RESEARCH ARTICLE / ARAŞTIRMA

DOI: 10.4274/mjima.galenos.2022.2022.45
Mediterr J Infect Microb Antimicrob 2022;11:45
Erişim: http://dx.doi.org/10.4274/mjima.galenos.2022.2022.45

The Impact of COVID-19 on Central Line Bloodstream Infections Standardized Infection Ratio in Intensive Care Units: A 3-year Surveillance Data

Yoğun Bakım Ünitelerinde COVID-19'un Santral Kateter İlişkili Kan Dolaşımı Enfeksiyonları Standardize Enfeksiyon Oranları Üzerine Etkisi: 3 Yıllık Sürveyans Verisi

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Abstract

Introduction: Healthcare-associated infections have increased during the Coronavirus disease-2019 (COVID-19) pandemic because of inadequate adherence to infection control measures. Central line-associated bloodstream infections (CLBSI) are one of the infections with an increased incidence. In this study, CLBSI standardized infection ratio (SIRs) in three periods were compared, and the effect of the COVID-19 pandemic on CLBSI observed in intensive care units (ICUs) was evaluated. The hand hygiene compliance rates were also examined for the same period.

Materials and Methods: The 3-year (2019, 2020, and 2021) SIR, standardized utilization ratio (SUR), and SIR change rates between years in 12 adult ICUs were compared. Calculations were made using the SIR and SUR calculation tool prepared by the General Directorate of Public Health of Turkey. The formula [(SIR/SUR of year Y-SIR/SUR of year X) / SIR/SUR x 100 of year X] was used when calculating the SIR/SUR change rates between periods.

Results: In 2019 and 2020, SIR was detected as >1 only in the Burn ICU. Anesthesiology and Reanimation 1 and 2 and Internal Medicine 3 were the ICUs with the highest SIR increase rate in 2020. In 2021, the SIR was <1 in all units. In Anesthesiology and Reanimation 2, Internal Medicine 1 and 3, and Cardiovascular Surgery ICUs, the SUR was >1 in all periods. When the mean SIR values of ICUs between 2019, 2020, and 2021 were compared, the rate was significantly higher in 2020 (p<0.05). A significant increase was found in hand hygiene compliance in 2021 compared with previous years (p<0.05).

Conclusion: With the COVID-19 pandemic, an increase in CLBSI-SIR was observed in 2020. In 2021, a decrease in CLBSI-SIR and an increase in hand hygiene compliance were achieved by gaining experience in the follow-up and treatment of patients with COVID-19, implementing infection control programs, and conducting on-site training and inspections.

Keywords: COVID-19, central line-associated bloodstream infection, standardized infection ratio, infection control, hand hygiene

Cite this article as: Arslan Gülen T, Turunç T, Oruç E, Şahin Eker HB. The Impact of COVID-19 on Central Line Bloodstream Infections Standardized Infection Ratio in Intensive Care Units: A 3-year Surveillance Data. Mediterr J Infect Microb Antimicrob. 2022;11:45.

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Received/Geliş Tarihi: 08.06.2022 **Accepted/Kabul Tarihi:** 05.12.2022 **ORCID ID:** orcid.org/0000-0001-5706-9824

