

The current in-vitro diagnostic (IVD) environment is demanding faster, more robust assays which can be performed in decentralised settings by minimally trained users at low-cost. This has led to a whole new field of miniaturisation, with the aim of smart diagnostic cartridges that can perform complex protocols. There are a number of objectives when miniaturising assays:

|             |   |   |
|-------------|---|---|
| Financial   | – | reducing the costs of materials and manufacturing process,              |
| Ease of use | – | simplification of sample preparation, analysis and result presentation, |
| Mobility    | – | utilisation in point-of-care situations, and                            |
| Complexity  | – | multiple analyte testing with each sample received                      |
| Automation  | – | eliminating inherent risk of manual pipetting steps                     |

As the term suggests, microfluidics deals with the behaviour, precise control and manipulation of fluids that are geometrically constrained to a small scale. Depending on the user requirements microfluidics can be designed deliver a large number of diagnostic relevant outputs, such as electrochemical applications, immunoassays and polymerase chain reactions (PCR).

There are a number of fundamental differences between tube based assays and microfluidic assays which are important to consider during assay design. Viscosity and surface tension play an important role when mobilising complex reagents through narrow channels.

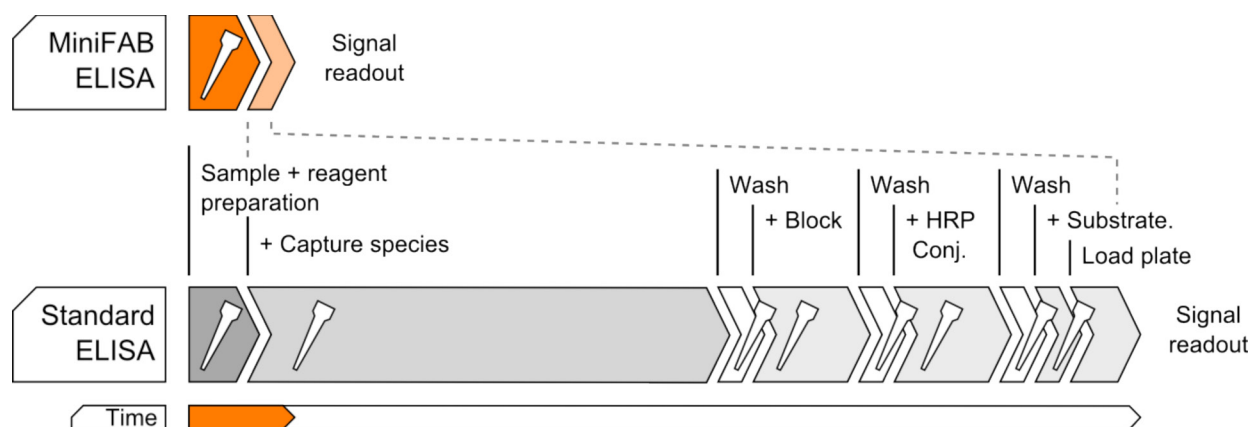
The small volumes utilised in microfluidic assays becomes significant when analysing low concentration samples. A reduced reaction volume may positively affect the kinetics of the assay because reagents come into contact with each other at higher rates in reduced volumes, thereby reducing the time required for the reaction to reach equilibrium. However, as the sample size is reduced, the number of molecules in the sample decreases which restricts the scale and sensitivity of assays.

Non-specific binding of samples and reagents can be more problematic due to higher surface-volume ratios than in a tube. Use of low-binding materials and use of surface blocking agents become critical to maintaining sensitivities.

In order to effectively translate tube based assays to a microfluidic cartridge it is critical that the individual inputs (sample), outputs (e.g. nucleic acids from extraction or PCR, NASBA), and process conditions (e.g. temperature, concentrations, pH) of often discontinuous bench top assay steps are fully understood. Translating individual assay steps to microfluidic cartridges allows benchmarking against industry standard tubes based approaches.

Only after the required sensitivities and specificities are demonstrated on individual cartridges should an integrated prototype be developed that performs all steps from sample collection and preparation, mixing of reagents, reaction, incubation, and detection.

MiniFAB works with its client to split your assay steps into microfluidic toolbox diagrams capturing each discrete assay step and then develop proof-of-principle cartridges for each step. Cartridge designs aim to leverage the existing fluidic control available on MiniFABs MiniChemlab workstation, avoiding costly development of instrument test beds, adding heating, electronic, or optical modules as required by the assay. Automated delivery of samples and reagents to the cartridge allow for robust and repeatable assay development.



## For More Information

John McCormack

Project Manager

Email: [contact@minifab.com.au](mailto:contact@minifab.com.au)

Telephone: +61 39764 2241

