“What's In Your Blood: Systems Analysis of Human Antibody Immunity”

Antibodies are present in blood at high concentrations (about 10 mg/ml) and are critical for defense against pathogens; in fact the main mechanism of protection to infection elicited by nearly all approved vaccines is the production of circulating antibodies that bind to, and neutralize the pathogen. The human immune system can generate well over $10^{12}$ different antibodies, yet only a relatively small set (which we estimate is of the order of $10^4$ antibody proteins) are present in the blood of an individual at any time.

Remarkably, more than 100 years since the discovery of antibodies, it is only possible to determine whether an individual has an antibody response to a pathogen (say, HIV or srep tests) but not the numbers, specific amino acid sequences, relative amounts or biological functions of the pathogen-specific antibodies produced in that person. Understanding the nature of antibodies elicited by disease or vaccination is very important for therapeutic and prophylactic purposes.

We have developed a technology for the deconvoluting the identities and relative amounts of antibodies in biological fluids from humans. We have used this approach to elucidate a number of broadly interesting questions such as: (i) what is the repertoire and functionality of antibodies elicited in humans following tetanus or flu vaccination; (ii) how many different antibodies in toto are typically present in the blood etc. Importantly we are also developing therapeutic antibodies to infectious diseases discovered via the mining of the protective antibody responses that enabled convalescent patients to overcome that infections.