Untapped potential – how can nanotechnology and microfluidic based technology be used to improve the field of transfusion medicine

Rena Hirani[*1,2], *Laura Rey Gomez*[2], *Yuling Wang*[2], *David Inglis*[2], *Andrew Care*[3] *and David O Irving*[1,3]

[1] Australian Red Cross Lifeblood, Sydney NSW Australia; [2] Macquarie University, Sydney NSW Australia; [3] University of Technology Sydney, Sydney NSW Australia
[*] *rhirani@redcrossblood.org.au*

For more than 90 years Australian Red Cross Lifeblood (Lifeblood) has supplied blood and biological products nationally for the Australian community. These products include red blood cells, plasma, platelets, cryoprecipitate and various fractionated components. Plasma contains nutrients, hormones and various proteins, like antibodies, and was particularly valuable at the beginning of the COVID-19 pandemic since convalescent plasma, containing antibodies to the virus SARS-CoV-2, was one of the only available treatments for severely affected patients.

Donated COVID-19 convalescent plasma was classified by Lifeblood based on whether it contained antibody levels suitable for direct therapeutic interventions or whether it had lower levels more appropriate for the production of hyperimmune medicines. To classify plasma donations, Lifeblood had to outsource additional testing via accredited external laboratories which caused delays in product provision.

Despite COVID-19 convalescent plasma requirements becoming increasingly redundant due to the introduction of vaccination, developing a rapid point-of-care test that is scalable and cost-effective to categorise donations would be valuable to prepare for any future infectious diseases. Rapid antigen tests (RATs), based on lateral flow technology, were developed for the general community to test for COVID-19 disease. However, they only provide a binary result in response to viral infection and were not aimed towards classifying the development of antibodies following infection.

In this study we aim to develop a proof-of-concept semi-quantitative gold nanoparticle based lateral flow test to screen for antibodies to SARS-CoV-2 and classify plasma donations according to therapeutic levels of antibodies (Figure 1). Assay specificity and sensitivity will be tested using samples with known classifications that were collected at numerous timepoints during the pandemic until mid-2022 when vaccine coverage was over 95% and using COVID-19 negative samples prior to SARS-CoV-2 detection in Australia. We have promising detection after testing at least one sample each of low, medium and high convalescent plasma.

The development of rapid tests with the ability to screen blood donations for therapeutic potential should be explored to enable the preparation for the any future infectious disease that may impact the community and require therapeutic products from blood donors.

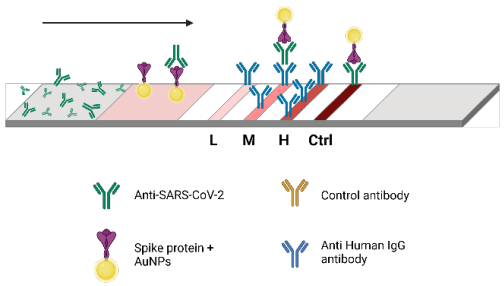

Figure 1: Design of a semi-quantitative lateral flow immunoassay to detect low (L), medium (M) and high (H) quantities of antibodies to SARS-CoV-2 in donated convalescent plasma with a positive control line (Ctrl).