Bio 126 – Diversity of microorganisms

Almost forgotten but still dangerous –measles situation in Switzerland

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Summary

In 1997 the World Health Organization identified the targets that would allow the elimination of measles in Europe by 2010 (other sources give 2007). At that time a careful and complex plan was made, which was rewritten at the 2005 World Health Assembly, however achieving the desired aim appears to be distant. Analyzing the situation in Switzerland where some measles cases appear annually every spring, the hypothetical outbreak that could happen even now is intended to show how much more needs to be done to eradicate measles. The two greatest, but not the only, strategies that have to be overcome to achieve the desired aim are: establishing and maintaining high vaccination coverage and efficient disease surveillance. However no matter how simple it may seem there are multifactor and complex problems to be dealt with. Those include: social factors, political will and economic costs. Concluding I would like to emphasize that even though the effective measles vaccine has been known for years, the disease remains a realistic and underestimated threat.

Introduction

Measles is a highly infectious children's disease causing serious health problems and even deaths in the developed countries. It is an airborne disease which can spread very easily through the population. The causing agent is a paramyxovirus of the genus Morbillivirus. It is a genus of single strand RNA viruses. The fusion proteins and the attachment proteins appear on the surface of the spherical virion. Virions are enveloped and the matrix proteins inside stabilize virus structure. The core of the nucleocapsid consists of: genomic RNA, nucleocapsid proteins, phosphoproteins and polymerase proteins.

The infection begins when the measles virus enters the nose or throat by an airborne transmission. The incubation period lasts from 7 to 18 days however the most common period is 14 days. Acute period when all the disease symptoms are clearly visible usually lasts from 7 to 8 days. Measles is a very dangerous disease which mortality can reach up to about 20% (mostly due to complications).

Measles are characterized by a high fever, which is the first symptom that begins approximately 10 to 12 days after the infection and is followed by runny nose (coryza), cough, red watery eyes and small white spots inside the cheeks. Eventually the rash develops on the face and upper neck, and later proceeds downward to the body. Complications after measles are common in about 11% or more of cases.

Measles can be diagnosed basing on the symptoms. The most important one are so called Koplik's spots. Those are irregular, red spots that can be found inside the mouth even a few days before the rash appears. However the spots often disappear very fast or may not be seen at all. Also laboratory tests to diagnose measles are available. Those tests confirm the disease by isolating from the blood of a patient the measles antibodies (they appear about 5 days after the initiation of infection) or by isolating the measles virus RNA from the respiratory specimens.

Even though an effective vaccine has been in common use since 1985, measles have been eliminated from only a few developed countries. Eradication of measles has been the target of WHO since 1997. Even though significant progress has been made, there is still a lot more to be done. At the World Health Assembly in 2005 an effective program on how to strengthen national immunization was invented. The main goals of this program are: to achieve greater coverage and equity in access to immunization and also access to existing or future vaccines. To achieve these objectives, key strategies were invented, including: achieving and sustaining coverage higher than 95% with two doses of measles vaccine, strengthening surveillance systems, and improving

availability of valuable information about the disease not only for the doctors but also for the patients [1]. Those are not new ideas but it is easier to write them down on paper than to action them in reality. Under these circumstances the deadline to eliminate measles till 2010 may move in time a few years. This can be shown by a realistic measles simulation in Switzerland, where sporadic cases of the disease appear every year including a massive outbreak in 2003. This took place because there was insufficient vaccination coverage in the society and therefore lower "herd immunity".

In Switzerland the vaccine coverage (86,13% first dose and 30,2% second dose) allows the outbreak to spread even in quite big communities, but it cannot spread all over the country or cause any tremendous damage. The surveillance system was improved in 2003 when reporting each measles case started to be mandatory. The hypothetical outbreak, described in this paper, has been invented as an example to demonstrate how the disease could spread around Switzerland nowadays. However its main goal is to show how far we are from the eradication of measles and how much still needs to be done in order to achieve this goal.

