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A REVIEW OF "COMPARATIVE EVALUATION OF RAPID ANTIGEN AND RT-PCR TESTING IN COVID-19 DIAGNOSIS

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ABSTRACT

Accurate and timely laboratory diagnosis has been central to the clinical and public-health response to COVID-19. This paper reviews a dissertation that compared the diagnostic performance of the Rapid Antigen Test (RAT) against reverse transcription polymerase chain reaction (RT-PCR) in a cohort of 500 suspected COVID-19 patients. The dissertation reports a RAT sensitivity of 80.0%, specificity of 95.8%, positive predictive value of 93.3%, and negative predictive value of 86.9%, relative to RT-PCR as the reference standard, and concludes that RAT is a useful screening adjunct while RT-PCR remains the gold-standard confirmatory test. This review summarises the dissertation's aims, methodology, and findings; situates the results within the wider published literature on antigen-based COVID-19 diagnostics; and offers a critical appraisal of the study's methodological strengths and limitations, concluding with recommendations for future research.

1. INTRODUCTION

The emergence of SARS-CoV-2 created an urgent need for diagnostic tools that could combine accuracy with speed and scalability. RT-PCR, which detects viral RNA through reverse transcription and cyclic amplification, was rapidly adopted as the reference standard because of its high analytical sensitivity, but its dependence on specialised equipment, trained personnel, and multi-hour turnaround times limited its usefulness for mass, point-of-care screening. Antigen-based rapid tests were developed as a faster and cheaper alternative capable of detecting structural viral proteins directly from respiratory specimens within

minutes, making them attractive for triage, outbreak containment, and resource-limited settings. However, published evaluations of antigen tests have reported widely varying sensitivity, generally lower than that of nucleic-acid amplification methods, prompting continued debate over how RAT and RT-PCR should be used together in clinical and public-health practice.

This debate has practical consequences beyond the laboratory bench. During periods of high transmission, health systems have needed to balance the diagnostic certainty offered by RT-PCR against the operational reality that centralised molecular testing cannot always be scaled quickly enough to serve mass screening, workplace surveillance, or community-level contact tracing. Antigen tests were positioned to fill this gap, but their adoption raised legitimate concerns about missed infections among individuals with lower viral loads, including many asymptomatic carriers who nonetheless contribute to onward transmission. Resolving how much sensitivity can reasonably be traded for speed, and in which populations that trade-off is acceptable, has therefore depended on an accumulating body of comparative diagnostic-accuracy studies conducted across different countries, patient populations, and antigen-test brands. The dissertation under review contributes a single-centre comparative dataset to this debate, evaluating both tests against a defined patient population of 500 suspected COVID-19 cases and reporting the standard set of diagnostic accuracy metrics — sensitivity, specificity, positive predictive value, and negative predictive value — that allow its findings to be set against the wider published literature summarised in this review.

2. Overview of the Reviewed Study

2.1 Aims and Objectives

The dissertation's primary objective was to compare the diagnostic accuracy of RAT and RT-PCR for COVID-19 detection. Secondary objectives included evaluating the sensitivity and specificity of RAT relative to RT-PCR, determining its positive and negative predictive values, comparing turnaround time and practicality between the two methods, and assessing the utility of RAT for screening and early case detection.

2.2 Methodology

The study enrolled 500 patients with suspected COVID-19 and tested each participant with both an immunochromatographic RAT device and RT-PCR, using nasopharyngeal or nasal swab specimens collected under standard infection-control procedures. RAT was performed according to the manufacturer's protocol, with antigen extracted into a buffer solution and applied to a lateral-flow device, while RT-PCR followed the conventional one-step workflow

of RNA extraction, reverse transcription, and cyclic amplification with fluorescent probe detection, generating a cycle threshold (Ct) value for each sample. RT-PCR was treated as the reference standard against which RAT results were classified into true positive, false positive, true negative, and false negative categories.

3. Summary of Key Findings

The cohort was predominantly composed of younger and middle-aged adults, with the largest proportion of participants aged 31–40 years, followed by those aged 18–30 years; participants over 60 years made up the smallest proportion. Slightly more than half of participants were male, and a similar proportion were symptomatic at the time of testing, with the remainder identified through screening or contact-tracing pathways.

RT-PCR identified 210 positive cases (42%) compared with 180 positive cases (36%) identified by RAT. Cross-tabulation of the two tests against each other produced the diagnostic accuracy figures summarised below.

Parameter	Formula	Value
Sensitivity	TP / (TP + FN)	80.0%
Specificity	TN / (TN + FP)	95.8%
Positive Predictive Value	TP / (TP + FP)	93.3%
Negative Predictive Value	TN / (TN + FN)	86.9%

The underlying 2×2 counts were: true positive = 168, false negative = 42, false positive = 12, true negative = 278. RAT sensitivity was markedly higher among symptomatic patients (132 of 285 positive) than among asymptomatic patients (48 of 215 positive), consistent with the expectation that antigen shedding is greatest when viral load is high. In terms of turnaround time, RAT produced results within 15–30 minutes, compared with 6–24 hours for RT-PCR, underscoring the practical case for using RAT where speed is prioritised.

