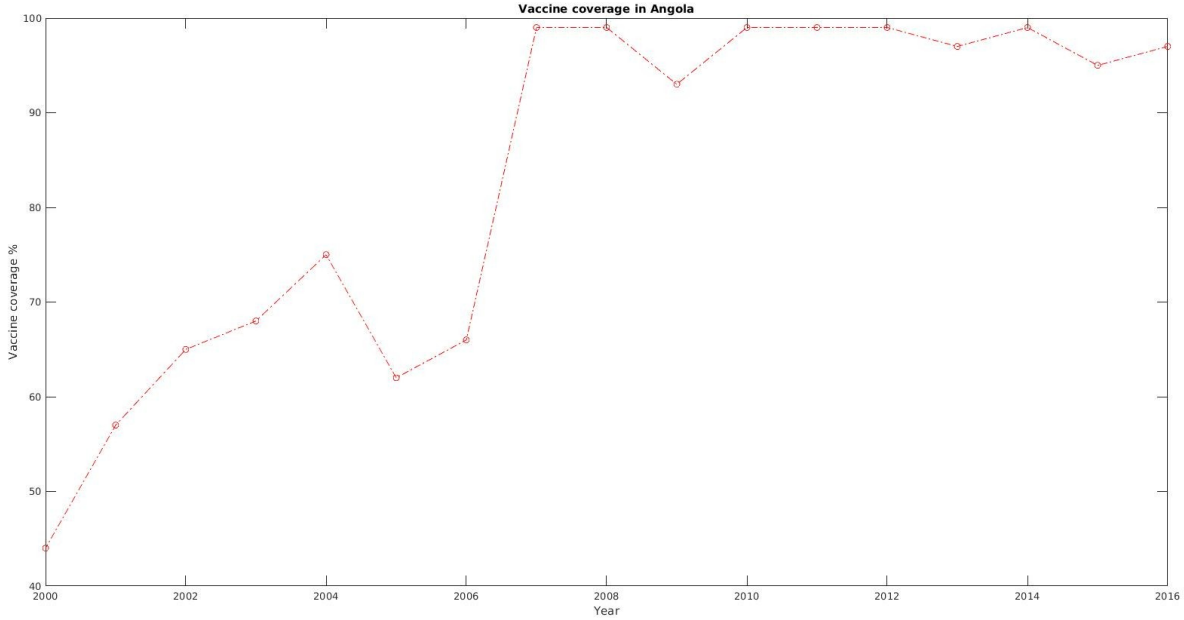
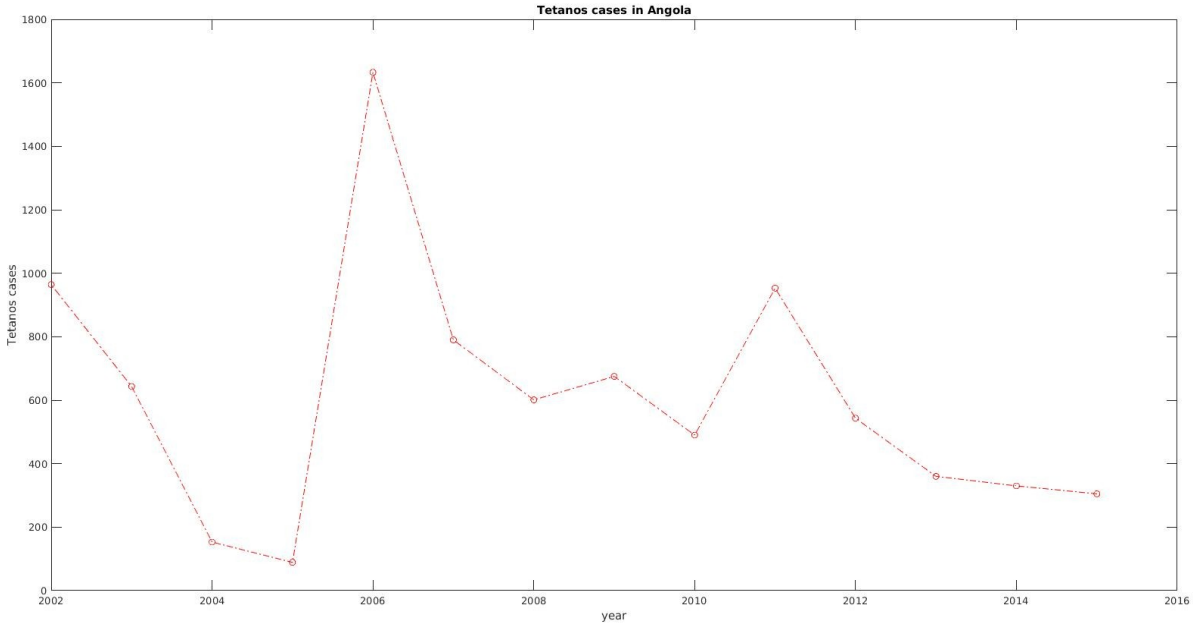
Vaccine efficiency Study

