

# Persistence of SARS-CoV-2 RNA in Nasopharynx, Blood, Urine and Stool of Patients with COVID 19: A Hospital-based Longitudinal Study

**Farahnaz Joukar**

Guilan University of Medical Sciences

**Tofigh Yaghubi Kalurazi**

Guilan University of Medical Sciences

**Mahmoud Khoshsorour**

Guilan University of Medical Sciences

**Sonbol Taronian**

Guilan University of Medical Sciences

**Lida Mahfoozi**

Guilan University of Medical Sciences

**Heydar Ali Balou**

Guilan University of Medical Sciences

**Alireza Jafarinezhad**

Guilan University of Medical Sciences

**Aydin Pourkazemi**

Guilan University of Medical Sciences

**Ezat Hesni**

Guilan University of Medical Sciences

**Mehrnaz Asgharnejad**

Guilan University of Medical Sciences

**Mohammad Shenagari**

Guilan University of Medical Sciences

**Issa Jahanzadi**

Tehran University of Medical Sciences

**Mohammadreza Naghipour**

Guilan University of Medical Sciences

**Saman Maroufizadeh**

Guilan University of Medical Sciences

**Fariborz Mansour-Ghanaei** (✉ [fmansourghanaei@gmail.com](mailto:fmansourghanaei@gmail.com))

Guilan University of Medical Sciences <https://orcid.org/0000-0002-9197-0787>

## Research

**Keywords:** SARS-CoV-2 RNA, COVID-19, RT-PCR

**Posted Date:** February 19th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-218423/v1>

**License:**  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

# Abstract

**Background:** This study was conducted to determine the persistence of SARS-CoV-2 RNA in the nasopharynx, blood, urine and stool of patients with COVID-19.

**Methods:** In this hospital based longitudinal study, 100 confirmed COVID-19 cases were recruited, between March and August 2020 in Guilan province (Northern Iran). Nasopharynx, blood, urine and stool samples were obtained from each patient at the time of hospital admission, discharge, followed by one week after discharge and every 2 weeks until all samples were negative for SARS-CoV-2 RNA by reverse transcription polymerase chain reaction (RT-PCR). Survival analysis was used to identify the duration of virus persistence over time.

**Results:** Positive blood, urine, stool RT-PCR were detected in 24%, 7% and 6% of patient respectively. The median duration of virus persistence in blood, urine and stool were 7 days (95% CI: 6.07–7.93), 6 days (95% CI: 4.16–8.41) and 13 days, 95% CI: 6.96–19.4), respectively. The maximum duration of virus persistent in blood, urine and stool were 17, 11 and 42 days from admission, respectively.

**Conclusions:** According our results, until obtaining definite evidence of the duration of infective viral shedding, prolonged isolation duration at least 25 days from admission to hospital and strict hygienic measures for about one month were recommended.

## 1. Introduction

The Coronavirus disease 2019 (COVID-19) was declared a global epidemic by the World Health Organization in December 2020 [1]. By November 22, 2020, it has infected almost 57 million people with more than 1,300,000 deaths [2]. Iran was classified as the 8th country in terms of COVID-19 mortality [3]. There were 1,189,203 confirmed cases of COVID-19 with 54,440 deaths in Iran, as of 15 February 2020 until 25 December 2020 [4].

The principle route of COVID-19 transmission was reported to be direct and indirect contact with respiratory droplets [5]. Although, other routes of transmission, such as: mother to fetus, fecal-oral, airborne are currently controversial and subject to future investigations [6, 7], however, the epidemiological studies have shown that COVID-19 patients had close contact or proximity in distance with someone who has COVID-19 [8].

Initially, SARS-Cov-2 was isolated and recognized in respiratory samples by real-time RT-PCR [9]. However, in recent studies, viral nucleic acids have subsequently been detected in urine, stool, and gastrointestinal mucosa [10, 11]. A study reported, after nasopharyngeal RT-PCR was negative, eight of ten children with COVID-19, had persistently positive RT-PCR on rectal swabs [12].

Base on The Centers for Disease Control and Prevention (CDC) guidelines, all patients with a positive respiratory RT-PCR test must be isolated until at least 24 hours with no fever, and at least 10 days from

initial symptom onset [13]. However, there are several case reports on the persistence of positive RT-PCR in patients with COVID-19, indicating that individuals can remain positive after symptoms have resolved [14, 15]. Therefore, the persistence of the virus in body fluids can increase the potential risk of virus transmission in asymptomatic or recovered patients [15]. So, it remains uncertain whether the quarantine duration, recommended by CDC is sufficient to reduce transmission [16].

Considering that, the frequency with which SARS-CoV-2 RNA can be detected in body fluids and the period during which it remains detectable are not well understood; this longitudinal study was conducted to determine the persistence of SARS-CoV-2 RNA in the nasopharynx, blood, urine and stool of patients with coronavirus disease 2019 via collecting sequential samples every 2 weeks.

## **2. Materials And Methods**

### **2.1. Study population and design**

This hospital based longitudinal study was designed for a period of 6 months, between March 2020, and August 2020.

