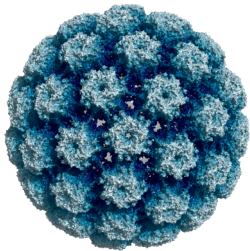


“Życie na żywo” (Polish for “Live life”) is a single author column series in *Delta* that concerns life sciences.



HPV type 16 viral capsid protein.
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Virus means poison

The history of the discovery of viruses, forms of life that require a host cell (bacterial, animal, or plant) to survive, is not too distant. It was with surprise that Louis Pasteur, in the late 19th century, observed the virus causing rabies, realizing that an infectious agent could be isolated by filtering tissue extracts through porcelain filters that retained bacteria. This was the first indication that the rabies virus must be smaller than bacteria. With the invention of electron microscopes, we were able to see various viruses and learn about their shapes. This device turned out also incredibly useful in studying the fundamental processes of large molecules necessary for life, such as proteins, nucleic acids, and their structural and metabolic interrelationships. The word “virus” is widely known, although detailed knowledge about different viruses is accessible only to specialists. From time to time we come across news in newspapers about viruses and our relationship with them (pandemics!), and then it is useful to listen to what the virologists have to say.

At the end of May, registration for non-compulsory and free vaccinations against human papillomaviruses (HPV) for 12 and 13-year-old children has begun in Poland. This vaccine is an exceptional medical achievement. HPV viruses cause morphological changes in the squamous epithelial cells of the cervix, which can eventually transform into squamous cell carcinoma. The discovery that cancer may be virus-induced led to the successful development of the vaccine. It was designed 17 years ago. Clinical safety studies were conducted under the supervision of the European Medicines Agency. There are also data on the effectiveness of the vaccine: according to a study of more than 2,000 women from Scandinavian countries, the incidence of cervical cancer decreased by 90% compared to the number of cases in the period when there were no vaccinations. During the 8 years of the study, there was not a single new case of this disease among the participants, which proves its high effectiveness. Universal vaccination was first introduced in Australia, in 2007, followed by the United Kingdom in 2008, and by 2019, almost all European Union countries had implemented such free vaccinations for both girls and boys. These vaccinations are now used in 125 countries worldwide (data as of May 2023).

There are over 150 types of HPV known, including low-risk types that cause benign genital warts and high-risk types responsible for precancerous changes, cervical cancer, and other malignancies. HPV infection usually occurs through sexual contact, most commonly in the early stages of sexual activity. Throughout their lives, 80% of sexually active women and men have been or will be infected with HPV. HPV infections can also lead to anal, vaginal, vulvar, penile, oral, and head and neck cancers. The three most common highly oncogenic types of HPV are HPV-16, HPV-18, and HPV-45, which are believed to be responsible for 80-90% of the aforementioned cancers. For every one million women infected with oncogenic HPV, 8000 develop cancer, and the mortality rate for cervical cancer is 50%.

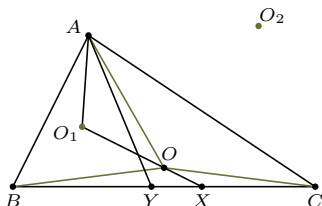
The vaccines constructed according to the same principle have the viral protein L1 as the antigen. Vaccines targeting different types of viruses consist of different (though chemically similar) L1 proteins specific to each virus type. These proteins form virus-like shells that do not contain any genetic material and do not cause infections. They are produced using genetic engineering, not from propagation of real viruses.

HPV vaccines are the first medicinal products with primary purpose to prevent cancer. For me, it’s a revelation!

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Solution to Problem M 1751.



Let O_1 and O_2 be the centers of the circumcircles Ω_1 and Ω_2 of triangles AOB and AOC respectively. Note that O_1 lies on the line OX , hence we have:

$$\sphericalangle AO_1X = 2\sphericalangle ABO = \pi - \sphericalangle AOB = \pi - 2\sphericalangle ACB = \sphericalangle AXY,$$

thus O_1 lies on the circumcircle of the triangle AXY . Similarly, we can prove that O_2 lies on that circle.