COVID-19 Reinfection and Disease Severity in the New York City Health + Hospitals System

Jenny R. Smolen, MPH[1], Thomas D. Filardo, MD[2], Annie George, PhD, RN, NEA-BC, NPD-BC, CCRN-K[3], Sakil Bhuiyan, MD[4], Dawa Gurung, MD[4], Sowmya Kalava, MD[5], Noor Shahin, MD[5], Jonathan S. Farkas, MD[6], Jazila Mantis, MD[7], Merjona Saliaj, MD[4], Vikramjit Mukherjee, MD[8], Carlos R. Salama, MD[9], Benjamin J. Eckhardt, MD[2], Gabriel M Cohen, MD[1,2]

[1]Office of Population Health, New York City Health and Hospitals (NYC H+H); [2]Division of Infectious Diseases, NYC H+H Bellevue; [3]Office of Patient Centered Care, NYC H+H; [4]Department of Internal Medicine, NYC H+H Queens; [5]Department of Internal Medicine, NYC+H Elmhurst; [6]Department of Pediatrics, NYC H+H Bellevue; [7]Division of Infectious Diseases, NYC H+H Queens; [8]Division of Pulmonary and Critical Care, NYC H+H Bellevue; [9]Division of Infectious Diseases, NYC H+H Elmhurst

Introduction

Reinfection with SARS-CoV-2 has been well documented in the literature. Large cohort and observational analysis suggested that COVID-19 reinfection is often asymptomatic.[1-3]

- Uncertainty remains regarding the likelihood of more severe reinfections compared to index infection.
- This study examines data from early in the pandemic, which may help provide a point of comparison for newer variants.

Methods

Patients who received SARS-CoV-2 PCR testing between March 1, 2020 and March 1, 2021 at New York City Health and Hospitals (NYC H+H) facilities and had two positive tests >=90 days apart were included in the analysis.

For patients who had two positive tests >=90 days apart:

- Clinical data was extracted from the EMR
- Manual chart review confirmed symptomology and assessed COVID-19 related hospital admissions

Patients were classified according to symptomatology, PCR and antibody testing and lack of alternative diagnoses as: “unlikely reinfection,” “possible reinfection,” “probable reinfection,” or “unable to be assessed.”

Patients with possible or probable reinfection were analyzed further to:

- Determine disease severity of index and reinfection (WHO classification)
- Assess severity at index infection compared to second infection

References

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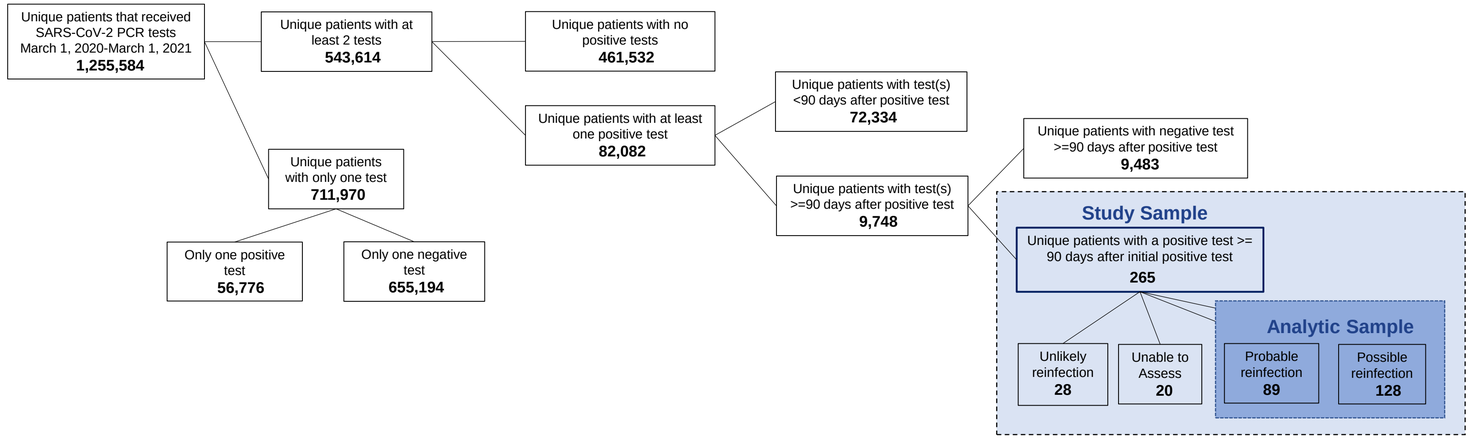
3. Liotti FM, Menchinelli G, Marchetti S, Posteraro B, Landi F, Sanguinetti M, et al. Assessment of SARS-CoV-2 RNA Test Results Among Patients Who Recovered From COVID-19 With Prior Negative Results. JAMA Intern Med. 2020.