Methods

The exact numbers of cases for each of the cantons used to describe the hypothetical outbreak was chosen form a set of data from other scientific publications. Based on the information, provided by Bundesamt für Gesundheit [2], concerning vaccination coverage of children in Switzerland, the middle value of vaccination coverage of 1st[1] and 2nd[2] dose was calculated. Two articles, about measles outbreaks in the Netherlands in the year 2000 [3] and in Switzerland in 2003 [4], delivered crucial information about the statistical distribution of measles. The percentage value of complications was calculated by making the average of the complications percentages from both mentioned articles.

The parameter called the reproductive number (R), used to illustrate the probability of a measles outbreak, was calculated based on the Santinella report data [10]. The formula for the R value follows: R=1- 2/m; where m is the average size outbreak and 1 and 2 constant numbers [5].

Results

The hypothetical outbreak happened in the spring of 2006 affecting cantons: Obwalden, Bern and smaller range cantons Zürich, Thurgau and Freiburg, and lasted approximately 5 months: from February till the end of June. The total number of cases was 200, which were spread among the infected cantons as follows: Obwalden 31% (the canton with the lowest vaccination rate), Bern 19%, Freiburg 18%, Zürich 15% and Thurgau 17%. The median or average age of the infected person was 10,3 years. In cantons Obwalden and Freiburg mostly children at the age of school departure were infected, whereas in cantons Bern, Thurgau and Zürich the infected were mostly children at the age of school entry but also some older ones. Complications after the measles disease itself appeared in 18% of infected cases that is in 36 cases. Among the most common

[1] 1st dose –the first portion of the measles vaccine given to a patient (usually a child). This vaccine gives some resistant against the measles virus however the immunity is not strong.
[2] 2nd dose –the second portion of the measles vaccine given to a patient that has already been vaccinated once in order to sustain the immunity.

complications were: Pneumonia[3], Otitis[4], Encephalitis[5],or only hospitalization without a given reason. Those are the most common complications after measles. The complications were most common among the infected in the age group of 18 years or older. However they were also common among infants and children under 5 years of age. Almost all of the people who were not vaccinated were susceptible and also many of those that took only one dose were at high risk and eventually fell ill (ca 90% [4]).

In this outbreak the index case is impossible to define, because of lack of real data. However it is most probable that the virus was imported form another European country, which happens in 50% of measles cases in Europe.

	Vaccination	coverage	Outbreak cases	
Canton	1st dose	2nd dose	[%]	[n of cases]
Bern	84,20%	25,87%	19%	38
Freiburg	86,43%	23,50%	18%	36
Obwalden	84,23%	21,53%	31%	63
Thurgau	88,80%	18,63%	17%	34
Zurich	88,50%	25,77%	15%	30
Switzerland	86,13%	30,20%	total cases:	200

Table 1. The vaccination coverage in a few Swiss cantons with outbreaks and number and percentage of outbreak cases.

The presented outbreaks, even though invented, shows how big the risk of an epidemic is, however the numbers could even be larger.

To emphasize how big the probability of the measles outbreak is a single parameter called the reproductive number can be calculated. It is approximately proportional to the fraction of the population that hasn't been vaccinated [6]. When the R parameter is smaller than one the disease is not endemic however outbreaks of varying sizes are possible. They tend to increase the size and frequency with the increase or the reproductive number until 1 is reached and the situation is said to be critical. The reproductive number based on the data presented below about the outbreaks in years 1999-2004 equals 0,62. It is not a critical value however it clearly shows that still quite big outbreaks can happen.

[3] Pneumonia –disease of lungs and respiratory system
[4] Otitis –ear infection
[5] Encephalitis –acute inflammation of the brain