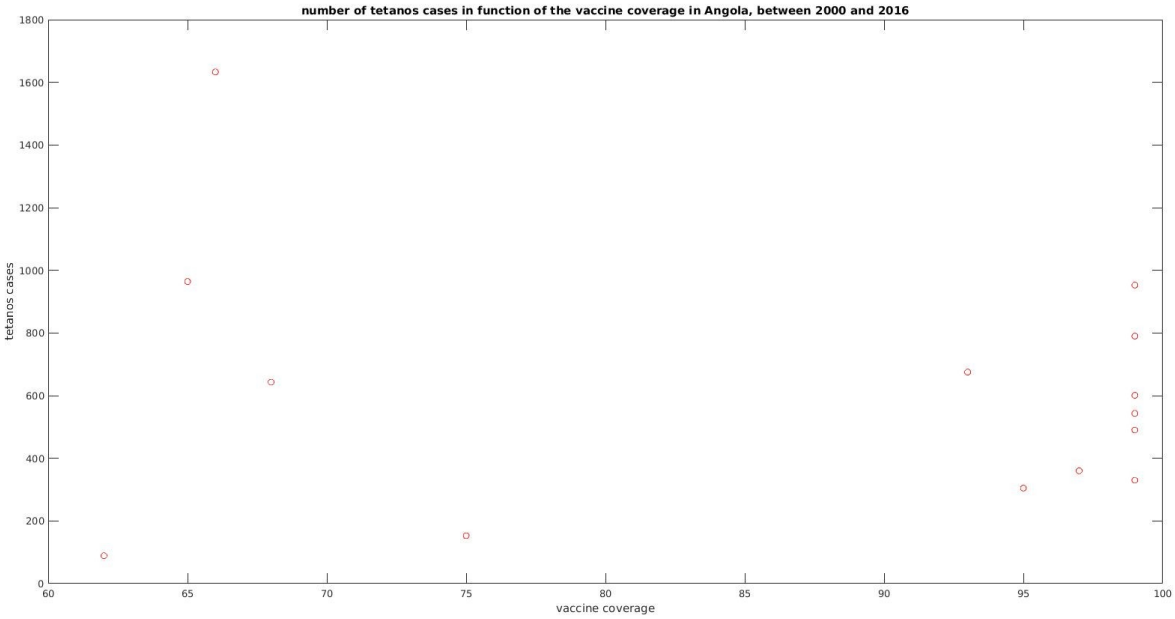
Abstract :
In this study we will ask a simple question : have vaccines proven to be effective. What we mean by that is, is there a direct correlation between the use of vaccines on a portion of population and the reduction of the number of cases of illness prevented by said vaccine. We will focus on the Tetanus vaccine, the DTP.
We start here by seeing that simply showing a decrease in diseases accompanying an increase in vaccines over the years, while providing positive insights, does not prove the efficiency of vaccines. We then try to derive a more complete approach to prove actual correlation.

First analysis :
DTP1 vaccine coverage and Tetanus cases in Angola over the past years.





To better see if the data is linked, we also derived the number of cases in function of the vaccination coverage. Comparing percentage of coverage and number of cases makes sense only if we assume a somewhat constant population. We will come back on this hypothesis later.