Study participants were selected by a covenant sampling method from patients who were hospitalized with a confirmed coronavirus 2019 diagnosis in the only referral Hospital of Rasht, Guilan (Northern Province of IRAN). Confirmed case of COVID-19 was defined as positive real-time fluorescent quantitative polymerase chain reaction (RT-PCR) of nasopharyngeal specimen [17]. The sample size was estimated to be 100 participants with confidence level of 95% and test power of 80%. If participants refused to give a sample, they were excluded from the study.

The study was approved by the local ethical committee of Guilan University of Medical Sciences, Rasht, Iran (permit code IR.GUMS.REC.1399.013). Written informed consent was obtained from every participant.

### **2.2. Measurements**

The samples of nasopharynx, blood, urine and stool were obtained from each participant through following schedule: at the time of admission - at the time of discharge - one week after discharge and every 2 weeks until all samples were negative for SARS-CoV-2 RNA on RT-PCR. At the time of admission, all four samples (nasopharynx, blood, urine and stool) were collected from each participant and were analyzed for SARS-CoV-2 RNA by PCR. At the time of discharge nasopharynx and stool samples were collected from each participant, but blood and urine specimen were collected if they were positive for SARS-CoV-2 RNA, at the time of admission. At each follow up visit, samples of nasopharynx, blood, urine and stool were collected if they were positive for SARS-CoV-2 RNA, at the previous visit.

Nasopharynx and stool samples were obtained by sterile, Dacron swabs. Also, five ml whole blood and urine were collected for SARS-CoV-2 virus-specific real-time RT-PCR. The samples were processed immediately after sampling by a trained laboratory technician. The samples were tasted for SARS-CoV-2

virus using the Ribo Virus RT-PCR Kit (Sacace Biotechnologies, Como, Italy) according to the manufacturer's instructions.

In addition, relevant information on clinical and demographic characteristics of participants was collected. The collected data on sociodemographic characteristics of patient was included age, gender, marriage, job, education, Residency, socioeconomic status. The collected data on clinical manifestation of COVID-19 were included fever, cough, sore throat, dyspnea, weakness, muscular pain, headache, diarrhea, nausea and vomiting and chills. Information on underlying disease (including diabetes, hypertension, cardiovascular disease, immunodeficiency, cancer and respiratory disease) and inflammatory markers (including WBC, ESR and CRP) were also collected. Hospital treatment plans were categorized in 4 groups, including hydroxychloroquine, anti-viral (such as lopinavir, Sovodak (Sofosbuvir at 400 mg and daclatasvir at 60 mg and Remdesivir), interferon  $\beta$ 1 (five doses (44 $\mu$ g each dose) /daily for 3 days a week / subcutaneous) and local treatment (including diphenhydramine, acetaminophen, zinc, vitamin C, famotidine). All the patients received corticosteroids (dexamethasone 8 mg/daily).

## 2.3. Data analyses

Comparisons of qualitative variables (clinical and demographic factors) between three groups (categorized based on duration of SARS-CoV-2 RNA persistence in the nasopharynx) were performed with the Chi-square or Fisher exact tests. Survival analysis was performed to identify the median and 95 percentile durations of SARS-CoV-2 persistence. To find clinical and demographic factors that might be associated with persistence of SARS-CoV-2 RNA, Cox regression analysis was used. Data analyses were performed using SPSS version 17.0 software (SPSS Inc., Chicago, IL, USA).

## 3. Results

During the study period, 106 hospitalized patients with positive nasopharyngeal RT-PCR of SARS-CoV-2 RNA were enrolled to the study, but 6 of these were died (5.66%). Mean age of the participants was 53.30  $\pm$  13.03 years (range 29–86 years) and the majority of the patients were male (60%), were married (84%), had educated, less than diploma (63%), were urban residents (85%), were employed (68%) and had low socioeconomic status(82%). The result of SARS-CoV-2 RNA RT-PCR on different sample, over time is shown in Fig. 1. Only 24% of RT-PCR on blood sample was positive at admission and one sample remained positive at discharge and was cleared after 1 week. RT-PCR on urine sample was positive in 6 % of participants at admission and all were cleared at discharge. RT-PCR was positive in stool samples at admission in 4 participants and 2 remained positive at discharge, in addition, 2 new stool samples were positive at discharge. Three of them were cleared after one week and one was cleared 5 weeks after discharge. At discharge, 30% of nasopharyngeal RT-PCR was positive and all were cleared after one weak.

Participants' clinical and demographic characteristics based on duration of virus persistence in the nasopharynx are shown in table2. Nearly 11% of patients had virus persistence in nasopharynx longer than 14 days from the first positive test. Demographic characteristics of patient were not significantly different among the 3 groups. Similarly, there was no significant association between COVID-19

symptoms and duration of nasopharyngeal persistence of the virus. Our data showed that the type of hospital treatment plan was not contributing to the virus persistence in the nasopharynx (Table 1).

