**Title: Vaccinology (CRN VIR-3178). Course policy and welcome notes.**

**Date: Monday, March 25, 2024.**

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**Dear future colleagues,**

It is known that the English physician Edward Jenner observed that milkmaids who contracted a mild viral disease called cowpox were rarely victims of a similar but deadly disease called smallpox. This observation led Jenner to infect a healthy young boy with cowpox virus, and six weeks later challenge the boy with fluid from a smallpox pustule; this kind of human testing is a crime punishable by law today. The boy remained free of smallpox. Many would say that the era of vaccinology began from that experiment. However, the truth is that Indians, Arabs, and Chinese were conducting immunization of sheep centuries earlier (whqlibdoc.who.int/smallpox/9241561106_chp6.pdf).

We conventionally define vaccines as harmless or inactivated foreign agents that stimulate the production of protective immunological memory against infection and/or disease. However, vaccines are more than the immunogens they contain; they are pharmaceutical preparations that we will discuss in detail during this course. Modern vaccines are also proteins, small molecules, and nucleic acids. Modern vaccines also contain immunogens that are subunit proteins and small molecules, or nucleic acids that can express important immunogens. New generations of vaccines will significantly improve human health and economy. Moreover, vaccines are being designed to treat existing disease and even prevent cancer (www.vet.uga.edu/research/vmes/.../VMES04.pdf).

Today, vaccines have saved millions of lives and improved the lives of billions more, and humanity has completely succeeded in eradication of some pathogens from specific areas of the world (e.g. smallpox, polio, and rinderpest). However, there are yet several challenges facing the development and/or success of vaccine-based control. These challenges include: (1) the nature of pathogens; (2) the emergence of new pathogens as in the case of SARS-CoV-2; (3) our limited understanding of disease pathogenesis; (4) our limited understanding of immunogenesis; (5) the limitation of current vaccine production technology; (6) the demographic and sociopolitical situation of the world; (7) economic considerations and misdistribution of global wealth.

In this course we will discuss the basic aspects of vaccine development and quality control. We will also focus on innovations that helped improve vaccine quality, efficacy, manufacture process, and economics of vaccine-based control strategies. Regulatory and economic aspects of vaccine development will be discussed when appropriate. Special attention will be given to the ethical aspects of vaccine development and distribution.

Vaccine production in Egypt is at the verge of a once-in-a-generation boom. This course will help you get ready for the market demand. It will help you become better at supporting the Egyptian “Bioshield”. Enjoy!

**Course objectives**

On completion of this course, graduate students should have a working understanding of:

1. The role of vaccination in integrated disease control strategies.
2. Limitations of some current vaccines and alternative approaches to increase vaccine efficiency.
3. Critical aspects of novel vaccine design.
4. Advances in vaccine development (including NA vaccination and mucosal vaccines).
5. How to design a vaccine evaluation protocol.
6. The ethical and economic aspects of vaccine development.

**Course Requirements and Policy**

1. Teaching, exams, and reports will be in English.
2. The course material is supported by key papers reporting one or more aspects of vaccinology.
3. You will be given guidance on how to get the course material (see below) early in the course. You are

required to read it. Several exam questions will involve concepts discussed in the journal articles assigned to you.

4. You are required to make a short scientific review* discussing any topic related to vaccine quality control or quality assurance. Topics related to the community will be favored. At the end of this course, you will be required to present your review to your colleagues.
5. You are required to devise a one-page experimental design* to attempt solving one of the problems you see relevant to the topic you have reviewed or, simply to improve vaccine quality or production process.
6. There will be two pop exams* to access what you really absorbed during our contact and to determine what needs to be done to improve the outcome of your learning activities. The exams are not mandatory; however, your scores in these exams will be added to your total sum in the form of extra-credit points. Please, take them seriously.
7. Practical parts related to vaccine development and testing will be discussed during lecture or afterwards.
8. Plagiarism is prohibited and will not be tolerated. The simplest description of plagiarism is defined by "claiming that something is yours while it is the work and thought of someone else". You MUST think, write using your own style, and reference people that have helped you create your own ideas and style. YOU WILL FAIL IF YOU COMMIT PLAGIARISM.

**Course materials**

Required course material:

1. Effect of inactivation method on the cross-protective immunity induced by whole 'killed' influenza A viruses and commercial vaccine preparations. https://doi.org/10.1099/vir.0.018168-0.
2. Development of a freeze-stable formulation for vaccines containing aluminum salt adjuvants. doi: 10.1016/j.vaccine.2008.
3. Recombinant, Live-Attenuated Tetravalent Dengue Virus Vaccine Formulations Induce a Balanced, Broad, and Protective Neutralizing Antibody Response against Each of the Four Serotypes in Rhesus Monkeys. DOI: 10.1128/JVI.79.9.5516-5528.2005.
4. Mucosal vaccines and technology. Clin Exp Immunol. 2019 May; 196(2): 205–214. doi: 10.1111/cei.13285.

Recommended course material:

5. Terrestrial Manual, 2022. https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/. (Only specific sections).
6. Adams, A. (Ed.), 2016. Fish Vaccines. doi:10.1007/978-3-0348-0980-1. (Only specific sections).

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*Activities and % of final grade:

| Activity | Objective | % of grade |
|---|---|---|
| Short Report. | Practice scientific communication skills. Encourage creative thinking. Practice reporting and organization. | 10% |
| Experimental Design (written). | Encourage creative thinking. Practice reporting and organization. | 10% |
| Discussion of assigned journal articles (#=4)/ORAL | Measure student progress. Measure course progress. | 10% |
| Laboratory Exam | Measure ability to apply practical knowledge. | 20% |
| Final Exam | Measure student outcome, and rank students. | 50% |
| Pop test 1 | Encourage regular study, creative thinking. | Extra Credit 2.5% |
| Pop test 2 | Encourage regular study, creative thinking. | Extra Credit 2.5% |

End