Transforming PCR protocols in pandemic response with automated non-contact liquid dispensing

Denise Grovewood[1], Frances Pitt[2], Suhayl Mulla[2], Tamsin Redgwell[2], Russell Buckley-Taylor[1], Suki Lee[3], Giorgio Fedele[4], Graham Hill[5], Paul Harper[6], Donald Fraser[7]

[1]SPT Labtech, Melbourn, SG8 6HB, UK [2]UKHSA, UK Health Security Agency, London, E14 4PU, UK [3]Utrecht University, Utrecht, 3584 CS, Netherlands
[4]University of Calabria, Rende, 87036, Italy [5]Animal and Plant Health Agency, Bury St Edmunds, IP33 2RX, UK [6]AstraZeneca, Cambridge, CB2 0AA, UK
[7]Omix Ltd, Oakham, LE19 9LA, UK / Acknowledgements: Miles Gibson, Nicholas Moiseiwitsch, Tom Fowler

Introduction

The UK's first testing "megalab", the Rosalind Franklin Laboratory (RFL) in Royal Leamington Spa, was established in 2021 with the aim of processing and sequencing thousands of COVID-19 tests a week, playing a key role in preventing disease outbreaks and responding to new variants of concern and future disease threats.

With the critical need for accurate pathogen surveillance, the manual execution of PCR workflows emerged as a bottleneck, limiting throughput and introducing potential for human error and variability among lab personnel. To enhance efficiency and data quality, the lab chose to adopt dragonfly® discovery to improve the accuracy and reliability of extraction plate preparation for the UltraDX SARS-CoV-2 N1/N2/RP assay (LGC, Biosearch Technologies).

Why dragonfly discovery?

- **Cost efficiency:** dragonfly discovery aligns high performance liquid dispensing with affordability.

- **Space-saving design:** Its compact footprint allows for convenient placement on any standard lab bench.

- **User-friendly interface:** The system is equipped with intuitive, highly adaptable software.

- **Exceptional support:** SPT Labtech's responsive Field Application Scientists and Field Service Engineers provided outstanding support and assisted in the development of new protocols.

- **Versatile functionality:** dragonfly discovery boasts impressive flexibility, featuring up to 10 syringes for simultaneous dispensing and compatibility with deep well plates. This versatility makes it ideal for downstream applications on automated extraction instruments like the ThermoFisher Kingfisher.

- **Enhanced efficiency:** The system markedly reduces the reagent dead volume in PCR workflows due to its integrated positive displacement non-contact dispensing technology.

- **Unmatched precision:** dragonfly discovery delivered precise and uniform dispensing across both 96 and 384-well plates. Its delicate handling effectively prevented bubbling during elution.

- **Broad compatibility:** Positive displacement dispensing is liquid-class agnostic and well suited to dispensing viscous liquids, most relevantly the elution buffer used in the referenced workflow.

- **Continuous flow:** A peristaltic pump and autofeed reservoir (AFR) provided a continuous reagent supply, that simultaneously kept beads in constant suspension and resulted in precise dispensing across all wells.