Published: 8 December 2022

Öz

Giriş: Sağlık hizmeti ilişkili enfeksiyonlar, Koronavirüs hastalığI-2019 (COVID-19) pandemisi döneminde enfeksiyon kontrol önlemlerine uyumda yetersizlik nedeniyle artış göstermiştir. Santral kateter ilişkili kan dolaşımı enfeksiyonları da (SKİ-KDE) artış gözlenen enfeksiyonlardan biridir. Bu çalışmada, 3 dönemdeki SKİ-KDE standardize enfeksiyon oranı (SIR) verileri karşılaştırılarak COVID-19 pandemisinin yoğun bakım ünitelerinde (YBÜ) gözlenen SKİ-KDE üzerine olan etkisinin değerlendirilmesi amaçlanmıştır. Aynı döneme ait el hijyeni uyum oranları da irdelenmiştir.
Gereç ve Yöntem: On iki erişkin YBÜ'lerindeki 3 yıla ait SIR, standardize araç kullanım oranı (SUR) ve yıllar arasındaki SIR değişiklik oranları hesaplanarak ve 2019, 2020 ve 2021 yıllarının karşılaştırması yapıldı. Hesaplamalar Türkiye Halk Sağlığı Genel Müdürlüğü Bulaşıcı Hastalıklar Dairesi tarafından hazırlanan SIR ve SUR hesaplama aracı üzerinden yapıldı. Dönemler arası SIR/SUR değişiklik oranları hesaplanırken [(Y yılına ait SIR/SUR - X yılına ait SIR/SUR) / X yılına ait SIR/SUR x 100)] formülü kullanıldı.
Bulgular: 2019 ve 2020 yılında, sadece yanık YBÜ'de SIR >1 olarak tespit edildi. Anesteziyoloji ve Reanimasyon-1, 2 ve Dahiliye-3 YBÜ'ler 2020 yılında SIR artış oranı en yüksek olan YBÜ'ler idi. 2021 yılında ise tüm ünitelerin SIR <1 olarak saptandı. Anesteziyoloji and Reanimasyon-2, Dahiliye-1, 3 ve Kardiyovasküler Cerrahi YBÜ'de tüm dönemlerde SUR >1 idi. 2019, 2020 ve 2021 yıllarındaki YBÜ'lerin SIR ortalaması karşılaştırıldığında 2020 yılında oran anlamlı yüksek idi (p<0,05). 2021 yılında önceki yıllara göre el hijyeni uyumunda anlamlı artış olduğu bulundu (p<0,05).
Sonuç: COVID-19 pandemisi ile 2020 yılında SKİ-KDE değerlerinde artış izlenmiştir. 2021 yılında ise COVID-19 tanılı hastaların takip ve tedavisinde tecrübe kazanılması, enfeksiyon kontrol programlarının uygulanması, yerinde eğitim ve denetimlerin yapılması ile SVK-KDE SIR'da azalma ve el hijyeni uyumunda artış sağlanmıştır.

Anahtar Kelimeler: COVID-19, santral kateter ilişkili kan dolaşımı enfeksiyonu, standardize enfeksiyon oranı, enfeksiyon kontrolü, el hijyeni

Introduction

Healthcare-associated infections (HCAIs) cause significant cost increases, mortality, and morbidity and are preventable infections as a result of the implementation of infection control measures. Hospital-initiated HCAIs also have special importance because they are an indicator of healthcare quality. During the Coronavirus disease-2019 (COVID-19) pandemic, HCAI has increased because of the increase in the number and workload of patients followed up in hospitals, especially in intensive care units (ICUs), assignment of trained personnel in this regard to other places, or contracted. During the pandemic, COVID-19 cases were followed more closely, standard clinical practices were changed, the use of protective equipment increased, and adequate equipment could not be provided in some countries and centers, especially in the early period of the pandemic. In addition, since the replacement of equipment takes time, compliance with infection control measures in the transition from patient to the patient had decreased. Fear of being infected among healthcare workers also contributed to this increase[1,2].

The risk of HCAIs can vary greatly between hospitals, depending on the characteristics of the patients and their services. For example, healthcare facilities serving older people or patient populations with more complicated conditions may have higher HCAI rates[3]. To make a more objective comparison between health institutions, a new criterion called "standardized infection ratio" (SIR) was developed by the American Center for Disease Prevention and Control (CDC) based on the patient characteristics assumed for each health facility and the type of services provided. The SIR compares the actual reported number of HCAIs with the estimated or expected number, given the standard population. A SIR >1.0 indicates more HCAIs observed than expected, whereas SIR <1.0 indicates that less HCAI is observed[4]. The standardized utilization ratio (SUR) is a summary measure used to track device use at a national, state, local, or facility level over time. The SUR adjusts for various facility and location factors contributing to device use[5].

The CDC and the American National Healthcare Safety Network (NHSN) stated an increase in central line-related bloodstream infections (CLBSIs), especially in the early period of the pandemic, and the results of previous studies also support this[6-8]. Based on these data, this study aimed to evaluate the SUR, CLBSI-SIR, and cumulative attributable difference (CAD) in our ICUs in 2019, 2020, and 2021 and to reveal the effect of the pandemic on CLBSIs.