Table 1  
patients clinical and demographic characteristics based on duration of SARS-CoV-2 RNA persistence in the nasopharynx

Category	duration of RNA persistence in the nasopharynx				
	All patient	≤ 7 days after admission	7–13 days after admission	≥ 14 days after admission	p-value*
Count	100	46(46%)	43(43%)	11(11%)	
Age (SD)					
< 50	39	17(43.6%)	18(46.2%)	4(10.3%)	0.878
>=50	61	29(47.5%)	25(41%)	7(11.5%)	
Gender					
Male	60	27(45%)	28(46.7%)	5(8.3%)	0.479
Female	40	19(47.5%)	15(37.5%)	6(15%)	
Marriage					
single	16	7(43.8%)	8(50%)	1(6.2%)	0.730
married	84	39(46.4%)	35(41.7%)	10(11.9%)	
Job					
No	32	14(43.8%)	13(40.6%)	5(15.6%)	0.598
Yes	68	32(47.1%)	30(44.1%)	6(8.8%)	
education					
Less than diploma	63	26(41.3%)	29(46%)	8(12.7%)	0.441
Diploma and more	37	20(54.1%)	14(37.8%)	3(8.1%)	
Residency					
Urban	85	40(47.1%)	34(40%)	11(12.9%)	0.195
Rural	15	6(40%)	9(60%)	0	
socioeconomic status					
Low	82	37(45.1%)	35(42.7%)	10(12.2%)	0.280
Moderate to high	18	9(50%)	8(44.4%)	1(0.06%)	
Underling disease					
No	50	23(46%)	21(42%)	6(12%)	0.945

Category		duration of RNA persistence in the nasopharynx			
Yes	50	23(46%)	22(44%)	5(10%)	
O2 saturation (mean ± SD)	93.84 ± 4.3	93.85 ± 4.1	93.88 ± 3.9	93.64 ± 6.1	0.986
Hospital treatment plan <sup>a</sup>					
Hydroxychloroquine	5	2(40%)	2(40%)	1(20%)	0.477
Local treatment <sup>b</sup>	62	32(51.6%)	25(40.3%)	5(8.1%)	
Anti-viral <sup>c</sup>	18	5(27.8%)	11(61.1%)	2(11.1%)	
interferon	15	7(46.7%)	5(33.3%)	3(20%)	
Covid-19 symptoms					
Dyspnea					
No	44	18(40.9%)	18(40.9%)	8(18.2%)	0.122
Yes	56	28(50%)	25(44.6%)	3(5.4%)	
Sore throat					
No	78	38(48.7%)	32(41%)	8(10.3%)	0.586
Yes	22	8(36.4%)	11(50%)	3(13.6%)	
Muscular pain					
No	82	37(45.1%)	38(46.3%)	7(8.5%)	0.152
Yes	18	9(50%)	5(27.8%)	4(22.2%)	
Headache					
No	76	34(44.7%)	32(42.1%)	10(13.2%)	0.470
Yes	24	12(50%)	11(45.8%)	1(4.2%)	
Diarrhea					
No	84	38(45.2%)	36(42.9%)	10(11.9%)	0.795
Yes	16	8(50%)	7(43.8%)	1(6.2%)	
Fever					
No	19	9(47.4%)	8(42.1%)	2(10.5%)	0.991
Yes	81	37(45.7%)	35(43.2%)	9(11.1%)	



Category		duration of RNA persistence in the nasopharynx			
Cough					
No	30	14(46.7%)	15(50%)	1(3.3%)	0.249
Yes	70	32(45.7%)	28(40%)	10(14.3%)	
Weakness					
No	93	43(46.2%)	39(41.9%)	11(11.8%)	0.550
Yes	7	3(42.9%)	4(57.1%)	0	
Nausea and vomiting					
No	79	40(50.6%)	32(40.5%)	7(8.9%)	0.145
Yes	21	6(28.6%)	11(52.4%)	4(19%)	
Chills					
No	21	9(42.9%)	10(47.6%)	2(9.5%)	0.886
Yes	79	37(46.8%)	33(41.8%)	9(11.4%)	
Inflammatory markers					
WBC cell/mL (mean ± SD)	7.41 ± 3.9	7.15 ± 3.4	7.96 ± 4.6	6.37 ± 3.1	0.415
ESR mm/h (mean ± SD)	53.38 ± 29.6	50.78 ± 29.6	55.88 ± 26.4	54.45 ± 29.6	0.692
CRP mg/L					
< 12	24	11(23.9%)	11(25.6%)	2(18.2%)	0.473
12–20	16	6(13%)	9(20.9%)	4(36.4%)	
> 20	57	29(63%)	23(53.5%)	5(45.5%)	
Data are presented as number (percentages).					
* Statistical significance based on the Chi-square or Fisher's Exact test or ANOVA test					
a) All of the patients received corticosteroids					
b) Including diphenhydramine, acetaminophen, zinc, vitamin C, famotidine.					
c) Including lopinavir, Sovodak (Sofosbuvir at 400 mg and daclatasvir at 60 mg, Remdesivir)					
Abbreviations: WBC: Wight blood cells; ESR: Erythrocyte sedimentation rate; CRP: C-reactive protein;					

The median duration of SARS-CoV-2 persistence in nasopharynx from the first positive RT-PCR test at admission time was 8 days (95% CI: 6.91–9.09) and maximum duration of virus persistence among them was 25 days from admission (Fig. 2). The median duration of SARS-CoV-2 persistence in blood from the first positive RT-PCR test at admission time was 7 days (95% CI: 6.07–7.93) and maximum duration of virus persistence among them was 17 days from admission (Fig. 2). The median duration of SARS-CoV-2 persistence in stool from the first positive RT-PCR test was 13 days (95% CI: 6.96–19.4) and maximum duration of virus persistence among them was 42 days from admission (Fig. 2). The median duration of SARS-CoV-2 persistence in urine from the first positive RT-PCR test at admission time was 6 days (95% CI: 4.16–8.41) and maximum duration of virus persistence among them was 11 days from admission (Fig. 2).