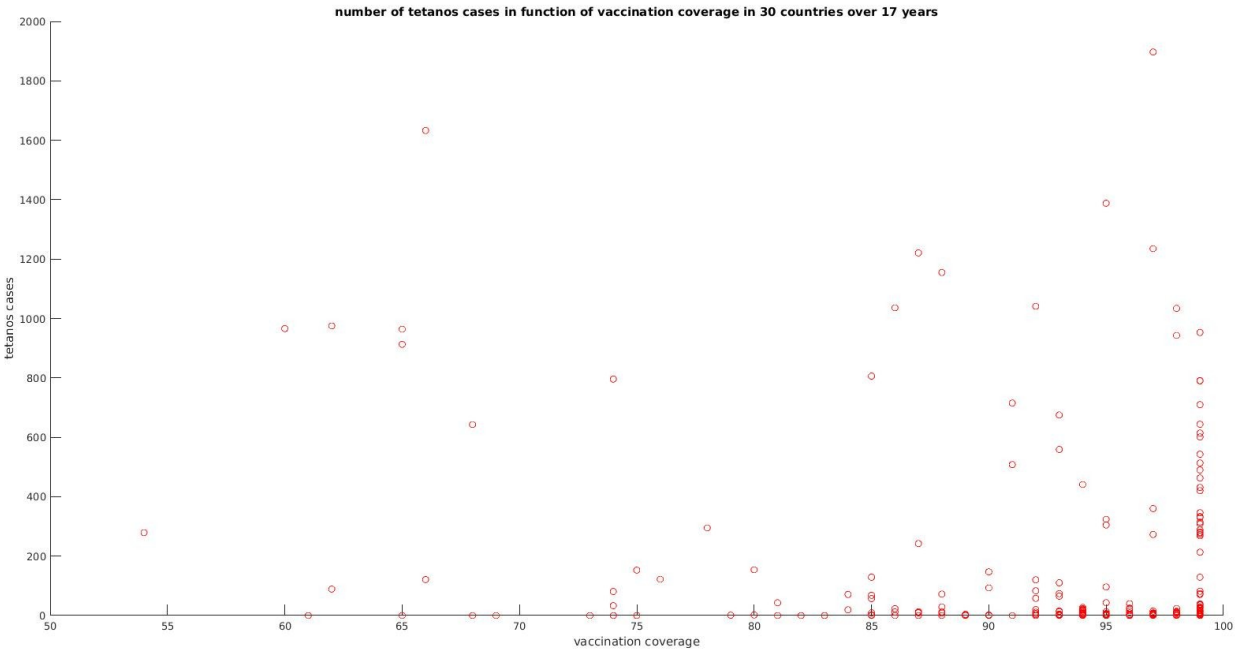
From this kind of limited data we can't conclude on the efficiency of vaccines at all for several reasons :
The data is not big enough. We would need at least twice the samples to get a statistically sound tendency. Adding other country as sources could provide statistical soundness.
Even if we get a statistically credible joint tendency, it won't prove causality, but just provide some incomplete insight, in which case we will need to provide additional sources.

Second Analysis :

Let's now use the data on DTP1 vaccine coverage and tetanus cases in the last 17 years in 30 different countries.

We need a way to “average” the data so that it can provide a statistically sound compound.

A first idea, visual, is to display the number of cases in function of the vaccination coverage with this time much more data.



