Influenza and other emerging viruses

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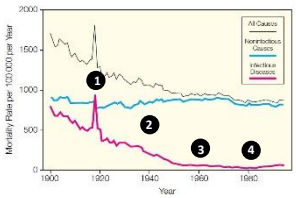
Historical perspective

The decrease in mortality rate related to infectious diseases along the firsts decades of 20th century led to complacency

In 1981 the mortality rate of infectious diseases increased again because of VIH/AIDS emergence and the danger of infectious diseases became obvious

VIH emergence in the 1980s taught us that infections diseases:

- Are still a serious threat even when their mortality decreases
- We can expect them to emerge and/or reemerge in the future
- Are very dynamic and their emergency cannot be predicted



1. First use of penicillin
2. 1918 influenza pandemic
3. Introduction of polio vaccine
4. First VIH description

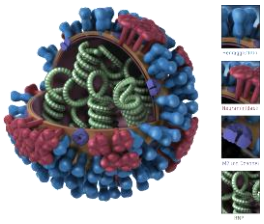
Influenza virus

Influenza viruses have a RNA segmented genome
There are 3 antigenically different influenza virus (A, B and C):

- Influenza A virus infect avian, human and other mammalian species whilst influenza B and C virus mainly infect humans
- Influenza A and B viruses cause seasonal influenza epidemics
- Influenza C virus causes a mild infection
- Influenza A virus can also cause occasional pandemics

Influenza A virus is further divided into subtypes according to two surface proteins:

- **Hemagglutinin** *(H1-H17)*: mediates viral entry by binding to acid sialic and is the main target of host antibodies, which can prevent subsequent infections
- **Neuraminidase** *(N1-N10)*: allows the release of virus particles and is the target of anti-influenza drugs that can shorten the severity and duration of illness



Credit: CDC

Every influenza A subtype combination can be found in waterfowl, which act as their natural reservoir and don't develop any disease sign

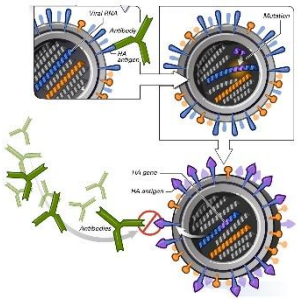
Antigenic drift

Is the cause of seasonal epidemics and the reason why the influenza vaccine is reformulated annually

RNA polymerases lack proof-reading activity and thus have a low replication fidelity

If a replication error result in a surface protein that can't be neutralized by antibodies the mutant will be fixed

Without a positive selection (immune response in humans) the mutants won't be fixed (this is why avian viruses haven't change in 50 years)



Credit: National Institute of Allergy and Infectious Diseases

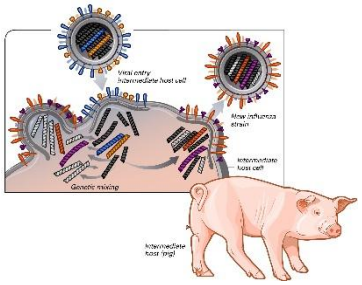
Antigenic shift

Is less frequent but results in bigger changes than antigenic shift

The segmented nature of its genome allows the re-assortment of gene segments when two different viruses infect the same 'cell

Because influenza B and C viruses mainly infect humans antigenic shift has only been found in influenza A viruses

Since they are susceptible from infection of both human and avian influenza A viruses pigs are thought to be an intermediate host



Credit: National Institute of Allergy and Infectious Diseases

Influenza pandemics (1918-2009)

Because its agriculture practices bring together pigs, ducks and people Southeastern Asia is considered as an "*influenza epicenter*"

1918 Spanish flu infected one third of the world population resulting in about 50 million deaths and differed from subsequent pandemics in its mortality rate (which was higher) and the age group affected most severely (that between 20 and 40 rather than the younger and the elderly)

Spanish flu H1N1 1918 → Asian flu H2N2 1957 → Hong Kong flu H3N2 1968 → Russian flu H1N1 1977 → Swine flu H1N1 2009

Conclusions

Since aquatics birds are the reservoir of every influenza A subtype virus influenza is not an eradicable disease

Because we are still unable to predict influenza pandemics is important to maintain surveillance in avian an swine species since they are associated to interspecies transfer of influenza virus

References

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