In our analysis of factors that might be associated with durations of SARS-CoV-2 persistence by Cox regression, we did not find any statistically significant associations (data not presented).

Frequency of some COVID 19 gastrointestinal (GI) symptoms according to result of stool RT-PCR are presented in Fig. 3. Abdominal pain and diarrhea were significantly more common in stool RT-PCR positive patient than stool negative ones.

In analysis of clinical and demographic factors that might be associated with positive blood and urine RT-PCR, we did not find any statistically significant associations (data not presented).

## 4. Discussion

In this longitudinal study, we demonstrate that the maximum duration of nasopharyngeal (25 days) and fecal (42 days) SARS-CoV-2 RNA shedding is longer than the recommended (at least 24 hours with no fever, and at least 10 days from initial symptom onset) quarantine duration [13].

Nearly, one third of our hospitalized COVID-19 patients had positive nasopharyngeal RT-PCR at the time of discharge and about one tenth of them had virus persistence in nasopharynx longer than 14 days from the first positive test. Maximum duration of nasopharyngeal shedding was 25 days from admission. These findings are compatible with some studies that revealed, some patients continued to be upper respiratory tract RT-PCR positive after discharge from hospital, for the next few days [18, 19]. We did not identify any determinants of viral persistence, but a study in china demonstrated that the prolonged presence of the virus in upper respiratory tract was associated with disease severity [20]. While, another study in Portugal revealed the viral RNA persistence not associated with disease severity and stronger immune response are the determinants of virus RNA clearance [21].

Positive blood SARS-CoV-2 RNA RT-PCR was detected in about one third of our patient, but most of them turned to negative at the time of discharge. The studies on detecting SARS-CoV-2 RNA in blood were limited, but a study in china revealed that the SARS-CoV-2 RNA detected in the blood of 6 out of 57 Chinese patients and all 6 positive bloods RT-PCR had a severe clinical picture [22]. The higher positive

rate of blood RT-PCR in our study was probably due to the disease severity in our patients and hospital-based design.

Our findings revealed that the positive urine SARS-CoV-2 RNA RT-PCR was less common (7 out of 100 patients) in our study population and all of them turned to negative at the time of discharge. Our result was in accordance with studies in Turkey and China that demonstrated nearly 5–7% of COVID-19 patient had positive urine RT-PCR [23, 24].

Positive stool SARS-CoV-2 RNA RT-PCR was detected in only 6 out of 100 patients in our study, but the duration of time for a positive stool RT-PCR test to turn negative was longer than nasopharynx, urine and blood RT-PCR tests, with a maximum duration of fecal shedding of 42 days. Therefore, fecal positive hospitalized patients with positive stool RT-PCR, represent the need for precautions and protective equipment for interventional procedures involving the gastrointestinal tract in a hospital environment., Similarly, a study in china demonstrates that an asymptomatic case was positive in the stool RT-PCR for a period as long as 42 days and also, reported that in almost two third of patients, the clearance of fecal shedding takes a longer time than the nasopharyngeal sample [19].

Although, our findings demonstrate that the maximum duration of nasopharyngeal and fecal SARS-CoV-2 RNA shedding is longer than the recommended quarantine duration by the CDC <sup>13</sup>, however, it is unclear whether individuals with persistent positive RNA PCR represent an infectious risk. Future studies are needed to determine whether PCR positivity is due to infective virus or non- infective nucleic acid fragments. Therefore, until such studies are concluded, prolonged isolation duration at least 25 days may be recommended, and aggressive contact tracing might also be considered. Also, patients are advised to take strict hygiene measures, especially those with gastrointestinal symptoms for about one month, in order to prevent potential fecal-oral transmission.

The strengths of the current study are the long term follow up and detecting virus RNA in respiratory and extra-respiratory sites. However, the hospital-based design is the limitation of our study, leading to more severe patient enrollment that limits the generalizability of findings. Another limitation of our study was that the day of symptom onset was not available, and all calculations and analyses were based on first nasopharyngeal RT-PCR test at admission time thus, the duration of viral shedding was underestimated. Another limitation of current study was that the, virus isolation and tests of specimens' infectivity were not conducted and CT value of RT-PCR was not available.

## 5. Conclusion

Our findings demonstrate that the maximum duration of nasopharyngeal and fecal SARS-CoV-2 RNA shedding in hospitalized COVID-19 patients is longer than the recommended quarantine duration by CDC. Therefore, until obtaining definite evidence of the duration of infective viral shedding, prolonged isolation duration for at least 25 days from admission to hospital may be recommended and aggressive contact tracing might also be considered. Also, patients are advised to take public health measures such as strict

personal hygiene, especially those with gastrointestinal symptoms for about one month, in order to prevent potential fecal-oral transmission.

