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Rapid Communication

Polymerase-chain reaction testing to prevent hospital-acquired severe acute respiratory syndrome coronavirus 2 infection in Shinjuku, an epicenter in Tokyo: The Tokyo Women's Medical University model

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ABSTRACT

Hospital-acquired severe acute respiratory virus coronavirus 2 (SARS-CoV-2) infection is a healthcare challenge. We hypothesized that polymerase chain reaction testing of symptomatic triaged outpatients and all inpatients before hospitalization in Shinjuku, a coronavirus disease 2019 (COVID-19) epicenter in Tokyo, using the Tokyo Women's Medical

Abbreviations: COVID-19, coronavirus disease 2019; PCR, polymerase chain reaction; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; TWMU, Tokyo Women's Medical University.

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University (TMWU) model would be feasible and efficient at preventing COVID-19. This retrospective study enrolled 2981 patients from March to May 2020. The prevalence of SARS-CoV-2 infection was 1.81% (95% credible interval [CI]: 0.95–3.47%) in triaged symptomatic outpatients, 0.04% (95% CI: 0.0002–0.2%) in scheduled asymptomatic inpatients, 3.78% (95% CI: 1.82–7.26%) in emergency inpatients, and 2.4% (95% CI: 1.49–3.82%) in symptomatic patients. There were no cases of hospital-acquired SARS-CoV-2 infection. This shows that the TWMU model could prevent hospital-acquired SARS-CoV-2 infection and is feasible and effective in reducing the impact of SARS-CoV-2 infection in the hospitals.

1. Introduction

Coronavirus disease 2019 (COVID-19) has spread rapidly worldwide [1]. As of September 14, 2020, a total of 28,637,952 cases have been reported worldwide, including 917,417 deaths [2]. Patients with hospital-acquired infections may increase the mortality rates [3] because they often have comorbidities such as cardiovascular disease, cancer, diabetes mellitus, and chronic obstructive pulmonary disease, which worsen the prognosis of COVID-19 [4]. In addition, COVID-19 can cause healthcare systems to collapse during the pandemic. Patients with asymptomatic severe acute respiratory virus syndrome coronavirus 2 (SARS-CoV-2) infection and emergency inpatients with COVID-19 are sources of hospital-acquired SARS-CoV-2 infection [5]. These patients play an important role in SARS-CoV-2 transmission [6]. To prevent this hospital-acquired infection, we hypothesized that polymerase chain reaction (PCR) testing for SARS-CoV-2 in triaged outpatients and all inpatients may be feasible and efficient, and it may reveal the prevalence of COVID-19 with other comorbidities in the Shinjuku area, an epicenter in Tokyo during the first wave of the COVID-19 epidemic. The purpose of this study was to assess the effectiveness of PCR testing for SARS-CoV-2 at preventing hospital-acquired SARS-CoV-2 infection, and to determine the prevalence of SARS-CoV-2 infection in triaged outpatients and all hospitalized patients using the Tokyo Women's Medical University (TWMU) model.

2. Materials and methods

A total of 2981 patients were enrolled in this retrospective study from March to May 2020 at TWMU Hospital using data retrieved from the patients' medical records. Informed consent was obtained from all the patients before PCR testing. Patients who refused PCR testing were excluded.

Patients aged over 18 years were eligible and were divided into four groups. The first group comprised triaged outpatients with any symptoms suggestive of COVID-19, such as fever, cough, sore throat, dyspnea, dullness, chills, muscle pain, nausea, vomiting, diarrhea, and loss of taste and smell. The second group comprised scheduled asymptomatic inpatients hospitalized for a disease other than COVID-19. These patients were tested for SARS-CoV-2 using PCR within 7 days before hospitalization. The third group comprised emergency inpatients with problems such as pneumonia, bleeding, myocardial infarction, or heart failure. The fourth group comprised a combination of the symptomatic triaged outpatients and the emergency inpatients in the first and third groups, respectively. Inpatients with COVID-19 symptoms, such as fever or pneumonia, before hospitalization were hospitalized in a private room with/without a depressurized device. Because the probability of a false-negative PCR test result decreases to 20%, 8 days after exposure or 3 days after symptom onset [7], inpatients were scheduled to undergo up to 3 PCR tests, depending on their computed tomography imaging results. Patients were quarantined according to their PCR test results.

We defined the TWMU model as systematic PCR testing of triaged outpatients and all inpatients on admission to the hospital, and the retesting of inpatients after admission, as described above. The study was approved by the Institutional Review Board of TWMU Hospital (approval number: 5649), the board disclosed the study on the hospital website.

Samples were collected from patients' nasal cavities with a swab (503CS01-E, BP100; Shin Corporation, Hyogo, Japan). Viral RNA was extracted using QIAamp Viral RNA Mini Kit (QIAGEN, Tokyo, Japan). Real-time reverse transcription PCR testing was performed using StepOne (Thermo Fisher Scientific, Waltham, MA, USA) with the 2019-nCoV RT-PCR kit as the amplification reagent (BGI Genomics, Shenzhen, China).

