TB in children increased significantly over the study period. This finding indicates ongoing primary transmission of DR TB strains in China. Ongoing primary transmission of DR TB strains among children may cause catastrophic consequences. Other studies have reported that independent host factors that

predispose to TB recurrence are malnutrition, smoking, HIV infection, and other immunosuppressive states. After the state of the host changes, even a person with a favorable treatment outcome (cure or completion) or a latent infection could become a reservoir for disease relapse or reactivation. In conclusion, primary cases of DR TB in children in Shandong Province, China, increased over the past decade. DR TB strains, especially MDR TB, are mainly transmitted by airborne infection from an adult source case-patient

Another example of an emerging infectious disease is the new variant of Creutzfeldt-Jakob disease, which was first described in 1996. The agent is considered to be the same as that causing bovine spongiform encephalitis, a disease which emerged in the 1980s and affected thousands of cattle in the UK and Europe, from contaminated batches of human growth hormone (medical technology).<sup>7</sup>

### Factors Contributing to Emergence of Infectious Illnesses

Considering the Epidemiological Triad of diseases in Figure 1 .several factors are responsible for emergence of infectious illnesses which includes the Agent (organism), Host factor, environmental factors and Vector. *'Disease does not occur in a vacuum'*

---

<sup>7</sup> World Health Organization. (1995). Communicable disease prevention and control: new, emerging, and re-emerging infectious diseases. WHO Doc. A48/15; Feb. 22, 1995.

World Health Organization. (2016). Global tuberculosis report 2016. Geneva: The Organization; WHO/HTM/TB/2016.13.

World Health Organization. (2016). Legionella and the prevention of legionellosis [cited 2016 Aug 1]. [http://www.who.int/water\\_sanitation\\_health/emerging/legionella.pdf](http://www.who.int/water_sanitation_health/emerging/legionella.pdf)

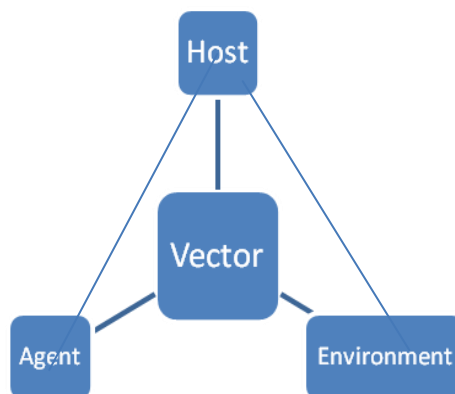


Figure 1

### Agent

Evolution of pathogenic infectious agents (microbial adaptation & change), Mutations Development of resistance to drugs, Resistance of vectors to pesticide, Antimicrobial drug Resistance stand out as a famous as a result of Wrong prescribing practices, non-adherence by patients, Counterfeit drugs, Use of anti-infective drugs in animals & plants, Community-acquired (TB, Pneumococcal) & Hospital-acquired (Enterococcal, Staphylococcal, Antiviral (HIV), Antiprotozoal (Malaria), Antifungal agents with consequences of Prolonged hospital admissions. Higher death rates from infections Requires more expensive, more toxic drugs higher health care costs.

### Host

Human demographic change (inhabiting new areas), increase contact with animals and natural Environment Human behaviour (sexual & drug use- sharing needles, drug abuse, body piercing) Human susceptibility to infection (Immunosuppression), stress and lifestyle changes and also nutritional changes can influence the emergence or re-emergence of infectious illnesses. Also Globalization of travel and trade, Increased international travel which influences illnesses like Influenza, *Aedes albopictus* mosquito eggs were isolated in shipments of used tyres which causes dengue fever, Long-distance travel; wild animal trade leading to Monkey pox. West Nile Virus (New York City, 1999)

was reported and SARS, 2003 these are as a result globalization and international travels.

### **Transmission of Infectious Agent from Animals to Humans-ZOONOTIC diseases**

Greater than 2/3rd emerging infections originate from animals both wild & domestic (CDC, 2006) E.g. Emerging Influenza infections in Humans associated with Geese, Chickens & Pigs, Animal displacement in search of food after deforestation/ climate change led to Lassa fever, Humans themselves penetrate/ modify unpopulated regions and came closer to animal reservoirs/ vectors this led to (Yellow fever and resistance Malaria strain<sup>8</sup>.

### **Recommended Strategies in Nigeria**

1. Inter-sectoral Surveillance approach at National, State and Local government level
  - Epidemiologically, through setting up of alert and response systems or units for epidemics preparedness and other public health emergencies in cosmopolitan sectors of the country.
  - Laboratory: an Alert system which will be centrally coordinated to always alert the Local health or regional offices in the national, state or local government level.