Method

Extraction workflow for UltraDx SARS-CoV-2 N1/N2/RP assay
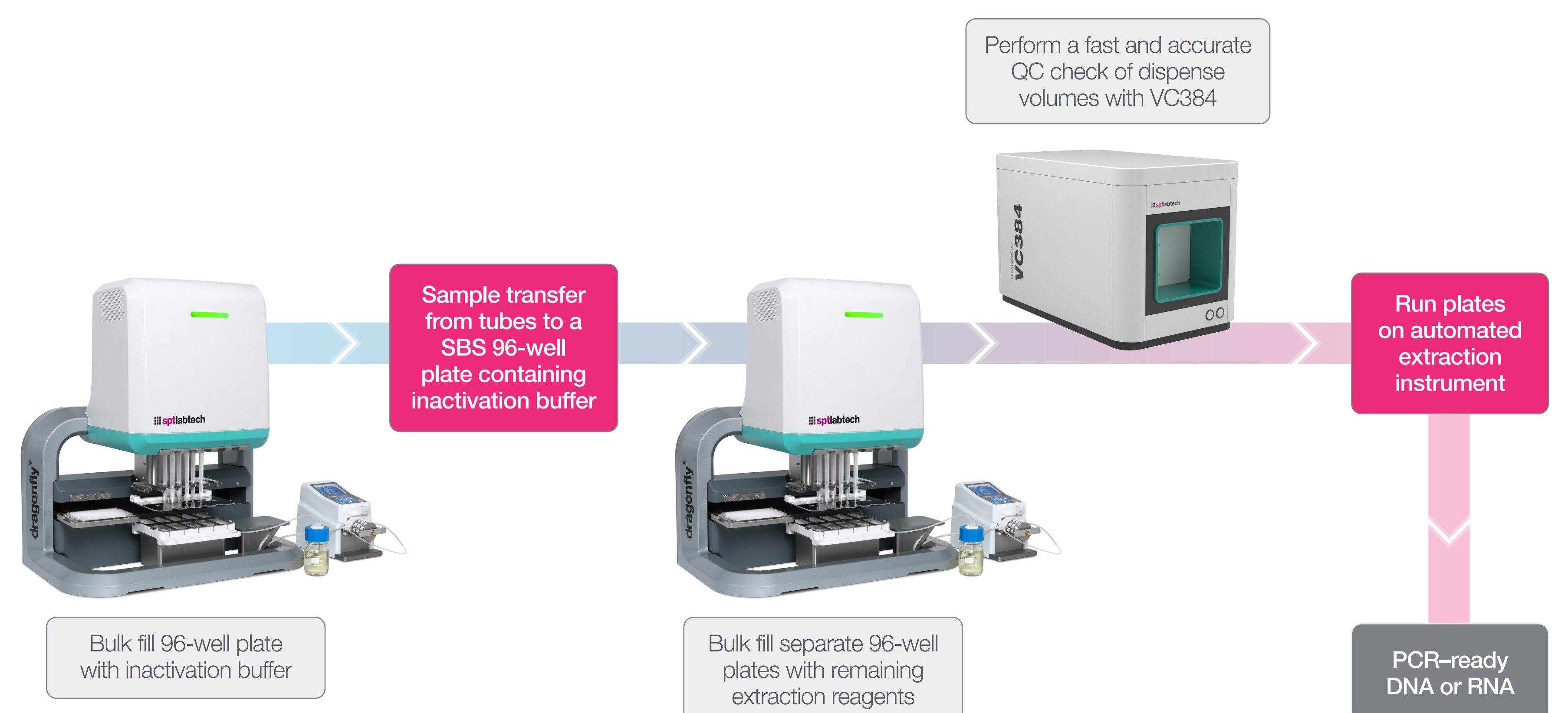