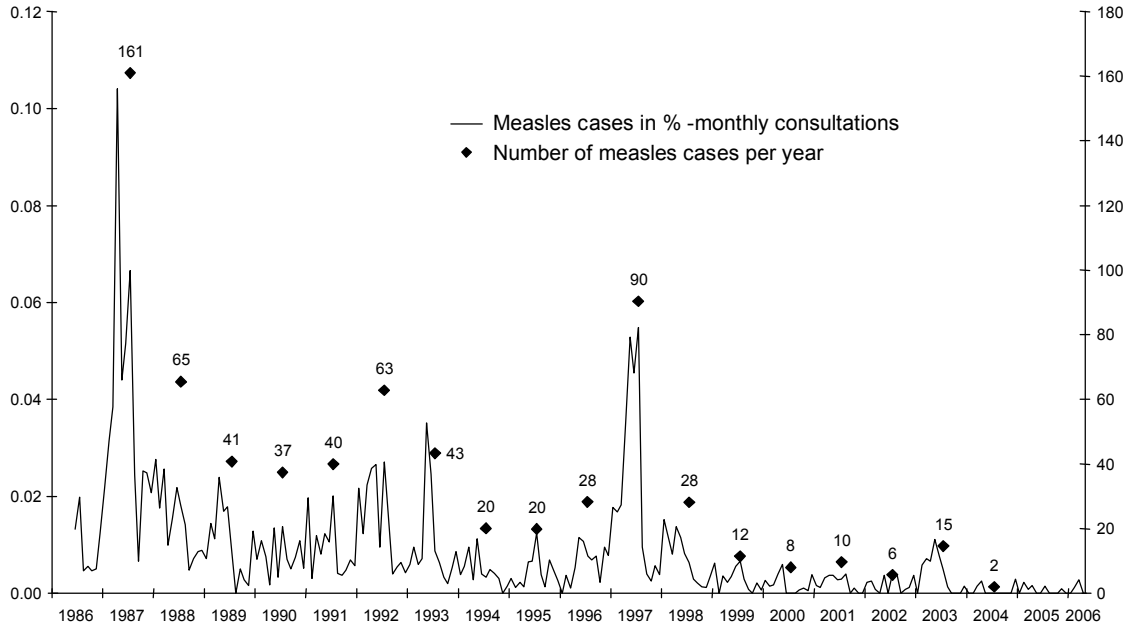

Diagram1. (Sentinella report [10]) Left Y-axis: cases of measles based on monthly reports per 100 consultations; Right Y-axis: Yearly measles cases projected on 100 000 residents in Switzerland.

Discussion

The fact that it was possible to create the hypothetical measles outbreak or that just 3 years ago a real incident took place shows that the plan to eradicate measles from Europe still has to be improved. The goals set by WHO are relatively straightforward, but their execution needs cooperation of many governmental sectors. Nevertheless, the most important are the social issues that have to be overcome. Nowadays most people fear the birds' flue epidemic and don't take a disease such as measles seriously. Therefore some people either do not get vaccinated at all, or finish the program after the first dose. However it is measles that caused over 30 million cases in the world just in the year 2003 so it shouldn't be treaded so lightly. Finally, also the specialization of the visited doctor has influence on the vaccination coverage in communities. Research shows [7] that many homoeopathists and other alternative doctors often do not vaccinate their patients despite the fact that this is recommended by the homoeopathist society. Also pediatricians vaccinate their patients more often than physicians.

The Sentinella diagram presented above shows that the reported measles cases since 1986 (even though the general tendency is decreasing because of common use of vaccine) it is a disease that has not yet been eradicated and even bigger outbreaks, such as the invented one, can still happen.

Following the WHOs statement and as it was calculated by Anderson and May [8] the vaccination coverage should be increased and sustained at 95% of two doses given to the infants of 12 months or more. However the progress in this crucial step is really slow. The most important is to distribute appropriate information to the society that would show the importance of the vaccine. Again easy to do, but not much is done, because a leaflet you may find in a hospital is not a national or even a global campaign. Also the stress should be put on the second dose of the vaccine. Of course the risk of the infection after the first dose decreases, however the first dose could be called "half the

success, which in reality is not success at all". An analysis of past measles outbreaks shows that people vaccinated only with one dose can also get infected. This often happens some years after the shot and by that increases the risk of complications which are often becoming more severe with the age of a patient. As it is shown in the hypothetical outbreak the complications are almost a fifth of all cases. This number however could also increase. It is possible that one of the reasons for the increasing number of complications is the high percentage of people being vaccinated only with one dose of the measles vaccine. This has a negative impact on the age of the susceptible population by augmenting it. As it has been said before it increases the probability of complications or severances of the disease. Under these circumstances the Swiss average of the second dose coverage (30.20%) looks rather alarming. Moreover even the first dose coverage is not enough to keep the "herd immunity" at the required level. Furthermore not only newborns should be vaccinated but an additional vaccination campaign should also reach older people, especially those at high risk – working in the public sectors such as hospitals or schools. Until this basic requirement is fulfilled the eradication of measles in Switzerland or any other country is impossible.