---

<sup>8</sup> Garrison L.E, Kunz J.M, Cooley L.A, Moore M.R, Lucas C, Schrag S, et al. (2016). *Vital Signs: deficiencies in environmental control identified in outbreaks of Legionnaires' disease*. North America, 2000–2014. MMWR Morb Mortal Wkly Rep. 2016; 65:576–84.

Goeijenbier M, Van Kampen JJ, Reusken CB, Koopmans MP, van Gorp EC. (2014). Ebola virus disease: a review on epidemiology, symptoms, treatment and pathogenesis. *Netherland Journal of Medicine*; 72:442–8.

Lai S, Qin Y, Cowling B.J, Ren X, Wardrop N.A, Gilbert M, et al.

(2016). *Global epidemiology of avian influenza A H5N1 virus infection in humans*. 1997–2015: a systematic review of individual case data. *Lancet Infect Dis*. 2016; 16:e108–18. [http://dx.doi.org/10.1016/S1473-3099\(16\)00153-5](http://dx.doi.org/10.1016/S1473-3099(16)00153-5).

Levin-Rector A, Nivin B, Yeung A, Fine A.D, Greene S.K. (2014). Building-level analyses to prospectively detect influenza outbreaks in long-term care facilities: New York City. *American Journal of Infectious Control*; 43:839–43.

– Ecological: Government should enact laws and Regulations on how animals should be handled with restrictions on areas of the ecology to be trespassed by humans at all levels. This will prevent further interactions with animals.

2. Investigation and early control measures; Governments at all levels should allocate adequate resources into infection control and microbial stewardship programs. Generally, the Nigerian Government should increase its yearly budget in health sector which is 4% of the total budget for 2017(7.7 Trillion Naira) to conform to the consensus of the African heads of states which is 14% of the Total National Budget.

3. Implement prevention and control measures; prevention still remains the best form of treatment at all level these are primary, secondary and tertiary. Which includes Infrastructure and Training, Strengthen public health infrastructures to support surveillance, response, and research and to implement prevention and control programs, also Government should ensure prompt implementation of prevention strategies and enhance communication of public health information about emerging diseases.

4. Behavioural, political and environmental strategy; Also Governments at all levels should strengthen applied researches and Integrate laboratory science and epidemiology to increase the effectiveness of public health practice, they should be political will and support from government, Judicious use of antibiotics and provision of vaccines for all.

5. Infrastructure and Training: Strengthen public health infrastructures to support surveillance, response, and research and to implement prevention and control programs. Provide the public health work force with the knowledge and tools it needs.

6. Monitoring, evaluation of interventions and all processes put in place.

## **Conclusion**

Humans, domestic animals and wildlife are inextricably linked by epidemiology of infectious diseases (IDs). Human-induced

environmental changes, interspecies contacts, altered social conditions, demography and medical technology affect microbes 'opportunities. IDs will continue to emerge, re-emerge and spread if the strategies discussed are not implemented and evaluated. "Knowing is not enough; we must apply. Willing is not enough; we must do" Johann Wolfgang von Goethe, German poet (1749-1832).

### Bibliography.

- Ahmed S.M, Hall A.J, Robinson A.E, Verhoef L, Premkumar P, Parashar U.D, et al. 2014.*Global prevalence of norovirus in cases of gastroenteritis: a systematic review and meta-analysis*. Lancet Infectious Diseases;14:725–30.
- Ao Y, Wang J, Ling H, He Y, Dong X, Wang X, et al.2016. *Norovirus GII.P16/GII.2-associated gastroenteritis, China, 2016*. Emerg Infect Dis. 2017; 23:1172–5.
- Bhopal R.S, Fallon R.J, Buist E.C, Black R.J, Urquhart J.D. 1991. Proximity of the home to a cooling tower and risk of non-outbreak Legionnaires' disease. *BMJ*; 302:378–83.
- Centers for Disease Control and Prevention*.1994. Addressing emerging infectious disease threats: a prevention strategy for the United States. Atlanta: U.S. Department of Health and Human Services, Public Health Service.
- Centers for Disease Control and Prevention*.2007. Surveillance for travel-associated Legionnaires disease—United States, 2005–2006. *MMWR Morb Mortal Wkly Rep*. 2007; 56:1261–3.
- European Centre for Disease Prevention and Control*.2016. Legionnaires' disease in Europe, 2013 [cited 2016 Aug 1]. <http://ecdc.europa.eu/en/publications/Publications/legionnaires-disease-2015>.
- Feldmann H, Geisbert T .2011. *Ebola haemorrhagic fever*. Lancet; 377:849–62.
- Ferrer A, Calicó I, Manresa J.M, Andreu A, Moraga F, Valle I.2000.*Microorganisms isolated in cases of pertussis-like syndrome [in Spanish]*.EnfermInfectiousMicrobiology Clinical; 18:433–8.
- Fraser D.W, Tsai T.R, Orenstein W, Parkin W.E, Beecham H.J, Sharrar R.G, et al.1977. Legionnaires' disease: description of an epidemic of pneumonia. *N England.Journal of Medicine*; 297:1189–97.