Figure 1. Example of a potential extraction plate preparation workflow setup using dragonfly discovery.
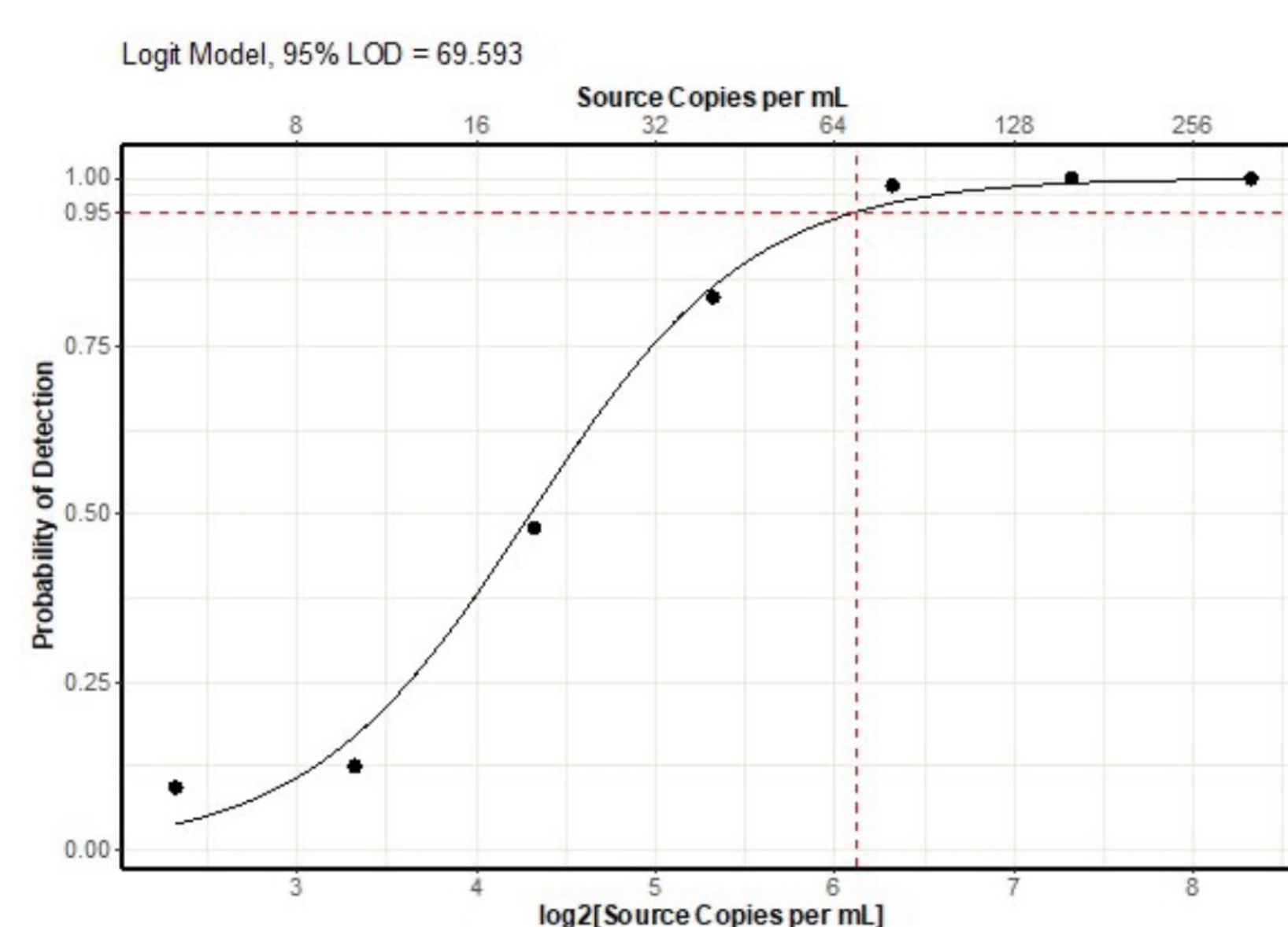
Results