Surveillance, which includes reporting each case of the disease, is also one of the aims to help eliminate measles. There are no regulations as to organizing the reporting programs in the WHO member counties. In Switzerland an organization called Sentinella-Meldesystem is responsible for the statistics and since 2003 there is an obligation to report every measles case appearing. However even now not all incidents are being reported either because not everybody visits a doctor or not every incident is diagnosed as measles. It is suspected that the number of outbreak cases in 2003 was twice as big as reported [7].

Critic of the WHO measles eradication plan based on the: *WHO European Region strategic plan 2005-2010.*

The World Health Organization established a careful multilayer plan of measles eradication in Europe till the 2010. It is not an easy goal to achieve, however the plan itself has many ideas however not much is being mentioned concerning their execution. Again we find ourselves facing the basic problem – too low vaccination coverage. But the problem remains unsolved. A statement that it should be higher than 95% does not change anything. The exact methods should be stated. One of a few ideas of how to execute the eradication plan is improving the immunization awareness and therefore the European Immunization week was invented and is being held annually. However this event is not commonly known, because of lack of the promotion in the media. In this special case the internet is not the optimal source of information because not many people seek the information about vaccinations, especially for such a disease as measles. Moreover some don't even know what measles is. A very important area of action connected to establishing the 95% vaccination coverage is the second opportunity for measles immunization for the ones that have never been vaccinated or have had only one dose. Therefore even groups of people at high risk were defined. However, yet again the information barely reaches the addressee. In the WHOs plan the stress is put on providing the information about the disease and the vaccine not only to the specialists but also to people who wish to know about the immunization program. However it is in doctors power, and this is the most important, to deliver the information and encourage the patients to get vaccinated.

Also the surveillance system should be described more precisely. Research shows [3] that during the measles outbreak in Switzerland in 2003 the estimated number of cases was about twice as big as the number that was reported. One of the reasons for this was the lack of information flow. A nurse at a school didn't contact the doctor or did it too late and in effect, the government was also

informed too late – when the outbreak was already unavoidable and was spreading among several communities. Nevertheless a fully operative national and also international surveillance system is one of the most difficult problems to overcome and no ready solutions are available. An internet monitoring program that is being upgraded monthly was invented and can be accessed on the web site http://data.euro.who.int/cisid/ . However the data presented in the program doesn't entirely correspond with the information found in some scientific publications.

The two most important factors to eradicate measles are: reporting every case of the outbreak and high level of vaccination coverage for all the habitants. These are of course obvious, but as life shows, they are very hard to fulfill.

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Supplementary material:

Illustration1 The red spots on the skin of a child. Those spots are one of the most characteristic symptoms of measles.
http://www.clinical-virology.org/gallery/images/rash_bacteria/measles_3.jpg

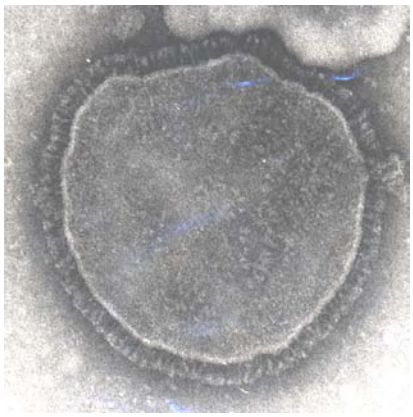

Illustration 2 The measles virus seen under a microscope.
http://www.uni-tuebingen.de/modeling/Mod_Measles_Intro_en.html