## Abbreviations

CDC: The Centers for Disease Control and Prevention

## Declarations

### Acknowledgments

We thank Prof. Dr. *Reza Nassiri* from Departments of Pharmacology and Toxicology, *Michigan State University*, USA, for comments that greatly improved the manuscript. The authors gratefully acknowledge the all personnel's in the Gastrointestinal and Liver Disease Research Center and vice-chancellor for research of Guilan University of medical science and the staff at Razi Hospital.

### Author's contributions

FA - conception, literature search, study design, data collection, data analysis, data interpretation, writing and final approval; T YK,S T,L M,HAB,A J,A P,E H- study design ,data collection, writing and final approval; MK and MS and IJ - data collection, laboratory activities (PCR); F M-G - conception, literature search, data collection, data analysis, data interpretation, writing and final approval; MN-literature search, data collection, data interpretation, writing and final approval; SM - data analysis, data interpretation, writing and final approval; MA- data collection, literature search, writing and final approval.

### Funding

None.

### Availability of data and materials

The datasets obtained during this study will be available upon request to the corresponding author.

### Ethics approval and consent to participate

This study was registered in the Research Department of Guilan University of Medical Sciences with the ethics code of IR.GUMS.REC.1399.013. This manuscript has not been published in whole or in part. All authors have read the manuscript and have agreed that the work is ready for submission and accept responsibility for its contents.

### Consent for publication

Not Applicable.

## Competing Interest

Authors have no competing interests.

## References

1. World Health Organization. Coronavirus disease 2019 (COVID-19): Situation Report – 51 WHO; 2020 [updated 2020 Mar 12]. Available from: <https://cutt.ly/qtW0ZpO>.
2. World Health Organization. Coronavirus disease 2019 (COVID-19): Situation Report WHO; 2020 [updated 2020 November 22]. Available from: <https://www.who.int/publications/m/item/weekly-epidemiological-update—24-november-2020>.
3. World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard; 2020 [updated 1 Dec 2020]. Available from: <https://covid19.who.int/>.
4. World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard; 2020 [updated 1 Dec 2020]. Available from: <https://covid19.who.int/region/emro/country/ir>.
5. Gupta M.K, Lipner S.R. Personal protective equipment recommendations based on COVID-19 route of transmission. *J Am Aca Dermatol*. 2020; 83(1): 45-46. doi.org/10.1016/j.jaad.2020.04.068.
6. Heller L, Mota C.R, Greco D.B. COVID-19 faecal-oral transmission: Are we asking the right questions? *Sci Total Environ*. 2020; 729: 138919. doi: [10.1016/j.scitotenv.2020.138919](https://doi.org/10.1016/j.scitotenv.2020.138919)
7. Setti L, [Passarini F](#), [Gennaro GD](#), [Barbieri P](#), [Perrone MG](#), [Borelli M](#), et al. Airborne transmission route of COVID-19: why 2 meters/6 feet of inter-personal distance could not Be enough. *Int J Environ Res Public Health* .2020;17(8):2932.doi:10. 3390/ijerph17082932.
8. Fisher K.A, Tenforde M.W, Feldstein L.R, Lindsell C.J, Shapiro N.I, Files D.C, et al., Community and close contact exposures associated with COVID-19 among symptomatic adults  $\geq$  18 years in 11 outpatient health care facilities—United States, July 2020. *MMWR Morb Mortal Wkly Rep*. 2020; 69(36):1258-1264. doi: [10.15585/mmwr.mm6936a5](https://doi.org/10.15585/mmwr.mm6936a5).
9. Ren L-L, Wang Y-M, Wu Z-Q, Xiang Z-C, Guo Li, Xu T, et al. Identification of a novel coronavirus causing severe pneumonia in human: a descriptive study. *Chin Med J* .2020; 133(9):1015-1024. doi: [10.1097/CM9.0000000000000722](https://doi.org/10.1097/CM9.0000000000000722).
10. Zhiwei Y, [Ganwen LI](#), [Xiaoling DAI](#), [Guirong LIU](#), [Gang LI](#), [Yusheng JIE](#). Three cases of novel coronavirus pneumonia with viral nucleic acids still positive in stool after throat swab detection turned negative. *Chinese Journal of Digestion*.2020: E002-E002.
11. Peng L, Liu J, Xu W, Luo Q, Deng K, Lin B, et al. 2019 Novel Coronavirus can be detected in urine, blood, anal swabs and oropharyngeal swabs samples. medRxiv, 2020. doi: [doi.org/10.1101/2020.02.21.20026179](https://doi.org/10.1101/2020.02.21.20026179).
12. Xu Y, Li X, Zhu B, Liang H, Fang C, Gong Y, et al., Characteristics of pediatric SARS-CoV-2 infection and potential evidence for persistent fecal viral shedding. *Nat Med*. 2020; 26(4):502-505.