Figure 2. Analytical sensitivity determined during R&D of SARS-CoV-2 end-point PCR assay workflow deployed at The Rosalind Franklin Laboratory. Data was generated from control material (Qnostics S01, 1x106 copies/mL, diluted to limit of detection range). Logit modelled concentration of lower limit of detection (95% detection rate) = c. 70 copies/mL of Source (Crude) Sample.
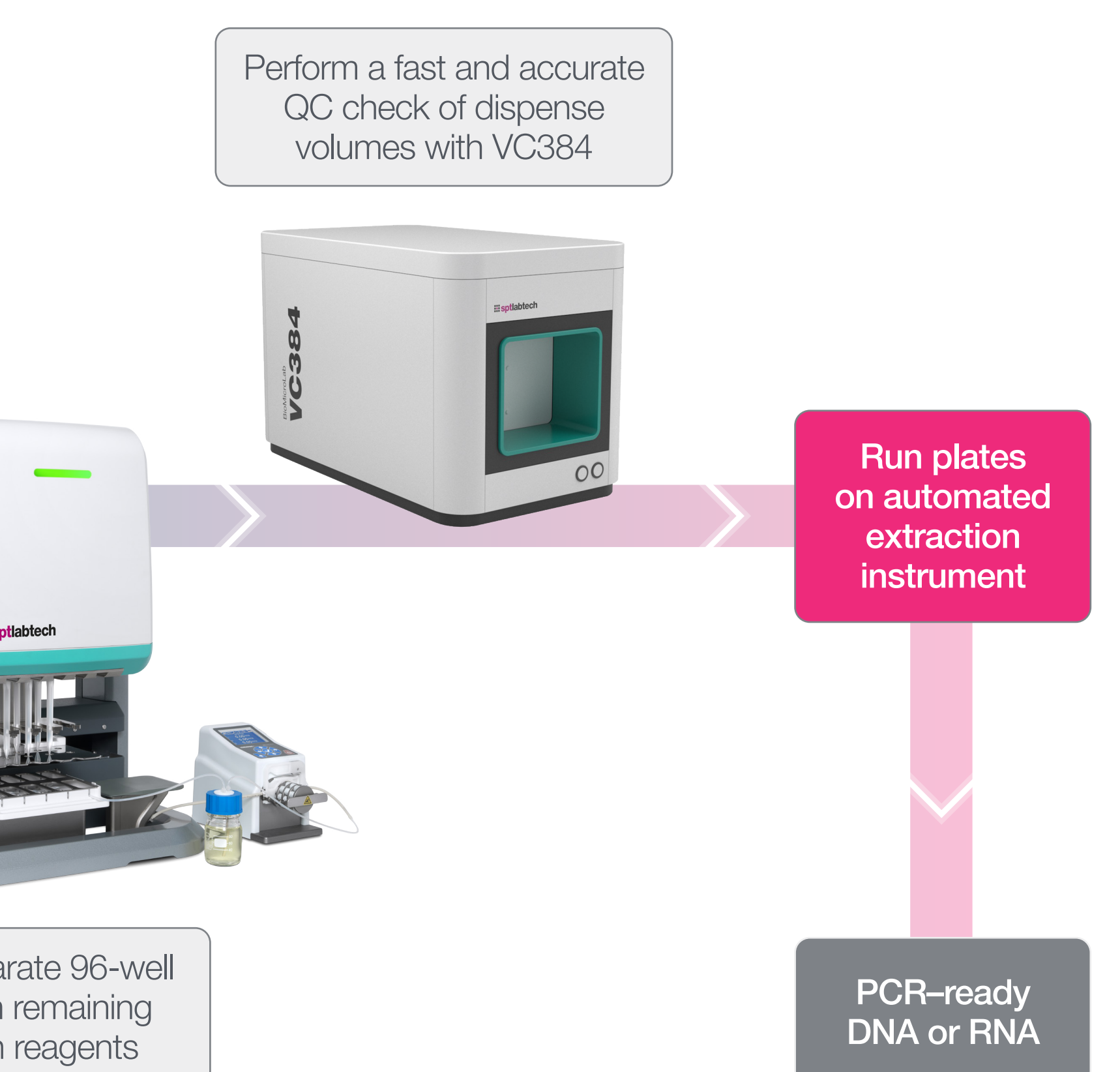

Figure 3. Inclusion of dragonfly discovery showed an LoD of 70 copies/mL (0.9 copies/reaction) for the N1 assay, which equates to an 80-fold reduction when compared to the reagent manufacturer's recommendation.

Conclusion

Integrating dragonfly discovery into the UltraDx SARS-CoV-2 N1/N2/RP assay led to an 80-fold reduction in the limit of detection for the N1 assay compared to the reagent manufacturer's recommendation. Some of this improvement can be attributed to dragonfly discovery's non-contact positive displacement dispensing, coupled with the AFR pump mechanism that ensures a continuous suspension of magnetic beads, enhancing accuracy and precision.

Beyond enhancing accuracy and precision in this specific assay, dragonfly discovery addressed other critical issues in pre-pandemic lab spaces. Its space-saving design allowed the instrument to be utilized in various stages of assay development and execution, from dispensing bulk reagents to preparing PCR master mix in an assay-ready format. This was achieved while conserving valuable reagents through low dead volume focused consumables.

dragonfly discovery's versatility supports a robust business-as-usual (BAU) process and is easily scalable for pandemic-level testing. Its user-friendly software interface requires zero computer programming knowledge, providing end-users with the flexibility to run multiple protocols on the same instrument, making it ideal for BAU assay processing. The instrument played a pivotal role in the UltraDx SARS-CoV-2 N1/N2/RP assay conducted by UKHSA during the pandemic, and SPT Labtech will continue to support UKHSA in their mission to protect communities from the impact of health threats.

sptlabtech