



## Research article

## Epidemiological analysis of the diagnostic results of COVID-19 infection in Bishkek by real-time PCR method

Aizhan Sadyrbaeva<sup>\*1,2</sup> , Kadyrbai Chekirov<sup>3</sup> 

<sup>1</sup> Kyrgyz-Turkish Manas University, Institute of Pure and Applied Sciences, Biology Program, 720038, Bishkek, Kyrgyzstan

<sup>2</sup> Republican Center for Quarantine and Especially Dangerous Infections of the Ministry of Health of the Kyrgyz Republic, Laboratory of Virology and Rare Infections, 720005, Bishkek, Kyrgyzstan

<sup>3</sup> Kyrgyz-Turkish Manas University, Faculty of Science, Department of Biology, 720038, Bishkek, Kyrgyzstan

### Abstract

The aim of the research is to analyze the diagnostic results of infected people with the COVID-19 in Bishkek. Therefore, in this study, with the aim of epidemiologically analyzing the COVID-19 infection in the city, diagnostic PCR research was carried out at the Center for Quarantine and Highly Dangerous Infections of the Ministry of Health of the Kyrgyz Republic in the Laboratory of Virology and Rare Infections. During the period of operation from 01<sup>st</sup> May 2020 to 31<sup>st</sup> March 2021, 28,863 samples from patients of the Sverdlovsky and Pervomaisky districts of Bishkek were examined by the real-time PCR. For laboratory diagnostics of COVID-19, according to the recommendations of the WHO and Russian regulatory documents, obtained biomaterials from the upper respiratory tract like swabs from the nasopharynx and oropharynx were used. Biological materials were collected from patients with symptoms of upper respiratory tract infections and from patients who contacted with COVID-19 infected people applied to Family Medicine Centers in Bishkek city for the purpose of preventive examination and treatment. The samples were identified by real-time PCR, in accordance with the “biological safety” rules. From 28,863 samples 3,255 positive and 25,575 negative results were found. In the study, the largest number of samples from patients with symptoms of COVID-19 infection was recorded in June, and July, 2021, as 7,604, and 4,074, respectively. In June, 738 positive results were detected from 7,604 samples, while in July, 540 positive results were detected from 4,074 samples. This period is estimated to be the acute dynamic period of the epidemiological situation in Bishkek (Pervomaisky and Sverdlovsky districts). The epidemiological situation was stable in August and September, with the number of infected in August was 17 cases, and in September 2 cases. However, since September 2020, the number of infected people with COVID-19 has been growing. Besides, the results of PCR diagnostics from 01<sup>st</sup> January to 31<sup>st</sup> March 2021 indicated that the epidemiological situation was assessed as “relatively stable”.

**Keywords:** Amplification; cDNA; COVID-19; RdRP; RT-PCR; SARS-CoV-2

### 1. Introduction

Humanity has been in eternal confrontation with the micro world for all the time of existence. The struggle between human and microbes is going on for centuries resulting in great losses of human’s lives since ancient times (Kolodkina et al., 2020). Throughout the history of society, mankind has faced a number

of epidemics of infectious diseases as smallpox, plague, cholera, swine flu, Ebola and many others (Razumenko, 2022).

SARS-CoV (Severe acute respiratory syndrome-related coronavirus) is an -enveloped single-stranded (+) RNA virus belonging to the subgenus Sarbecovirus of the genus Betacoronavirus (Genc, 2020). The new virus was named SARS-CoV-2 (Severe acute respiratory syndrome coronavirus

\* Corresponding author.

E-mail address: [aikasadyrbaeva80@gmail.com](mailto:aikasadyrbaeva80@gmail.com) (A. Sadyrbaeva).

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2) coronavirus of the second type, causing severe acute respiratory syndrome by the International Committee on the Taxonomy of Viruses (WHO, 2020a).

In December 2019, for the first time, World Health Organization (WHO) was informed about the appearance of a severe acute illness in Wuhan (Hubei Province, China), accompanied in some cases by the development of respiratory distress syndrome. The disease caused by the new coronavirus was named by WHO “COVID-19”, and the virus “SARS-CoV-2” (Gu et al., 2016; Tokel, 2021). On 30<sup>th</sup> of January 2020 WHO declared the outbreak of COVID-19 as a public health emergency (WHO, 2020b). On 11st of March 2020, due to the rapid and widespread infection, WHO declared the COVID-19 as a pandemic (WHO, 2020c).

Since March 2020, the first cases of COVID-19 infection have been registered in Kyrgyzstan, and these cases were identified using the real-time PCR technique (Ministry of Health of the Kyrgyz Republic, 2020). A number of factors influenced the numerous registered cases of infection such as the organization of testing processes in the country, the potential resource of the healthcare system, the accuracy of the test systems used, the speed and quality of patient isolation and quarantine measures.

The purpose of the research is to analyze the diagnostic results of infected people with the COVID-19 and to assess the dynamics of the epidemiological situation in the capital of Kyrgyzstan, Bishkek (Sverdlovsky and Pervomaisky districts).

