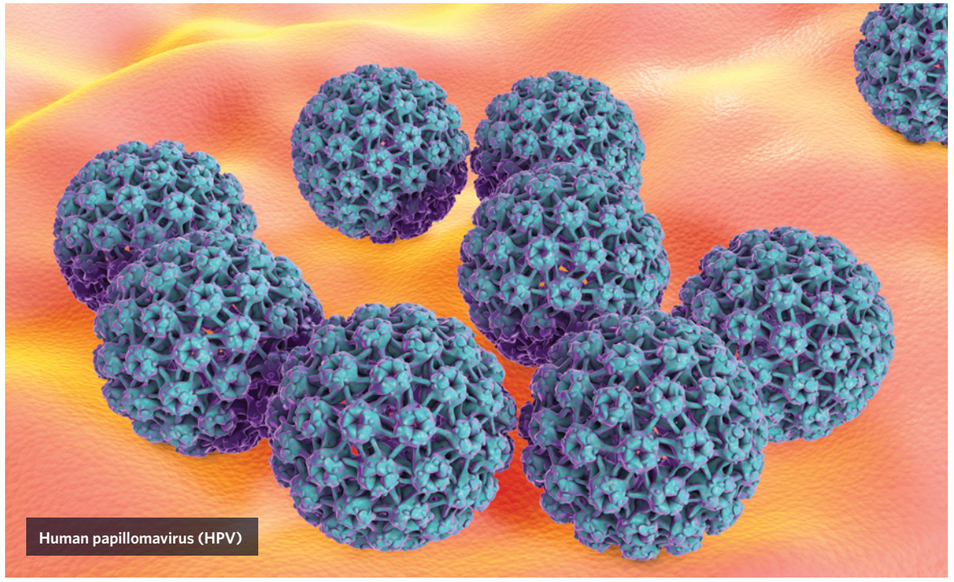
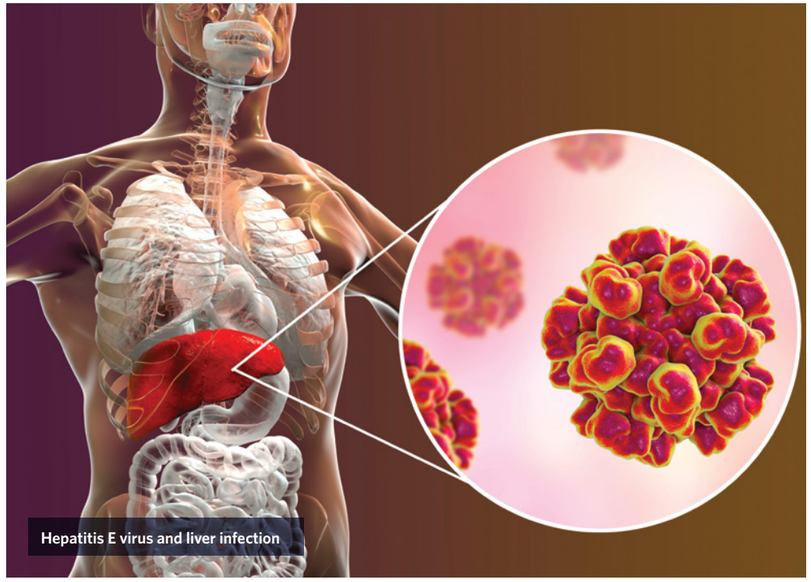
ADVERTISEMENT FEATURE

SAFEGUARDING PUBLIC HEALTH

Addressing public health crises, XMU researchers are dedicated to advancing medical research and promoting life-saving strategies.



Human papillomavirus (HPV)



Hepatitis E virus and liver infection

KATERYNA KON/SCIENCE PHOTO LIBRARY/GETTY

Researchers at XMU's School of Public Health (SPH) have combined field studies and experimental science to translate their research into strategies that improve population health. From hepatitis vaccines to HIV test kits, their medical innovations have contributed to the sustainable development goal of promoting good health and well-being.

Leading the race for vaccines

Pushing the frontiers of vaccine development, which is essential for the control of many infectious diseases, a team of researchers led by SPH dean, Ningshao Xia, has been studying virus-like particles (VLP) as potential vaccine candidates. These multi-subunit protein assemblies contain viral proteins, but not the viral genome, and are therefore non-infectious.

Among their discoveries is a new-generation human papillomavirus (HPV) vaccine. HPV has more than 200 viral types, some of which can lead to cervical or other cancers, while others may cause genital warts. HPV vaccines offering broader protection are needed, but providing wider protection on the currently available nine-valent HPV vaccine is challenging.

By studying structures of 20 HPV types, Xia's team has identified a molecularly modified chimeric VLP, which offers cross-protection against three viral types. They revealed the VLP's structure and the mechanism of its cross-protection. Their molecular design strategy has been used to identify other triplet-type chimeras, suggesting broader applicability. The technology has been awarded 14 patents, including nine international ones, and there are plans for a phase-III clinical trial for the next-generation HPV vaccine.