- García-Fulgueiras A, Navarro C, Fenoll D, García J, González-Diego P, Jiménez-Buñuales T, et al. 2003. *Legionnaires' disease outbreak in Murcia, Spain*. Emergent Infectious Diseases; 9:915–21.
- Garrison L.E, Kunz J.M, Cooley L.A, Moore M.R, Lucas C, Schrag S, et al. 2016. *Vital Signs: deficiencies in environmental control identified in outbreaks of Legionnaires' disease*. North America, 2000–2014. MMWR Morb Mortal Wkly Rep. 2016; 65:576–84.
- Goeijenbier M, Van Kampen JJ, Reusken CB, Koopmans MP, van Gorp EC. 2014. Ebola virus disease: a review on epidemiology, symptoms, treatment and pathogenesis. *Netherland Journal of Medicine*; 72:442–8.
- Lai S, Qin Y, Cowling B.J, Ren X, Wardrop N.A, Gilbert M, et al. 2016. *Global epidemiology of avian influenza A H5N1 virus infection in humans*. 1997–2015: a systematic review of individual case data. Lancet Infect Dis. 2016; 16:e108–18. [http://dx.doi.org/10.1016/S1473-3099\(16\)00153-5](http://dx.doi.org/10.1016/S1473-3099(16)00153-5).
- Levin-Rector A, Nivin B, Yeung A, Fine A.D, Greene S.K. 2014. Building-level analyses to prospectively detect influenza outbreaks in long-term care facilities: New York City. *American Journal of Infectious Control*; 43:839–43.
- Levin-Rector A, Wilson E.L, Fine A.D, Greene S.K. 2015. Refining historical limits method to improve disease cluster detection, New York City, New York, USA. Emergent Infectious Diseases; 21:265–72.
- Moreno R, Afonso S, Fevereiro T. 2006. *Incidence of sepsis in hospitalized patients*. Current Infectious Diseases Rep. 2006; 8:346–50.
- New York City Rules. 2016. Cooling towers: new Chapter 8 in Title 24 of the Rules of the City of New York to establish rules for maintenance of cooling towers [cited 2016 Aug 1]. <http://rules.cityofnewyork.us/content/cooling-towers-new-chapter-8-title-24-rules-city-new-york-establish-rules-maintenance>
- Piot P, Muyembe J-J, Edmunds WJ. 2014. *Ebola in West Africa: from disease outbreak to humanitarian crisis*. Lancet Infect Dis; 14:1034–5.
- Pittet L.F, Posfay-Barbe K.M. 2016. *Bordetella holmesii*: still emerging and elusive 20 years on. Microbiol Spectr.

- Stroup D.F, Williamson G.D, Herndon J.L, Karon J.M.1989. Detection of aberrations in the occurrence of notifiable diseases surveillance data. *Journal of Medicine*; 8:323–9
- Taylor-Robinson D, Jensen J.S.2011. *Mycoplasma genitalium*: from Chrysalis to multicolored butterfly. *Clinical Microbiology Rev.* 2011; 24:498–514.
- World Health Organization.1995. Communicable disease prevention and control: new, emerging, and re-emerging infectious diseases. WHO Doc. A48/15; Feb. 22, 1995.
- World Health Organization.2006. Guidance for national tuberculosis programmes on the management of tuberculosis in children. Geneva: The Organization; WHO/HTM/ TB/2006.371; WHO/FCH/CAH/2006.7.
- World Health Organization.2014. Guidance for national tuberculosis programmes on the management of tuberculosis in children. 2nd ed. Geneva: The Organization. WHO/HTM/TB/2014.03
- World Health Organization.2016. Global tuberculosis report 2016. Geneva: The Organization; WHO/HTM/TB/2016.13.
- World Health Organization.2016. Legionella and the prevention of legionellosis [cited 2016 Aug 1]. [http://www.who.int/water\\_sanitation\\_health/emerging/legionella.pdf](http://www.who.int/water_sanitation_health/emerging/legionella.pdf)