Figure 1: Study flowchart



From March 1, 2020 to March 1, 2021, **COVID-19 reinfection was rare** in a high incidence setting among patients tested at NYC H+H facilities.

Disease severity was generally milder in reinfection, but severe and critical disease occurred in a small number of patients.

Figure 2: Change in WHO disease severity classification from index to second infection

Index infection	Second infection: Asymptomatic (n=162)	Mild (n=23)	Moderate (n=23)	Severe (n=2)	Critical (n=3)	Unable to Assess (n=4)
Asymptomatic (n=79)	59 (27.19%)	9 (4.15%)	9 (4.15%)	1 (0.46%)	1 (0.46%)	
Mild (n=43)	29 (13.36%)	9 (4.15%)	2 (0.92%)			3 (1.38%)
Moderate (n=63)	49 (22.58%)	5 (2.30%)	6 (2.76%)		2 (0.92%)	1 (0.46%)
Severe (n=14)	10 (4.61%)		4 (1.84%)			
Critical (n=3)	1 (0.46%)		1 (0.46%)	1 (0.46%)		
Unable to Assess (n=15)	14 (6.45%)		1 (0.46%)			

Among possible or probable cases of reinfection (n=217):

- 24 total patients experienced a second infection that was **more severe** than their index infection (indicated in Orange)
- 100 patients experienced a second infection that was **less severe** than their index infection (indicated in Blue)
- 71 patients experienced **no change in severity** from index to second infection (indicated in White)
- For 19 patients, disease severity was unable to be assessed at either the index or second infection (indicated in Grey)

Results

During the study timeframe, **1,255,584 unique patients** received at least one SARS-CoV-2 PCR test. 265 patients had two positive tests >=90 days apart, and were classified according to available information as follows:

- **217 possible or probable reinfection**
- 20 unable to be assessed
- 28 unlikely reinfection
  - 27 judged unlikely to have true infection at either index or second positive test
  - 1 had evidence of persistent PCR positivity due to immunocompromise

For the 217 patients with possible/probable reinfection, we assessed the severity of the index and second infection.

At their index episode:

- 79 had an asymptomatic infection (36.4%)
- 17 were severe or critical (7.8%)

At their second episode:

- 162 patients had an asymptomatic infection (74.7%)
- 5 were severe or critical (2.3%)

Only 24 patients had a more severe COVID reinfection than index infection, and 20 of the 24 had asymptomatic index infections. Three patients were hospitalized at both episodes, and two deaths possibly attributable to COVID-19 reinfection were noted in this cohort.

Conclusion

From March 1, 2020-March 1, 2021, COVID-19 reinfection was rare in a high incidence setting among patients tested at NYC H+H facilities. Disease severity was generally milder in reinfection, but severe and critical disease occurred in a small number of patients.

- This study is based on clinical classification, not genetic surveillance, and may be impacted by variability in testing patterns over time.
  - In the early months of the pandemic, testing was limited and likely restricted to sicker patients and therefore fewer patients with asymptomatic/mild infection may have been captured.
- The study period ended before COVID-19 vaccination eligibility in NYC expanded to all adults (30 years and older), and therefore this study has very limited ability to draw conclusions about vaccination and reinfection.

These findings from earlier in the pandemic (likely wild-type and alpha variant) provide data for comparison in understanding how reinfection is evolving with newer variants and vaccination.