13. Centers for Disease Control and Prevention. Separate yourself from others if you have COVID-19; 2020 [updated Nov. 3, 2020]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/isolation.html>.
14. Cento V, Colagrossi L, Nava A, Lamberti A, Senatore S, Travi G, et al. Persistent positivity and fluctuations of SARS-CoV-2 RNA in clinically-recovered COVID-19 patients. *Journal of Cleaner Production*. 2020; 81(3):90-92. doi: 10.1016/j.jclepro.2020.06.024. Epub 2020 Jun 20.
15. Danzetta ML, Amato L, Cito F, Giuseppe AD, Morelli D, Savini G, et al. SARS-CoV-2 RNA persistence in naso-pharyngeal swabs. *Microorganisms*. 2020; 8(8): 1124. doi: 10.3390/microorganisms8081124.
16. Gombar S, Chang M, Hogan CA, Zehnder J, Boyd S, Pinsky B.A, et al. Persistent detection of SARS-CoV-2 RNA in patients and healthcare workers with COVID-19. *J Clin Virol*. 2020:104477. doi.org/10.1016/j.jcv.2020.104477.
17. Hanson KE, Caliendo AM, Arias CA, Hayden MK, Englund JA, Lee MJ, et al., Infectious Diseases Society of America guidelines on the diagnosis of COVID-19. *Clin Infect Dis*. 2020.
18. Jameel T, Baig M, Gazzaz ZJ. Persistence of Reverse Transcription-Polymerase Chain Reaction (RT-PCR) Positivity in COVID-19 Recovered Patients: A Call for Revised Hospital Discharge Criteria. *Cureus*. 2020; 12(7):9048. doi:10.7759/cureus.9048.
19. Hu Z, Song C, Xu C, Jin G, Chen Y, Xu X, et al. Clinical characteristics of 24 asymptomatic infections with COVID-19 screened among close contacts in Nanjing, China. *Sci China Life Sci*. 2020; 63(5): 706-711. doi: 10.1007/s11427-020-1661-4. Epub 2020 Mar 4.
20. Chang D, Zhao P, Zhang D, Dong J-H, Xu Z, Yang G, et al. Persistent viral presence determines the clinical course of the disease in COVID-19. *J Allergy Clin Immunol Pract*. 2020; 8(8): 2585-2591. doi: 10.1016/j.jaip.2020.06.015.
21. Carmo, A, Pereira-Vaz J, Mota V, Mendes A, Morais C, Coelho da Silva A, et al., Clearance and persistence of SARS-CoV-2 RNA in patients with COVID-19. *J Med Virol*. 2020; 92(10):2227-2231. doi: 10.1002/jmv.26103. Epub 2020 Jun 19.
22. Chen W, Lan Y, Yuan X, Deng X, Li Y, Cai X, et al. Detectable 2019-nCoV viral RNA in blood is a strong indicator for the further clinical severity. *Emerg microbes infect*. 2020; 9(1): 469-473. doi: 10.1080/22221751.2020.1732837. eCollection 2020.
23. Dheir H, Sipahi S, Yaylaci S, Cihad Genc A, Turkoglu Genc F, Bilal Genc A, et al. Is the COVID-19 disease associated with de novo nephritic syndrome? *Rev Assoc Méd Bras*. 2020; 66(9): 1258-1263. doi.org/10.1590/1806-9282.66.9.1258.
24. Ling Y, Xu S-B, Lin Y-X, Tian D, Zhao-Qin Z, Dai F-H, et al. Persistence and clearance of viral RNA in 2019 novel coronavirus disease rehabilitation patients. *Chin Med J*. 2020; 133(9):1039-1043. doi: 10.1097/CM9.0000000000000774.