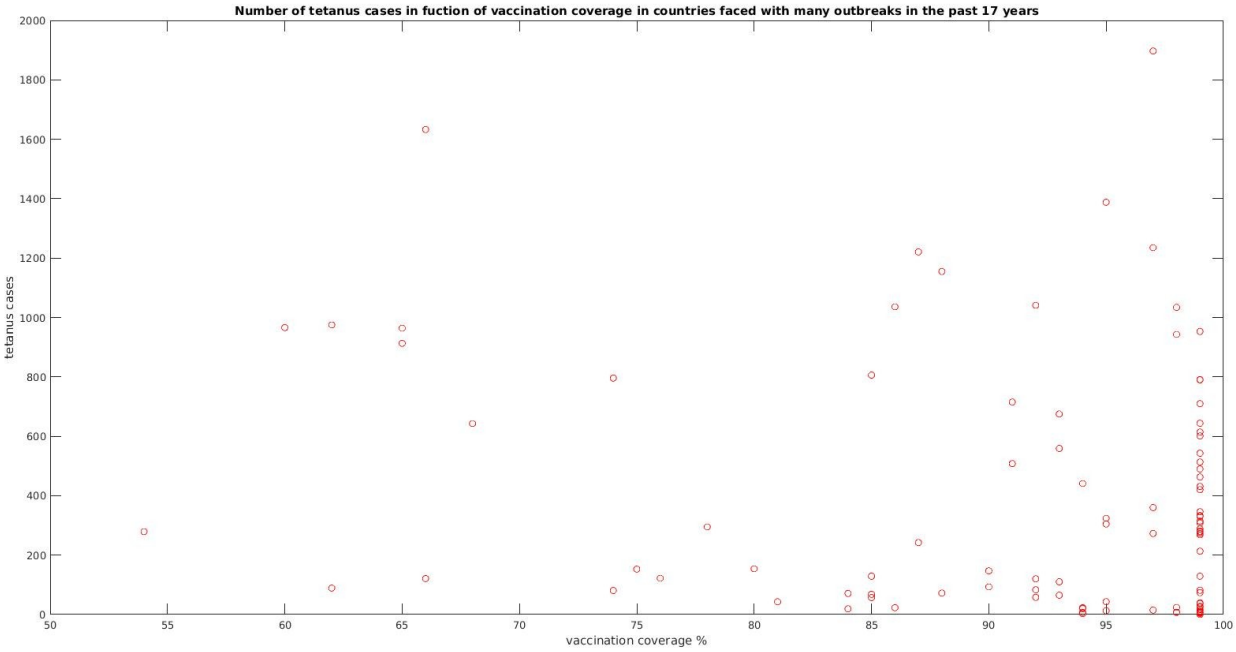
It seems we still do not get even a visual tendency. Several reasons can cause that (assuming there actually is a relation between vaccination and a reduction of tetanus cases). First, as stated before, the population of many of the country involved is not constant. It is however not varying quickly enough to justify suppressing correlation, so we will keep a study of cases percentage in function of vaccination percentage for a final cleaning of data. Second, there could be many outliers, either because of a sudden outbreak of a disease in a particular country or because of a country never having known the disease.

Still we can see a strong pull towards the point of 100% vaccination and 0 cases of disease. This can be explained by the many countries providing data between 90 and 100% coverage with 0 disease in the past years. The presence of a disease can vary for several reasons, and once no cases erupt, the chance for the disease to resurface is lower.

Third analysis :

As stated, keeping only the countries that have seen a high number a disease outbreak during the past 17 years might clean the data, as the others may never have needed vaccination and might not be good test subjects.

We only study here the number of tetanus cases in function of the vaccination percent for countries having had at least a year with 10 or more cases (the arbitrary nature of this number should be called into question later).



We can see the pull towards the bottom right remains strong, pointing at a correlation between high vaccination coverage and low number of tetanus cases.

We however need to remain aware that this does not prove that the DTP1 vaccine causes a reduced amount of tetanus cases. They could both be caused by a third factor at the same pace. It could be that the countries in this study have been able to cover more population with the vaccine because of increased budget, which also lead to better sanitary services that could be the sole reason for the reduction in tetanus apparitions.

Fourth analysis :

Conclusion (temporary, if no additional analysis can be provided) :

Even after getting statistically sound data by using as much as 30 countries over 17 years as input and after cleaning the data to suppress what could be called “obvious outliers”, we can't reached a definitive answer as to whether the DTP vaccines did cause a reduction in tetanus cases. The best we can say is there appears to be a weak correlation between more vaccines and less diseases.

As long a no further statistical analysis is provided, proving that vaccines do cause a reduced chance of catching a disease can only be done with medical studies of the actual effect the vaccine has on the body. (Such studies have obviously been provided at length and the mandatory vaccines in most country, including France are well proven to be effective) .

As an added thought, this implies that vaccines have been shown to have a certain probability to render a subject immune to a disease. The effect on the number on cases appearing in a population that is not completely vaccinated can then be derived, and it was shown that there is threshold of vaccination coverage above which disease have a sufficiently low chance to erupt. This in terms shows that vaccination doesn't only have a high chance to protect oneself but also is a way to get a much higher chance of protection if a big enough part of the population does it.