More recently, based on deeper understanding of the assembly of VLPs, the team has designed a capsomere-hybrid VLP that simultaneously provides protection against multiple HPV types. The assembly technique, combined with the chimeric VLP approach, paves the way for developing pan-HPV vaccines that may cover all 200 viral types. The technology also sheds light on designing vaccines that target multiple pathogenic variants, and antigen-targeted cancer vaccines.

Work by Xia's team has also led to China's first domestically-made bivalent HPV vaccine, developed by using VLPs derived from *E. coli*.

SPH's use of *E. coli* in vaccine development began with preparing VLPs for vaccines against the hepatitis E virus (HEV). Researchers genetically modified a strain of *E. coli* and produced a protein that can stimulate the body's immune system to fight against HEV. This attempt, led by Xia and his long-time SPH collaborator, Jun Zhang, proved the feasibility of developing VLPs from *E. coli*, providing a cost-effective approach for vaccine production. Their work led to the world's first HEV vaccine, launched in 2012. The achievement attracted attention from global media, and was recognized by multiple national awards.

Accelerating accurate diagnostics

SPH's vaccine research informs diagnostic methods for viral infections. Based on the revelation of the HEV structure, for instance, SPH researchers have developed a novel reagent for HEV antigen tests. Their approach has improved accuracy of diagnosis from 60-70% to more than 95%.

For another liver condition, hepatitis B, the SPH team has developed quantitative blood tests based on antibody against HBcAg (Hepatitis B core antigen). Their exploration using genetic engineering techniques revealed a highly stable HBcAg, which became the basis for a novel test kit that detects and quantifies antibody levels. The study significantly improves the reliability of HBcAg detection.

The SPH team is also globally recognized for the development of a urine-based immunoassay cassette for HIV tests. This non-invasive kit has been continually refined to enhance simplicity, speed, privacy and safety, without compromising accuracy, making it ideal for patient self-testing. It was approved by Chinese regulatory bodies for marketing in 2019.

Studies on HIV antigens by Xia's team can be traced back to their collaboration with Beijing Wantai Biological Pharmacy Enterprise in 1996. They co-developed various HIV test kits, including China's first third-generation and fourth-generation HIV diagnostic reagents, and obtained WHO prequalification in 2016. Now their products are used across the world, contributing to the control of HIV/AIDS.

This year, the SPH team has responded rapidly to the COVID-19 pandemic by developing reagents for antibody tests. They began by working with hospitals to measure the kinetics of antibody development after infection. Their studies showed that total antibody test, which detects levels of IgM, IgG, and IgA antibodies against SARS-CoV-2, has higher sensitivity and specificity than tests for IgM, IgG alone, or for both IgM and IgG. "It can be an effective supplement to the nucleic acid tests," says Zhang, who led the study. The nine test kits developed by Zhang's team are widely used across the world now.

Broadening the public health safety net

Studies on infectious diseases should look beyond treatment of individuals, according to Xia, who emphasizes the importance of integrating perspectives from sociology and public administration. This is also illustrated in studies on ageing, from chronic diseases, to disability services, led by SPH professor, Ya Fang, who makes links between health and economic policies to improve elderly care.

In the past five years, Fang's team has undertaken more than 60 research projects, leading to more than 100 published papers, many of which informed policy-making. In one study, they surveyed elderly people who had lost their independence. The study identified accidental injury as a major cause of their disabilities and adverse economic circumstances. Based on the finding, the local government enhanced its safety net for the elderly.

Another research focus at SPH explores the health effects of environmental exposure to chemicals. A team led by Zhongning Lin has leveraged the school's interdisciplinary strengths in molecular toxicology, environmental epidemiology, and bioinformatics to conduct toxicology studies. They have revealed the regulatory mechanisms by which cellular communication signals mediate the toxic effects of exogenous substances, informing the design of early and targeted intervention strategies, and toxicological risk assessment of new materials. ■

DIGGING DEEP AND REACHING FAR

Established in 2011, SPH specializes in subjects from epidemiology and health statistics, to nutrition and food sciences, and health management. Its multidisciplinary research is supported by **44** full-time faculty members, and two national-level research platforms.

- **State Key Laboratory of Molecular Vaccinology and Molecular Diagnostics:**
Established in 2013, it focuses on fundamental studies and R&D of vaccines, diagnostic reagents, therapeutics, molecular imaging probes and medical devices. It has undertaken **147** national key projects, in addition to provincial, municipal and enterprise-funded projects, with an average annual research budget reaching ~**55 million** yuan. It has obtained **153** domestic and international patents.

- **National Institute of Diagnostics and Vaccine Development in Infectious Diseases:**
Housing >**200** researchers, it has developed a chain of technologies for vaccines, diagnostic reagents, and biologic therapeutics, contributing to disease control.

Research accomplishments:

- Published >**700** papers in leading international journals, including **85** papers in journals with an impact factor greater than 10

- Obtained **two** certificates for national class-I new drugs, **three** approvals for clinical trials, and **77** medical device registration certificates

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