## Table

Figures

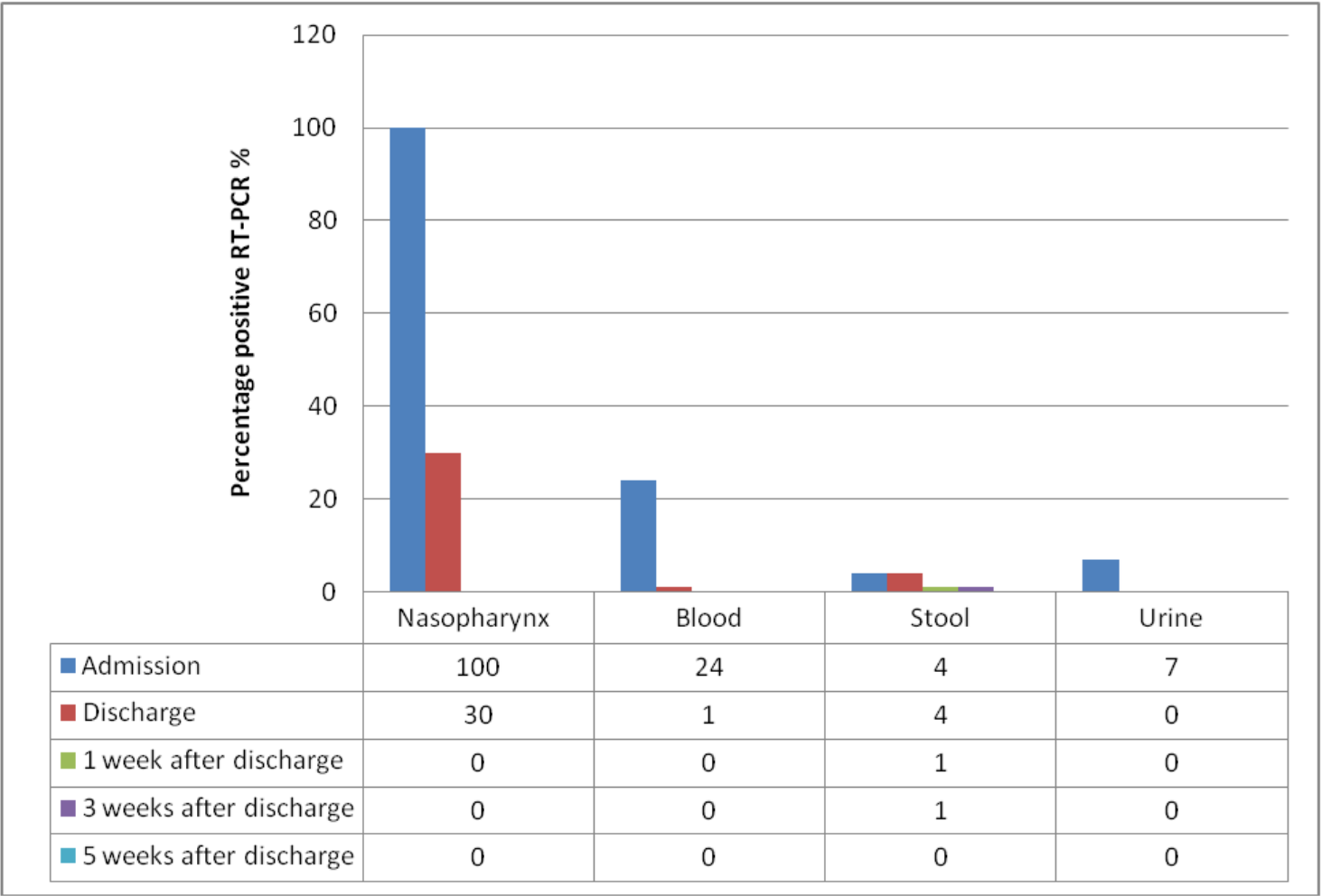
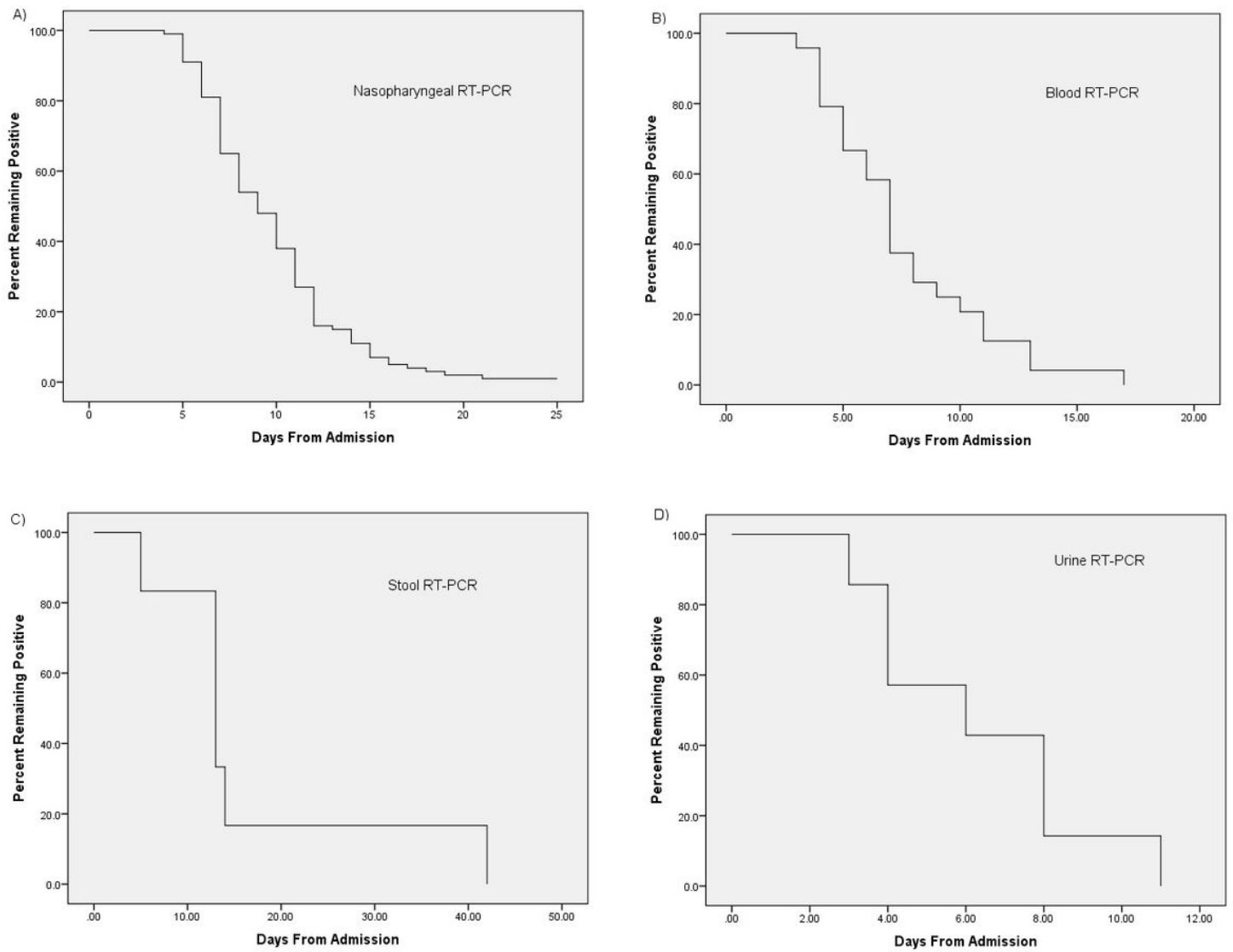