Materials and Methods

Study Design

A total of 12 adult ICUs with 161 beds in a tertiary training and research hospital were analyzed in the study (Anesthesiology and Reanimation-1, 2, 3, Internal Medicine-1, 2, 3, Burn, Neurosurgery, General Surgery, Cardiovascular Surgery, Neurology, and Coronary). In the ICUs, the number of patients, patient days, central catheter days, and CLBSI numbers obtained through active surveillance by our hospital infection control committee (ICC) were recorded in the national surveillance system for each ICU. CLBSI diagnosis was made according to the CDC/NHSN definition[9]. Moreover, 2019 was determined as the year before the pandemic, 2020 as the first year of the pandemic, and 2021 as the second year of the pandemic. CL-SUR, CLBSI-SIR, and CAD for each ICU in 2019, 2020, and 2021 were calculated retrospectively using ICC data. SIR was calculated by dividing the number of infections observed by the number of infections predicted. The number of predicted infections was calculated using multivariate regression models constructed from data collected nationally over a baseline period. These models were applied to a facility's denominator and risk factor data to generate an estimated number of infections (SIR=Observed HAIs-predicted HAIs)[4]. The SUR was calculated by dividing the number of observed device days by the number of predicted device days. The number of predicted device days was calculated using multivariable logistic regression models generated from nationally aggregated data during a baseline period. These models were applied to a facility's denominator data to generate a predicted number of device days (SUR=Observed device days-predicted device days)[5].

The calculation was made using the SIR and SUR calculation tools prepared by the Infectious Diseases Department of the General Directorate of Public Health of Turkey[10].

The following formula was used when calculating the SIR/SUR change rates between periods:

[(SIR/SUR of Y year-SIR/SUR of X year) / SIR/SUR of X year x 100)]

The ICUs included in the study are the units where COVID-19 cases are followed up periodically, and in this study, CLBSIs detected in the 1 year before the pandemic, the first year of the pandemic, and the second year of the pandemic was evaluated based on SIR and SUR. The effect of the COVID-19 pandemic on CLBSIs was revealed based on periodic SIR and SUR changes.

Statistical Analysis

Data were analyzed using IBM Statistical Package for the Social Sciences Statistics version 22.0 (IBM Corp., Armonk, NY, USA). Continuous variables were evaluated for normal distribution using the Shapiro-Wilk test. Categorical variables were expressed as frequency (n) and percentage (%), continuous variables that met the assumptions for parametric tests were presented as mean and standard deviation, and those that did not were presented as median, minimum, and maximum values. The paired t-test was used to compare normally distributed numerical data obtained from two dependent groups, and the Wilcoxon signed-rank test was used to analyze data that did not follow the normal distribution.

Results

A total of 12093 patients, 49932 patient days, 22588 central line days, and 50 CLBSIs were followed in 2019 (Table 1). In 2020, 9739 patients, 48115 patient days, 21672 central line days, and 62 CLBSIs were followed (Table 2). In 2021, 11671 patients, 55924 patient days, 25157 central line days, and 23 CLBSIs were detected (Table 3). For 2019 data, the SIR was found to be statistically significantly >1 in the Burn ICU, and the number of observed infections was higher than expected. In other ICUs, the SIR was <1 (Table 1). In the same year, SUR values were statistically significantly >1 in Anesthesiology and Reanimation 2, Internal Medicine 1, Internal Medicine 2, Cardiovascular Surgery, and Coronary ICUs (Table 4).

In 2020, although the Burn ICU had SUR <1, the CLBSI-SIR was statistically significantly >1 (Tables 2, 4). Especially with the pandemic, while the SUR was significantly higher in Anesthesiology and Reanimation 2, Internal Medicine 1, 2, and 3 ICUs, the SIR values were <1. However, considering the periodic SIR change rates, the SIR values of Anesthesiology and Reanimation 1 and 2 and Internal Medicine 3 ICUs increased by 89.5%, 96.3%, and 78.9%, respectively, in 2020. When the SUR

Table 1. January-December 2019; standardized infection ratio, cumulative attributable differences, and other surveillance data