4. Critical Appraisal

4.1 Consistency with the Wider Literature

The dissertation's headline figures sit within, though toward the favourable end of, the range reported by independent meta-analyses of antigen-based COVID-19 tests. A systematic review pooling data from 30 commercial RAT products found sensitivity ranging from 37% to 90% depending on the assay, with just over half of the evaluated kits reaching 70% sensitivity or better [8]. A meta-analysis of over 17,000 suspected cases reported a pooled sensitivity of 68.4% alongside a pooled specificity of 99.4% [7, 9]. Another synthesis of 60

studies reported comparable figures of 69% pooled sensitivity and 99% pooled specificity [10], and a review focused on low- and middle-income countries reported a pooled sensitivity of 78.2% with 99.5% specificity [11]. Against this backdrop, the dissertation's reported sensitivity of 80.0% is broadly consistent with, if slightly above, the pooled estimates from the literature, while its specificity of 95.8% is somewhat lower than the very high (97–99%+) specificity typically reported elsewhere. This pattern of high specificity but comparatively lower and more variable sensitivity is one of the most consistently replicated findings in the antigen-testing literature, and the reviewed dissertation's data reproduce it well, including the well-documented finding that sensitivity is higher in symptomatic than in asymptomatic individuals — attributable to the correlation between symptom onset, viral load, and antigen shedding.

4.2 Methodological Strengths

- A reasonably large sample size (n = 500) relative to many single-centre diagnostic accuracy studies, improving the stability of the sensitivity/specificity estimates.
- Use of a paired, within-subject design in which every participant received both tests, allowing direct 2×2 cross-tabulation rather than relying on separate cohorts.
- Reporting of a full set of standard diagnostic accuracy metrics (sensitivity, specificity, PPV, NPV) rather than sensitivity alone, and stratification of RAT performance by symptom status.
- Inclusion of turnaround-time data, which grounds the discussion in the practical trade-offs relevant to screening programmes and resource-limited settings.

4.3 Methodological Limitations

- The dissertation does not report the specific RAT brand/manufacturer used, the exact interval between sample collection and testing, or Ct-value distributions for RT-PCR-positive samples, all of which materially affect sensitivity and would strengthen comparability with other published evaluations.
- As a single-centre study, generalisability to other populations, viral variants, and testing conditions is limited; the pooled estimates from multi-study meta-analyses cited above are likely to be more representative of real-world performance across settings.
- The methodology chapter describes the RAT protocol in detail but gives comparatively little procedural detail on RT-PCR sample handling, primer/probe targets used in practice, or internal quality-control measures, which limits the reader's ability to fully assess the reference standard's own performance.

- No confidence intervals are reported alongside the point estimates for sensitivity, specificity, PPV, and NPV, which makes it difficult to judge the precision of the findings or to compare them statistically with other studies.
- The bibliography supporting the introduction focuses heavily on the haematological and inflammatory complications of severe COVID-19, which, while useful background, is only loosely connected to the diagnostic-accuracy question that is the dissertation's actual focus; a more direct engagement with the antigen-versus-RT-PCR literature would have strengthened the discussion section.

5. Implications for Clinical and Public Health Practice

Read alongside the wider meta-analytic evidence, the dissertation's findings support a tiered diagnostic strategy rather than a straightforward substitution of one test for the other. In symptomatic patients presenting early in the course of illness, when viral loads and antigen shedding are typically highest, RAT can identify the majority of true infections quickly enough to inform immediate isolation decisions, which is where its speed advantage delivers the greatest public-health benefit. In asymptomatic individuals, or in symptomatic patients whose RAT result is negative despite a compatible clinical picture, the lower sensitivity observed both in this dissertation and in the broader literature means that a negative RAT result cannot be treated as ruling out infection; RT-PCR confirmation remains necessary in these situations. The dissertation's own data, showing markedly higher RAT positivity among symptomatic than asymptomatic participants, illustrate exactly why symptom status and pre-test probability should continue to guide how heavily a negative antigen result can be relied upon in practice.

6. CONCLUSION AND RECOMMENDATIONS

The reviewed dissertation provides a coherent, adequately powered, single-centre comparison of RAT and RT-PCR for COVID-19 diagnosis, and its central finding — that RAT offers high specificity and a substantial time advantage but meaningfully lower sensitivity than RT-PCR — is well supported by its own data and corroborated by the broader meta-analytic literature. The practical conclusion, that RAT is best used as a rapid first-line screening tool with RT-PCR reserved for confirmation of negative results in symptomatic or high-risk individuals, mirrors the position adopted by major public-health bodies during the pandemic [12]. Future work building on this dissertation would benefit from multi-site recruitment, explicit reporting of the RAT product and Ct-value distribution, inclusion of confidence

intervals around all accuracy estimates, and stratified analysis by viral variant and time-since-symptom-onset, which would allow more precise, generalisable, and clinically actionable conclusions to be drawn.

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