Influenza remains a major health problem for humans and animals. Influenza viruses can be classified into A, B and C types. Among the virus proteins, hemagglutinin (HA) and neuraminidase (NA) are the most important glycoproteins on the surface of influenza virus that play critical roles in virus infection. Their subtypes are further designated according to the serological cross-reactivity of the antibodies against HA and NA. To date, 16 HA and 9 NA subtypes in influenza A viruses have been isolated from avian species. Annual epidemics of influenza are due to gradually point mutations (antigenic drift) in HA and NA, whereas irregular pandemics are caused by the genetic reassortment (antigenic shift) between human and avian viruses.

The common detection methods for influenza surveillance include the identification of antigenic strains through genetic sequencing and immunological tests. Virus isolation, hemagglutination inhibition and neuraminidase inhibition tests are recommended by World Health Organization as the standard methods to determine the subtypes of influenza viruses because of the high reliability of tests. However, these assays are often criticized for low sensitivity and tedious manipulations. On the other hand, the method using reverse transcription polymerase chain reaction (RT-PCR) has the advantage of high sensitivity; however, choosing the proper primer sets becomes more challenging due to the diverse virus subtypes and the continuing evolution of influenza viruses. The commercially available diagnostic kits use enzyme immunoassays to identify the relatively abundant virus nucleoproteins, but cannot distinguish the HA subtypes.

Some new methods include using surface plasmon resonance, multiplexed flow cytometry, quartz-crystal microbalance, Young interferometer, mass spectrometry, and microarray. The silicon nanowire field-effect transistor (SiNW-FET) has been developed as an ultrasensitive, label-free, rapid screening, and real-time sensorial tool. In this study, we demonstrate the ultrasensitive detection of influenza virus particles using a SiNW-FET. The specific antibody was immobilized on the SiNW-FET via a disulfide linker to render the reversible surface functionalization. The success of the reversible surface functionalization was verified by fluorescence and electrical examinations. Detections of very dilute influenza virus were conducted in PBS and in allantoic fluid. The investigation by AFM topography suggested that the ultrasensitive SiNW-FET device was able to perform single virus detection.