Figure 1

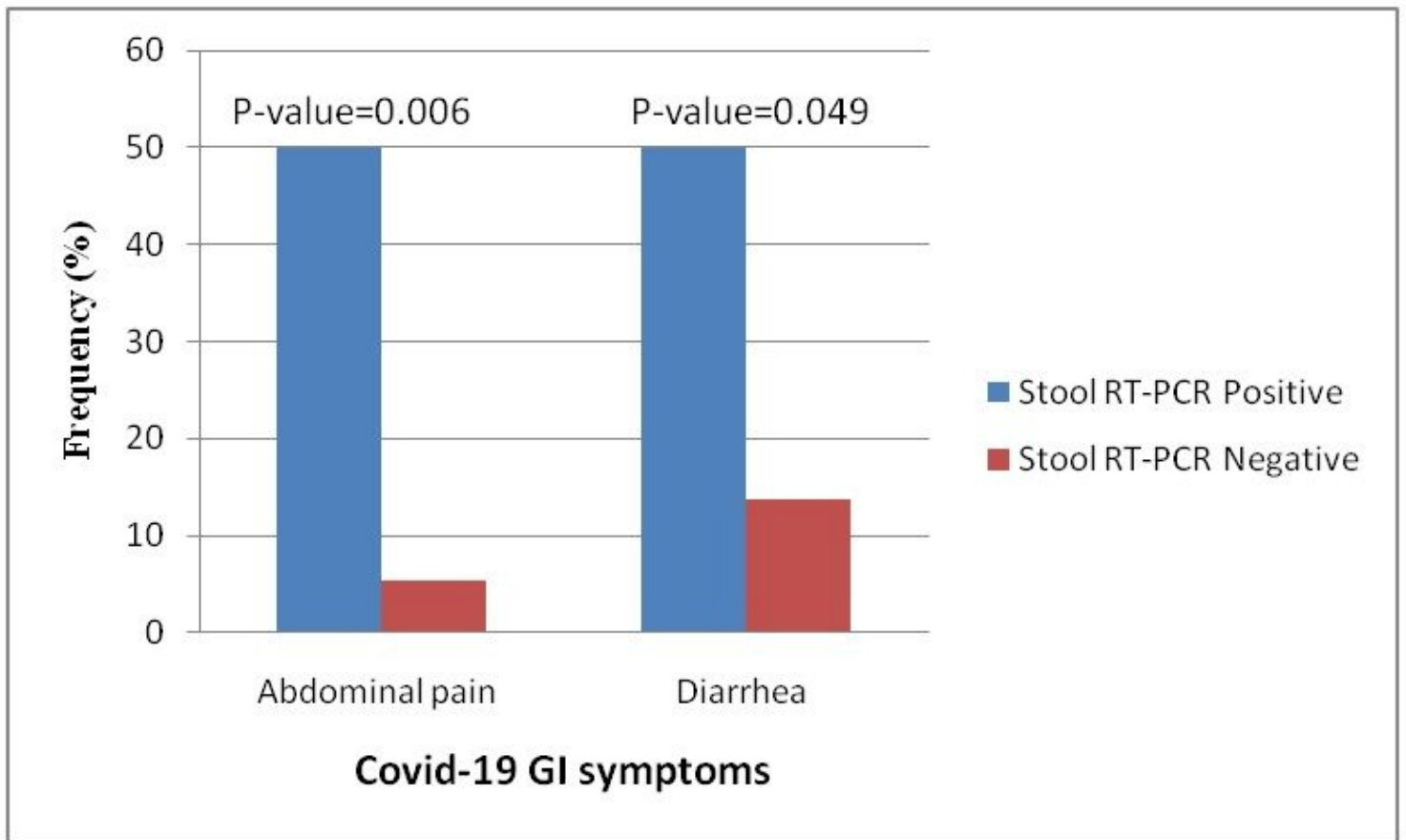
Result of SARS-CoV-2 RNA RT-PCR on different sample, over time (Note. A: Admission; D: Discharge; wk: Week; RT-PCR: Reverse Transcription-Polymerase Chain Reaction)



**Figure 2**

The duration for a positive SARS-CoV-2 RNA RT-PCR test to turn negative . A) Nasopharyngeal RT-PCR (n=100). B) Blood RT-PCR (n=24).C) Stool RT-PCR test (n=6). D) Urine RT-PCR test (n=7).





**Figure 3**

Frequency of COVID 19 gastrointestinal (GI) symptoms according to result of stool RT-PCR (Statistical significance based on Fisher's Exact test)