Data analysis was carried out using Statistical Analysis System (SAS Institute Inc., Cary, NC, USA). The standard deviation (SD) and 95% credible interval (CI) were used to compare the SARS-CoV-2 prevalence between groups.

3. Results

A total of 2981 patients were eligible for this study, including 442 symptomatic triaged outpatients, 2354 scheduled asymptomatic inpatients, 185 emergency inpatients, and 627 symptomatic patients. The female/male ratio was 48.1/51.9 and the median age was 60.9 years. A total of 16 patients (0.53%) tested positive, including 8 triaged symptomatic outpatients (0.27%), 1 scheduled asymptomatic inpatient (0.03%), 7 emergency inpatients (0.23%), and 15 symptomatic patients (0.5%). The prevalence of SARS-CoV-2 infection on PCR testing

in each group is shown in Table 1. After testing positive, those patients were quarantined at home or in the hospital for treatment, according to their symptom severity. As of September 14, 2020, our hospital had no hospital-acquired SARS-CoV-2 infections using the TWMU model.

4. Discussion

In this study, we assessed the effectiveness of PCR testing for SARS-CoV-2 to prevent hospital-acquired infection. The prevalence of infection among asymptomatic triaged patients and emergency inpatients was higher than that of scheduled asymptomatic inpatients, although the overall prevalence during this period was low.

In Japan there has been debate about whether the small number of patients diagnosed with COVID-19 was due to the limited testing. Some studies have found that 57–75% of individuals with SARS-CoV-2 infection are asymptomatic [8,9]. In our study, the prevalence of SARS-CoV-2 infection in asymptomatic patients with other diseases before scheduled hospitalization was 0.04%, which is relatively low compared to that of Western countries [8,9] despite the hospital bias in this study. Some plausible reasons for this difference are as follows. People in Japan do not usually hug or kiss when they greet each other. This social distancing may have prevented the spread of SARS-CoV-2 infection. Furthermore, people in Japan usually wear masks and wash their hands and mouths during the influenza and pollen seasons. These habits might also have contributed to the lower rate of SARS-CoV-2 infection [10].

On the other hand, the prevalence of SARS-CoV-2 infection in symptomatic triaged patients and emergency inpatients, including symptomatic patients, was relatively high compared to that of asymptomatic patients before scheduled hospitalization. Caution must be exercised when hospitalizing symptomatic patients. There were no hospital-acquired SARS-CoV-2 infections during the period using the TWMU model, although one patient who was excluded from the TWMU model tested positive for COVID-19 one week after hospitalization. This shows that PCR testing of symptomatic patients may help prevent hospital-acquired SARS-CoV-2 infection. Our hospital managed to continue essential hospitalization without severe restrictions. Using the TWMU model might contribute to better management in the health care system. The TMWU model was subsequently introduced in several institutions after the end of the study period.

To our knowledge, there have been no reports on the effectiveness of PCR testing for SARS-CoV-2 in healthcare settings using a similar model. Judging from our results, screening of both symptomatic and asymptomatic patients might detect undiagnosed infectious cases and control transmission. Therefore, the TWMU model is feasible and efficient for preventing hospital-acquired SARS-CoV-2 infection. Furthermore, this model may help to prevent future waves of COVID-19 or unknown virus pandemics in the future.

This study had several limitations. First, it was conducted in a single institution retrospectively and did not apply a randomized controlled design to validate the results. Second, it was conducted only at the epicenter in Tokyo, and the situation might be different in other epicenters in the world. Third, implementing this model is costly and it takes time to confirm the PCR result. Less costly rapid tests need to be developed.

Table 1 – Prevalence of SARS-CoV-2 infection on PCR testing according to group.

	Value (%)	Positive no./ total no.	SD (%)	95% CI (%)
Symptomatic triaged outpatients	1.81	8/442	0.68	0.95–3.47
Scheduled asymptomatic inpatients	0.04	1/2354	0.001	0.0002–0.2
Emergency inpatients	3.78	7/185	1.47	1.82–7.26
Symptomatic patients	2.4	15/627	0.62	1.49–3.82

Abbreviations: CI, credible interval; no., number; SD, standard deviation.

5. Conclusions

The prevalence of SARS-CoV-2 infection in symptomatic patients, including triaged outpatients and emergency inpatients with other diseases, was higher than that of asymptomatic patients undergoing scheduled hospitalization for other diseases. There were no hospital-acquired SARS-CoV-2 infections in our hospital. Therefore, the TWMU model is feasible and effective for preventing hospital-acquired SARS-CoV-2 infection.

Conflict of Interest

The authors have no conflicts of interest.

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