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# SARS-CoV-2 Breakthrough Infection Three Weeks after Second Vaccination

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The emergence of SARS-CoV-2 variants raises increasing concerns about the efficacy of currently available vaccines [1]. mRNA vaccines (BNT162b2, Pfizer-BioNTech; mRNA-1273, Moderna) are developed based on one specific part of the viral genome to elicit immune response. Therefore, they might be susceptible to immune escape mutations, such as the ones in the viral Spike protein [2]. This genomic site exhibits relevant point mutations that enable the evasion from the host immune response. Eventually, such mutations may prevail and end up characterizing new viral lineages, like B.1.1.7 (emerged in United Kingdom), B.1.351 (South Africa) and P.1 (Brazil). Thus, mRNA vaccines may turn out to be less effective against them and might need to be frequently updated to maintain efficacy [1]. In March 2021, a 45-years old healthy female, without history of COVID-19 infection or any risk factors tested positive for SARS-CoV-2 in a routine screening RT-qPCR. The next day, the diagnosis of pre-symptomatic COVID-19 was confirmed. Surprisingly, she had received the second dose of the BNT162b2 vaccine three weeks before (Figure 1). Sequencing of the SARS-CoV-2 RNA identified the B.1.351 variant. Three days after establishing the diagnosis, she developed muscle pain, runny nose, diarrhea and fatigue, which lasted for ten days. Two days after onset of symptoms, the other household members (12-years old daughter, 46-years old husband) also suffered from the same symptoms and tested positive for COVID-19 by RT-qPCR. All three patients recovered completely from the disease. Despite extensive contact tracing, the source of infection could not be identified.

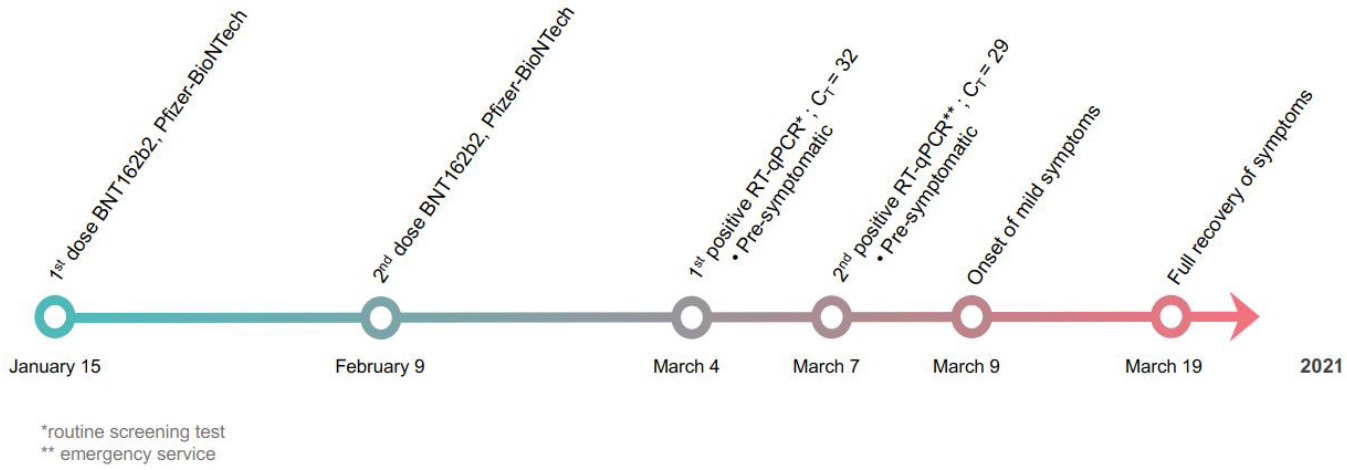


**Figure 1:** Patient immunized against SARS-CoR-2 with mRNA vaccine BNT162b2 (Pfizer-BioNTech) and subsequently diagnosed positive for COVID-19 in a routine RT-qPCR screening test. The patient was a woman about 45 years old, no comorbidities and no previous history of COVID-19. She was infected by the variant of concern B.1.351 (emerged in South Africa) and developed mild symptoms, such as muscle pain, runny nose, diarrhea and fatigue. Her family members living in the same household got the infection from her and presented the same symptoms. All of them were fully recovered after ten days of symptom onset.

This case highlights important aspects of the COVID-19 pandemic.

(1) COVID-19 vaccines may not always protect from infection, especially when a viral variant is involved. Here, insufficient response to the vaccine as well as immune escape of the virus variant may both explain the infection [3]. The B.1.351 variant is still uncommon in Europe, but further spread may have significant impact on pandemic mitigation strategies.

(2) Close household members also contracted the disease – potentially related to the high virus load observed in the patient, indicating that the vaccine also did not prevent transmission.

(3) Screening of asymptomatic individuals for SARS-CoV-2 infection, in addition to rapid mass vaccination campaigns, has a high impact on limiting the pandemic by breaking the chain of infection.

## Conclusion

In conclusion, broad testing for SARS-CoV-2 infection, surveillance for emergence of variants and respective adaptation of vaccines and diagnostic assays are paramount to the successful fight against the pandemic.

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