Intensive care units	Number of patients	Patient days	Central line days	Observed infections	Expected infections	SIR	95% Odds ratio	p value	CAD
Reanimation 1	302	3638	1798	2	10.3	0.19	0.02-0.70	<0.05	-5.72
Reanimation 2	295	3629	2605	4	15	0.27	0.07-0.68	<0.05	-7.25
Reanimation 3	196	3621	2050	13	13.4	0.97	0.52-1.66	>0.05	2.95
Internal Medicine 1	341	3445	1833	3	7.9	0.38	0.08-1.10	<0.05	-2.96
Internal Medicine 2	308	3146	786	6	8	0.75	0.28-1.64	>0.05	0.03
Internal Medicine 3	252	3615	2345	6	11.1	0.54	0.20-1.18	>0.05	-2.32
Burn	78	2089	424	9	1.8	5.15	2.35-9.78	**<0.05**	7.69
Brain-neurosurgery	673	5341	1214	3	3.4	0.88	0.18-2.58	>0.05	0.46
General surgery	1735	5050	1223	1	3.1	0.32	0.00-1.81	>0.05	-1.31
Cardiovascular surgery	1757	5107	5000	2	12.6	0.16	0.02-0.57	<0.05	-7.45
Neurology	28	301	74	0	0.3				
Coronary	6128	10950	3236	1	11.8	0.08	0.00-0.47	<0.05	-7.86

SIR: Standardized infection ratio, CAD: Cumulative attributable differences

differences between 2019 and 2020 were examined, Internal Medicine 2 ICU had the highest difference rate with 86.4% (Table 5). Since no infection was detected in the Neurology ICU in 2019, the SIR and change rate in SIR could not be calculated. A negative CAD means that the target of a 25% reduction in CLBSIs has been met or even exceeded. Accordingly, CLBSIs decreased in line with the target in 2020 compared with 2019 in units other than Burn, Reanimation 2, Internal Medicine 2, Neurosurgery, and Neurology ICUs.

In 2021, given the increase in the CLBSI-SIR in 2019 and 2020, a decrease in the SIR was achieved in ICUs in 2021 compared with that in 2019 (Table 3). In the Burn ICU, which had a statistically significantly CLBSI-SIR value >1 in the previous two periods, no significant elevation was detected in the third period. The SUR value was >1 in Anesthesiology and Reanimation 2, Internal Medicine 1, Internal Medicine 3, and Cardiovascular Surgery ICUs in all three periods (Table 4). When the SIR difference ratios between 2020 and 2021 were examined, a decrease was observed in the CLBSI-SIR difference ratios in ICUs other than Cardiovascular Surgery and Neurology ICUs; however, considering the CAD values, the target of at least a 25% reduction was achieved in 2021 (Tables 3, 5).

The SIRs (median, minimum-maximum) of the ICUs for 2019, 2020, and 2021 were 0.38 (0.08-5.15), 0.60 (0.20-4.75), and 0.25 (0.08-2.04), respectively. When the SIR values between 2019-2020 and 2020-2021 were compared, a statistically significant difference was found in both comparisons (p=0.045 and p=0.003, respectively) (Figure 1).

Hand hygiene compliance of healthcare workers was evaluated annually. The compliance rate in 2021 was statistically significantly higher than those in 2019 and 2020 (p<0.05).

Table 2. January-December 2020; standardized infection ratios, cumulative attributable differences, and other surveillance data

Intensive care units	Number of patients	Patient days	Central line days	Observed infections	Expected infections	SIR	95% Odds ratio	p value	CAD
Reanimation 1	300	3065	1525	3	8.4	0.36	0.07-1.04	>0.05	-3.31
Reanimation 2	252	3061	1985	6	11.4	0.53	0.19-1.15	>0.05	-2.54
Reanimation 3	274	3021	1750	12	9.8	1.22	0.63-2.14	>0.05	4.64
Internal Medicine 1	331	3664	2317	7	10.2	0.68	0.27-1.41	>0.05	-0.68
Internal Medicine 2	287	3141	1477	8	6.5	1.23	0.53-2.42	>0.05	3.12
Internal Medicine 3	213	3637	2501	5	12.5	0.40	0.13-0.93	<0.05	-4.38
Burn	96	1994	289	5	1.1	4.75	1.53-11.09	**<0.05**	4.21
Brain-neurosurgery	605	4739	1043	4	2.9	1.38	0.37-3.52	>0.05	1.82
General surgery	1419	4883	1690	2	4.3	0.46	0.05-1.68	>0.05	-1.23
Cardiovascular surgery	1220	4126	3838	2	9.8	0.20	0.02-0.74	<0.05	-5.32
Neurology	198	2395	537	3	2.4	1.24	0.25-3.62	>0.05	1.18
Coronary	4544	10389	2720	5	10	0.50	0.16-1.16	>0.05	-2.52

