The Science Ordeal

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Introduction

Science is not popular. Most people do not know much about the importance of science. They do not know that if not for science we would be dying before 40 years old out of flu. The worst part is that the Legislative does not know much about science either. When they receive a proposal from the Executive cutting scientific budgets as it is happening now during the Trump administration they end up approving reductions in scientific areas that are essential for society life quality. The science budget of 2018 in Brazil will be less than the budget of 2017. I will be dealing with subjects that should be known by the ordinary people. This information is available everywhere in the literature but I see no satisfactory effort to make science popular. When the Legislative cut science budgets the voice of society that should be heard stay silent.

Vaccines

The history of vaccine development started in China in the 10th century [1] with smallpox by the precarious inoculation of the virus. The history of vaccine development is a continuous battle that lasts more than a thousand years with pending results such as the lack of a vaccine for malaria that claimed the lives of millions in history particularly in developing Countries. In addition to date there is no vaccine for cancer despite of recent efforts with neo antigens that contain multiple mutated proteins, that are specific to an individual patient's tumor. Giving patients a dose of their tumor neoantigens, which look foreign to the immune system, should help activate immune cells called T cells to attack the cancer cells [2].

The second generation of vaccines was introduced by Louis Pasteur in the 1880s who developed vaccines for chicken cholera and anthrax [3]. During the nineties vaccines became a matter of national prestige and compulsory vaccination laws were passed [4]. The history of vaccination despite of the laws were not accepted by society easily. Oswaldo Cruz in Brazil during the early nineties campaigned against yellow fever. The President of Brazil then Rodrigues Alves by decree forced vaccination but society and even the army reacted. This was known in Brazil as the "vaccine revolt". Cruz had his life and the lives of his family menaced by ignorance [5]. It is important that this information becomes known because advances of sciences were not many times understood and accepted immediately

Antibiotics

The revolution in Medicine due to antibiotics started in the 20th century. Despite of many initial discoveries that led to the discover of antibiotics the major advance came with Alexander Fleming in 1928 when he identified penicillin from the mold *Penicillium chrisogenum*. His Nobel Prize came only in 1945 after he partnered with the chemists Chain and Florey who shared the prize with him. Together with vaccines antibiotics nearly eradicated many diseases such as tuberculosis in the developed world and polio almost everywhere. Different from vaccines however that were many times rejected antibiotics were overused. The World Health Organization classified antimicrobial resistance as a serious threat that is happening in every region of the world and affect anyone of any age in any country [6] The threat may have come to an end after Dale Boger in the Scripps Research Institute found a super Vancomycin, an advance that could eliminate the threat of antibiotic-resistant infections for years to come. "Doctors could use this modified form of vancomycin without fear of resistance emerging," said Boger. In addition punching holes in the Vancomycin molecule, gives vancomycin a 1,000-fold increase in activity, meaning doctors would need to use less of the antibiotic to fight infection [7].

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Last June 6th I contributed to a blog in Nature. The title was **Brazil's plunging science investment** [8] In my contribution to this blog I called attention for the fact that society does not understand the importance of science in Brazil. Science Journal last April [9] showed to me that we are not alone. A March for Science took place in the US and in many other countries in April 22nd precisely for the same reason or to achieve the same goal: popularize science. When I was very young in my native city in Rio de Janeiro, Brazil I saw a campaign to popularize nuclear energy. The population in Brazil only remembered and associated with nuclear energy the atom bombs that the US dropped in Hiroshima and Nagasaki. The Government invested to change this perception for reasons that some decades later became evident. In history the most aggressive campaign to overcome global problems announced the threat the climatic changes could cause to the planet. Global warming is not clearly understood by the people in general but they perceive that pollution can harm them. So most people are sympathetic with the replacement of gasoline by ethanol that emit less CO_2. Increase of CO_2 my cause the ocean level to increase 60 centimeters till the end of the century and countries will disappear unless we desalinate sea water as I proposed seven years ago [10]. The cost of desalination was very high then but it is not anymore. Projects of this kind are being developed mostly in the Middle East and will be feasible before

the end of the century. Unfortunately I do not see efforts of the kind we saw calling attention to the climatic changes anywhere to popularize science as a whole. People do not understand that if not for vaccines and antibiotics as I showed above we would all die young due to different kinds of plagues as it happened in the past. Jeremy Berg author of the Editorial in Science [11] with good reasons although advocating in favor of the March for Science claimed: "it should not however be an endpoint". I agree entirely but regret the fact that investments in this direction are not available at least in Brazil where not one museum shows the history of science as some exist in the US. I saw many of these museums in the US. They seek the goal to popularize science and only partially succeed. We have to pay to get in because most of these museums have harsh financial difficulties to survive.

Universities in the US offer open house days particularly coincident with home coming football events to demonstrate to the population where they are located what they do. I miss in Brazil museums that tell science history with the goal to demonstrate to all, particularly non-academic people, the importance of science and as such to facilitate more investments in Congress. Our scientific army in Brazil is too small to succeed doing Marches for Science. A Governmental initiative as we solely did for nuclear energy in the past should seek for private funds to accomplish this effort. Although the private sector of course benefit from the achievements of science they will not be attracted to participate in this initiative unless they receive a drop in taxes they pay every year. Perhaps another simpler fast and very effective way to popularize science we see in television in Brazil today that call attention for the importance of agriculture. This is shown every day in short films extremely well designed by Globo TV that probably is being subsidized by the Agriculture Industry. We should do an initiative of this kind for health and many other areas where science achieve important goals: energy, environment, engineering to mention only a few (Figure 1).

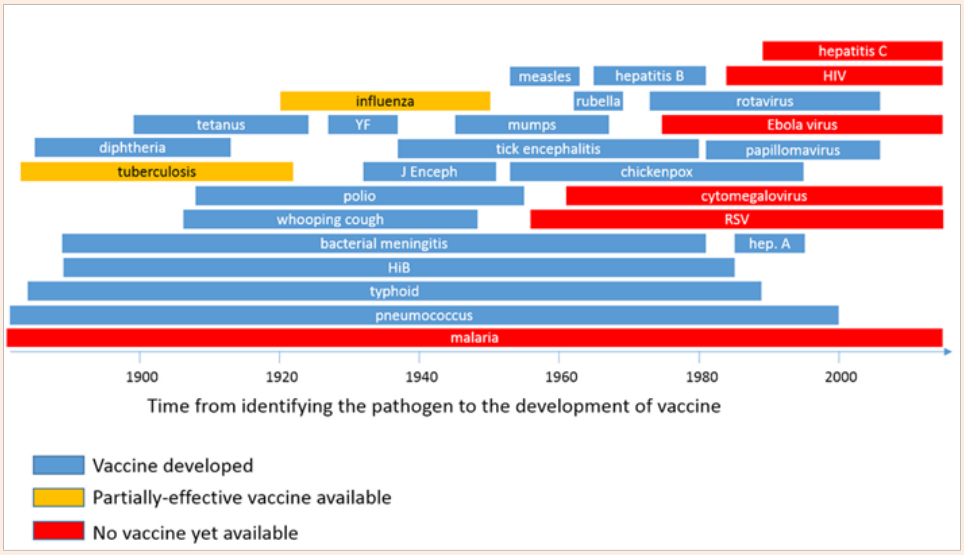

Figure 1: The history of vaccine development*.

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