Biological materials were collected from patients with symptoms of upper respiratory tract infections (fever, cough, fatigue, shortness of breath, muscle pain, sore throat and headache) and from patients who contacted with COVID-19 infected people applied to “Family Medicine Centers” in Bishkek city for the purpose of preventive examination and treatment. The samples were identified by real-time PCR, in accordance with the “biological safety” rules.

**2. Materials and methods**

The real-time PCR method was used to analyze the results of PCR diagnostics of COVID-19 infection, to research and assess the dynamics of the epidemiological situation. It is recognized as the standard reference for laboratory diagnosis of SARS-CoV-2 coronavirus infection. The main advantages of the system are; high sensitivity, specificity and the fact that the reaction and analysis are carried out simultaneously in a closed system, which minimizes the likelihood of obtaining false positive results due to contamination with amplification products. WHO recommends using the real-time PCR method together with reverse transcription of viral Ribonucleic acid (RNA) to confirm cases of COVID-19 infection (WHO, 2020d).

In this study, 28,863 samples from patients of the Sverdlovsky and Pervomaisky districts of Bishkek city were used as the source of material (Table 1).

In the process of PCR diagnostics of COVID-19, “AmpliSens RIBO-PREP” diagnostic kit was used for RNA extraction as recommended by the Central Research Institute of

Epidemiology of Russia. Then, “REVERTA-L” kit (AmpliSens) was used for obtaining cDNA to carry out the RT-PCR reaction. The AmpliSens Cov-Bat-FL kit was used for amplification with hybridization-fluorescence detection of amplification products (Table 2).

**Table 2**

The analysis of the accumulation curves of fluorescent signals was carried out on three channels.

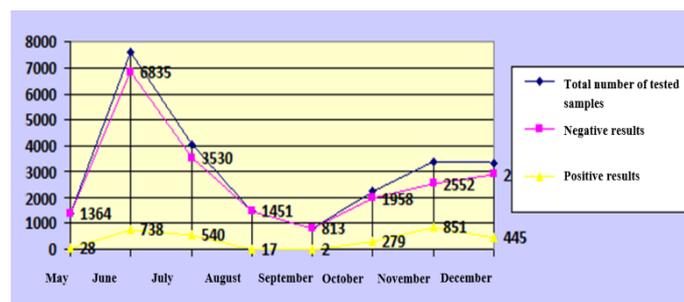
Fluorophore Channel	FAM	Hex/Rox
cDNA target sequences	cDNA IC sample	SARS-CoV-2
Amplification area	Artificial nucleotide sequence	RdRP gene (RNA-dependent RNA polymerase)

The diagnostic sensitivity of the kit for detecting SARS-CoV-2 coronavirus RNA is 100% (93-100), with a confidence level of 95%, while the diagnostic specificity of the kit for detecting SARS-CoV-2 coronavirus RNA is 100% (94-100), with a confidence level of 95% (Amplisens, 2020).

**3. Results**

During the process of operation from 01<sup>st</sup> May 2020 to 31<sup>st</sup> March 2021, 28,863 samples from patients of the Sverdlovsky and Pervomaisky districts of Bishkek were examined by the real-time PCR. From 28,863 samples, 3,255 patients were found infected with SARS-CoV-2, and the remaining 25,575 were negative (Table 3).

As obvious from the data in Table 1, the results of PCR diagnostics carried out from 01<sup>st</sup> May to 31<sup>st</sup> December 2020 indicate that the largest number of samples from patients with symptoms of COVID-19 infection was in June. There were 738 COVID-19 positive results out of 7604 tested samples (9.70%). This period can be called an “acute period” of the dynamics of the epidemiological situation in Bishkek. The change in the epidemiological situation during this period is clearly illustrated in Fig. 1.



**Fig. 1.** Graph of the dynamics of the epidemiological situation in Bishkek (Pervomaisky and Sverdlovsky districts) from 01<sup>st</sup> May 2020 to 31<sup>st</sup> December 2020 period.

The graph above (Fig. 1) shows that the epidemiological situation stabilized in August and September, while the number of those registered in the database with suspected contamination

**Table 1**

The total number of tested samples by months of 2020-2021.

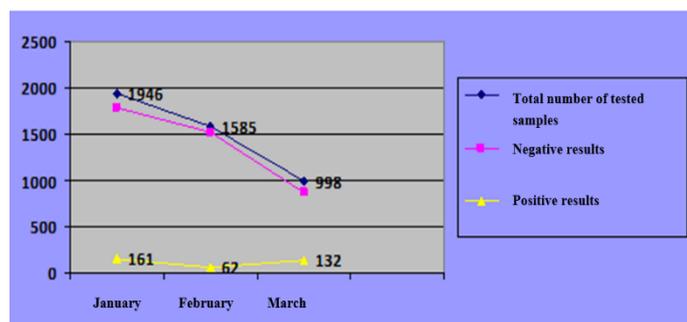
Number of Samples for PCR Diagnostics by Months											Total Number of Samples
2020 Year							2021 Year				
May	June	July	August	September	October	November	December	January	February	March	
1392	7604	4074	1468	815	2237	3403	3341	1946	1585	998	28863

**Table 3**

Dynamics of the epidemiological situation in Bishkek (Pervomaisky and Sverdlovsky districts) from 01<sup>st</sup> May 2020 to 31<sup>st</sup> March 2021 (monthly determined dynamic on the base of the results of PCR diagnostics).