SIR: Standardized infection ratio, CAD: Cumulative attributable differences

Table 3. January-December 2021; standardized infection ratios, cumulative attributable differences, and other surveillance data

Intensive care units	Number of patients	Patient days	Central line days	Observed infections	Expected infections	SIR	95% Odds ratio	p value	CAD
Reanimation 1	352	3819	2160	3	12.1	0.25	0.05-0.73	<0.05	-6.05
Reanimation 2	456	3940	2654	4	13.5	0.28	0.08-0.72	<0.05	-6.63
Reanimation 3	324	4082	2117	1	10.8	0.08	0.00-0.45	<0.05	-8.20
Internal Medicine 1	401	4099	2360	2	12.5	0.20	0.02-0.70	<0.05	-5.69
Internal Medicine 2	327	3363	1961	2	10.4	0.23	0.03-0.85	<0.05	-4.40
Internal Medicine 3	353	3726	2680	1	14.2	0.09	0.00-0.47	<0.05	-7.79
Burn	138	1965	308	2	2.3	2.04	0.23-7.37	>0.05	1.26
Brain-neurosurgery	771	5511	737	2	4.5	0.99	0.11-3.56	>0.05	0.48
General surgery	2319	5316	1759	0	10				
Cardiovascular surgery	1563	5241	5130	2	9.7	0.15	0.02-0.55	<0.05	-7.79
Neurology	254	2869	601	1	3.7	0.37	0.00-2.08	>0.05	-1.00

SIR: Standardized infection ratio, CAD: Cumulative attributable differences

Moreover, no statistically significant difference in hand hygiene rates was found between 2019 and 2020 (Figure 2).

Discussion

The COVID-19 pandemic has brought an extra burden to the healthcare system, causing disruptions in health services. This is greatly reflected in ICUs, and an increase in invasive device-associated infections was observed. More frequent follow-up of patients with COVID-19, advanced age, comorbidity, especially in ICUs, immunosuppression caused by glucocorticoid and interleukin antagonists used in the treatment, and prolonged hospitalization have contributed to the increase in the incidence of HCAIs[11].

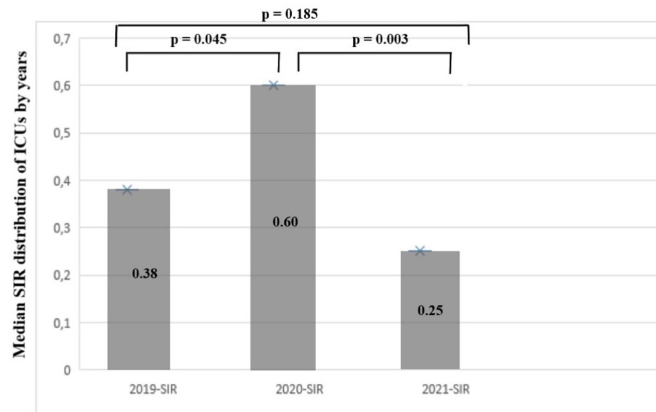

Figure 1. Comparison of the median SIR of ICUs
ICUs: Intensive care units, SIR: Standardized infection ratio

Table 4. Standardized utilization ratios of the central line for 2019, 2020, and 2021

Intensive care units	2019			2020			2021		
	SUR	95% Odds ratio	p value	SUR	95% Odds ratio	p value	SUR	95% Odds ratio	p value
Reanimation 1	0.99	0.94-1.04	>0.05	0.83	0.79-0.87	<0.05	0.94	0.90-0.98	<0.05
Reanimation 2	1.17	1.13-1.22	**<0.05**	1.06	1.02-1.11	**<0.05**	1.14	1.10-1.19	<0.05
Reanimation 3	0.87	0.84-0.91	<0.05	0.96	0.91-1.01	>0.05	0.85	0.81-0.88	<0.05
Internal Medicine 1	1.73	1.65-1.81	**<0.05**	2.02	1.94-2.10	**<0.05**	1.87	1.79-1.94	<0.05
Internal Medicine 2	0.81	0.75-0.87	<0.05	1.51	1.43-1.58	**<0.05**	1.89	1.81-1.97	<0.05
Internal Medicine 3	1.96	1.88-2.04	**<0.05**	1.98	1.91-2.06	**<0.05**	2.32	2.23-2.41	<0.05
Burn	0.30	0.27-0.33	<0.05	0.22	0.20-0.25	<0.05	0.26	0.23-0.29	<0.05
Brain-neurosurgery	0.40	0.38-0.42	<0.05	0.39	0.37-0.41	<0.05	0.24	0.22-0.26	<0.05
General surgery	0.45	0.43-0.48	<0.05	0.64	0.61-0.67	<0.05	0.62	0.59-0.65	<0.05
Cardiovascular surgery	1.83	1.78-1.88	**<0.05**	1.73	1.67-1.78	**<0.05**	1.82	1.77-1.87	<0.05
Neurology	0.79	0.62-0.99	<0.05	0.70	0.65-0.77	<0.05	0.67	0.61-0.72	<0.05
Coronary	1.12	1.08-1.16	**<0.05**	0.98	0.94-1.02	<0.05	0.83	0.80-0.86	<0.05

SUR: Standardized utilization ratios

Table 5. Standardized infection ratio and standardized utilization ratio differences between periods

Intensive care units	2019-2020 SUR difference (%)	2020-2021 SUR difference (%)	2019-2020 SIR difference (%)	2020-2021 SIR difference (%)
Reanimation 1	-16.2	13.3	89.5	-30.6
Reanimation 2	-9.4	7.5	96.3	-47.2
Reanimation 3	9	-11.5	25,8	-93.4
Internal Medicine 1	16.8	-7.4	78,9	-70.6
Internal Medicine 2	86.4	25.2	64	-81.3
Internal Medicine 3	1	17.2	-25.9	-77.5
Burn	-26.7	18.2	-7.8	-57.1
Brain-neurosurgery	-2.5	-38.5	56.8	-28.3
General surgery	42.2	-3.1	43.8	-
Cardiovascular surgery	-5.5	5.2	25	25
Neurology	-11.4	-4.3	-	70.2
Coronary	-12.5	-15.3	525	-40

SUR: Standardized utilization ratios, SIR: Standardized infection ratio

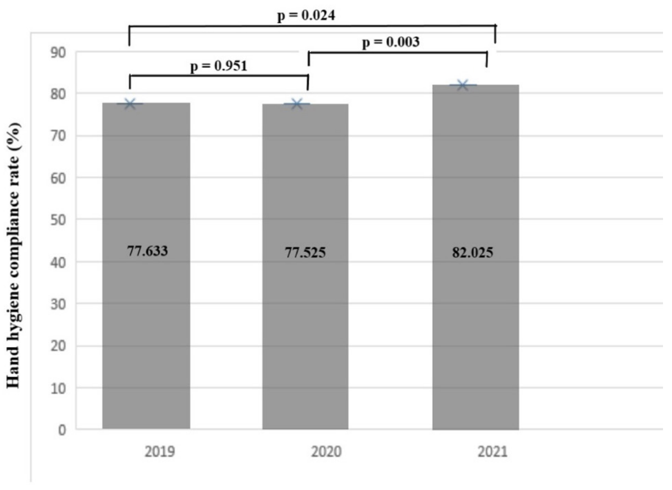

Figure 2. Hand hygiene compliance rates of healthcare professionals working in ICUs by year