Months	Total Number of Tested Samples	From the Total Number of Tested Samples					
		Identified Negative Results		Identified Positive Results		Questionable Results	
		Quantity	%	Quantity	%	Quantity	%
<b>2020 Year</b>							
May	1,392	1,364	97.99	28	2.01	-	-
June	7,604	6,835	89.89	738	9.70	31	0.41
July	4,074	3,530	86.65	540	13.25	4	0.1
August	1,468	1,451	98.84	17	1.16	-	-
September	815	813	99.75	2	0.25	-	-
October	2,237	1,958	87.53	279	12.47	-	-
November	3,403	2,552	74.99	851	25.01	-	-
December	3,341	2,895	86.65	445	13.32	1	0.03
<b>2021 Year</b>							
January	1,946	1,785	91.73	161	8.27	-	-
February	1,585	1,523	96.09	62	3.91	-	-
March	998	866	88.78	132	13.22	-	-

was 1,451 and 813, respectively. However, since October, the number of people infected began to rise again. In November, 3,403 patients were registered out of which 851 (25.1%) were infected, and the remaining 2,552 (74.9%) patients had negative PCR results. The total number of applications in December was 3,341, with 445 (13.32%) positive and 2,895 (86.65%) negative results.



**Fig. 2.** Graph of the dynamics of the epidemiological situation in Bishkek (Pervomaisky and Sverdlovsky districts) from 01<sup>st</sup> January 2021 to 31<sup>st</sup> March 2021 period.

The results of the PCR research carried out from 01<sup>st</sup> January to 31<sup>st</sup> March 2021 compared with the results of the PCR research conducted from 01<sup>st</sup> May to 31<sup>st</sup> December 2020. The number of registered patients with general symptoms in February was 1,585, including 62 (3.91%) infected cases of COVID-19, while 1,523 (96.09%) results were negative (Fig. 2). In March, 998 patients came with suspicion of infection of which 132 (13.22%) were positive and 866 (88.78%) were negative. Thus, the dynamics of the epidemiological situation in the Sverdlovsky and Pervomaisky districts of Bishkek at the beginning of 2021 (January, February, March) can be assessed as “relatively stable”.

#### 4. Discussion

When the epidemiological situation of COVID-19 infection in Kyrgyzstan from March 2020 to 31<sup>st</sup> March 2021 is assessed, the total number of patients infected with COVID-19 in Kyrgyzstan according to the Ministry of Health and Social Development of the Kyrgyz Republic, were 88,809, and the

number of deaths were 1,499 (1.69%).

Analyzing the general statistics of the laboratory’s research in two districts (Sverdlovsky and Pervomaisky) of Bishkek on 31<sup>st</sup> March 2021 showed that the number of detected positive results are 3,255 cases. According to the Ministry of Health and Social Development of the Kyrgyz Republic, the number of positive results accounted as 4% from the total number of detected cases throughout Kyrgyzstan (Ministry of Health of the Kyrgyz Republic, 2021).

For the analysis of the dynamics of the epidemiological situation by months in Pervomaisky and Sverdlovsky districts of Bishkek for the period from 01<sup>st</sup> May to 31<sup>st</sup> December 2020, it can be noted that the maximum number of positive PCR results occurred in June and July as 738 and 540 cases, relatively. This period can be called the “first wave” of the spread of COVID-19 infection. From August to October, the epidemiological situation with COVID-19 in the country was stabilized slightly. But in the following months (November, December) of 2020, the number of infections began to grow again due to various factors. This testifies the “growth” of the dynamics of the epidemiological situation in Kyrgyzstan.

Assessing the epidemiological situation for the period from 01<sup>st</sup> January to 31<sup>st</sup> March 2021, it can be concluded as “relatively stable”, since the number of tested samples and detected positive results during this period is significantly lower than the same indicators for the period from 01<sup>st</sup> May to 31<sup>st</sup> December 2020.

#### 5. Conclusion

According to the results of PCR diagnostics that carried out from 01<sup>st</sup> May 2020 and 31<sup>st</sup> March 2021, the greatest dynamics of the epidemiological situation in the Sverdlovsky and Pervomaisky districts of Bishkek were registered in June, July, November and December of 2020. The results of PCR diagnostics that carried out from 01<sup>st</sup> January 2021 to 31<sup>st</sup> March 2021 indicated that, the epidemiological situation in Bishkek city is assessed as “stable”.

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**Conflict of interest:** The authors declare that they have no conflict of interests.

**Informed consent:** The study was conducted with the permis-

sion of the Center for Quarantine and Especially Dangerous Infections of the Ministry of Health of the Kyrgyz Republic, No. P.30.2021-011-011 dated January 15, 2021.

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