ICUs: Intensive care units

In this study, in which we evaluated the effect of the COVID-19 pandemic on CLBSIs in our hospital's ICUs, we found an increase in CLBSI-SIR values in the first year of COVID-19. In the study of Fakih et al.[6], in which they compared the 12 months before the COVID-19 pandemic with the 6 months of the pandemic and evaluated the data of 78 hospitals in the NHSN data network, they found an increase in the rates of CLBSI and SIR values, especially in hospitals with >300 beds. In another study that revealed a change in CLBSIs in the early period of the pandemic, the data for the same quarter of 2019 and 2020 were compared, showing a 28% increase in the CLBSI-SIR value in 2020[7]. Conversely, Alsuhaibani et al.[12] found a decrease in the incidence of CLBSI in the first 6 months of the pandemic and an increase in the peak period of the pandemic. Similarly, a sharp increase in the incidence of CLBSI was observed during the pandemic in a multicenter study in which a center from Turkey participated and the data from seven underdeveloped and developing countries were evaluated[8]. Contrary to these results, a Singapore study with remarkable results found a decrease in the CLBSI rate during the pandemic period when compared with that during the pre-pandemic period[13]. This result was attributed to the easier compliance with infection control measures because of the experience with severe acute respiratory syndrome infection in 2003.

In our study, SIR values were significant >1 in the Burn ICU in the pre-pandemic period and the first year of the pandemic. Burn cases do have impaired defenses against infections because of their injuries, prolonged hospitalizations, hypermetabolic and hyper-catabolic conditions, and higher use rate of invasive devices[14]. Pathogen microorganism colonization is faster because local and systemic immunity is affected. As the total body area surface affected increases, the rate of HCAIs increases[15]. In 2021, although the SUR increased in the Burn ICU, the CLBSI-SIR value decreased. In addition, despite the increase in SUR, a decrease in CLBSI-SIR was observed in the second year of the pandemic in Internal Medicine 2 and Anesthesiology and Reanimation 2 ICUs. The most important reason is that only patients with COVID-19 have been followed up in these ICUs since the beginning of the pandemic.

Given the active role of infectious disease specialists in the management, follow-up, and treatment of COVID-19, serious disruptions occurred in infection prevention and control programs, especially in the first year of the pandemic. Although standard catheter care and follow-up practices were fulfilled in the first year of the pandemic, the CLBSI-SIR increased. Stangerup et al.[17] also showed a significant decrease in hand hygiene compliance among healthcare workers in the first year of the pandemic[16]. In a meta-analysis, the compliance rate of healthcare workers with hand hygiene increased in general during the pandemic period, which has been attributed to the fact that healthcare providers have a strong sense of self-protection. In the ICUs of our health center, although no difference was found between 2019 and 2020, the hand hygiene compliance rate in 2021 increased when compared with the rates in 2019 and 2020. In the second year of the pandemic, the emphasis on training on hand hygiene and other infection control measures and the knowledge and experience of healthcare professionals about COVID-19 contributed to a significant increase in hand hygiene compliance and a decrease in CLBSI-SIR.

Study Limitations

This study was limited by the single-center setting, and the ICUs that became operational during the COVID-19 pandemic could not be included because of the comparison of the pre-pandemic period with the pandemic period. Thus, a study including patient demographics, clinical, and microbiological data, and outcomes can be planned at the next stage.

Conclusion

In the first year of the COVID-19 pandemic in our ICUs, the CLBSI rates and CLBSI-SIR increased. Periodic training and monitoring of compliance with infection control measures are essential in HAI prevention. By focusing on training and inspections, a reduction in CLBSI-SIR was achieved in 2021. In the first period of the pandemic, the compliance rate of hand hygiene has decreased, which forms the basis for infection control measures. Strategies and protocols should be established in order not to adversely affect adherence to infection control measures in ICUs by drawing lessons from the current pandemic.

Ethics

Ethics Committee Approval: The study was approved by the Adana City Training and Research Hospital of Clinical Research Ethics Committee (approval no: 1932/105, date: 10.05.2022).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: T.A.G., H.B.Ş.E., Concept: T.A.G., T.T., Design: T.A.G., E.O., T.T., Data Collection or Processing: H.B.Ş.E., E.O., T.A.G., Analysis or Interpretation: E.O., T.T., Literature Search: H.B.Ş.E., E.O., T.A.G., Writing: T.A.G., E.O., T.T.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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