Research Article

Trends of Transfusion Transmissible Infections among Predominantly Male Blood Donors in Rawalpindi: A Five-Year Retrospective Study

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Abstract

Background: Blood transfusion carry an inherent risk of transfusion transmissible infections (TTIs). Monitoring trends and prevalence of TTIs may reveal crucial information regarding safety of blood supply and donor recruitment strategies.

Objective: To evaluate the critical indicators of blood safety including seroprevalence and temporal trends of hepatitis B virus, hepatitis C virus, human immunodeficiency virus and syphilis among blood donors in Rawalpindi.

Methods: The study was conducted in Armed Forces Institute of Transfusion. The data of 2,78,774 blood donors from 2016-2020 was retrospectively analyzed. Donors' demographics, type of donation, donation frequency and serological results of TTIs were retrieved and analyzed.

Results: Of the 2,78,774 blood donations, 3.6% (n=10,091) blood donors were positive for one or more TTIs. Among these, the most prevalent was HCV (1.5%) and the least prevalent was HIV (0.08%). The seroprevalence of TTIs illustrated a declining trend from 4.2 to 3.4% over the period under study. Regarding trend of each TTI with respect to year, HBV, HCV and HIV depicted fluctuating trend while decreasing trend was observed for syphilis from 2016-2020.

Conclusion: The seroprevalence of four major TTIs was evaluated between the year 2016 and 2020. A decreasing trend in the seroprevalence from 4.2 % to 3.6 % was observed over a five-year period. The HCV remained highest throughout the period whereas a gradual increase in HIV and a decrease in syphilis was observed.

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Introduction

Blood transfusion safety is integral to avoiding transfusion related adverse consequences. The detection of transfusion transmitted infections (TTIs) such as hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV) and syphilis (treponema pallidum) in an asymptomatic blood donor remains a mainstay of transfusion medicine.[1] Unsafe transfusion associated with high morbidity and mortality is a matter of concern in developing countries like Pakistan due to fragmented and under resourced health care systems. However, with a high prevalence of TTIs in general population in Pakistan, improper screening of donated blood under the pretext of limited resources might not be logical, which could cause a massive burden on the

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health care systems in the long run. Effective donor recruitment strategies, sensitive screening assays, and awareness of the self-deferral from donation may assist in enhancing blood safety.[2] The knowledge of the prevalence of TTIs may also assist in assessing blood safety and suggest measures to improve it at the national level. The provision of safe blood products is the responsibility of the blood centers. The regulatory requirements for testing for TTIs are different in different countries. However, in Armed Forces Institute of Transfusion which is a large regional blood bank in Rawalpindi, the WHO criteria was adopted which mandated compulsory testing of HBV, HCV, HIV and syphilis.[2] The more pathogens are tested, the safer the blood product, albeit at a higher cost. In the developed countries, there is a regulatory compulsion to screen blood products for an exhaustive list of TTIs to ensure transfusion safety. In United States of America, the prevalence of TTIs is already low in the general population and a study conducted from 2015 to 2019 in 27.5 million blood donors showed that the prevalence per 100000 donations was 2.6 (HIV),6.3 (HBV) and 19 (HCV).[3] Similarly in the United Kingdom, there were 1.7 million whole blood donations in 2021. A total of 280 TTIs (1 in 6000 donations) were detected and included 78 HBV,37 HCV,9 HIV and 146 syphilis cases.[4]

However, in resource constraint country like Pakistan, the relative basic requirement recommended by WHO were used to establish transfusion safety which included screening for HBV, HCV, HIV and syphilis.[2] The prevalence and trends of these TTIs in blood donors was important in making informed decisions regarding transfusion safety.

Since blood donors are from healthy individuals within a general population, public health interventions like vaccination for HBV, availability of HCV treatment and public knowledge about HIV can lead to a decrease incidence of these diseases overtime. Moreover, TTIs in blood donors can give a cross-sectional view of these diseases in a society.

The prevalence and temporal trends of TTIs may serve as a valuable indicator of the existing preventive strategies to improve blood safety, as the success or failure of any intervention can only be measured from the incidence and prevalence of disease over a longer time period. Therefore, this current study was conducted to evaluate the trends in seroprevalence of TTIs among blood donors over a five-year study period in a regional blood center in Rawalpindi.

Methods

A retrospective descriptive study was carried out at Armed Forces Institute of Transfusion (AFIT), a regional blood center located in Rawalpindi, Pakistan. The study was conducted after approval from the Institutional ethics committee (AFIT-ERC-21-004). On an average, about 60,000 blood donations were collected in this blood bank annually. The study population consisted of all blood donors who donated blood between January, 2016 to December, 2020. The donors were selected according to World Health Organization (WHO) blood donation criteria using a structured questionnaire. A record of 2,78,774 blood donors was reviewed and included in the study. Since this study was conducted to assess the trends of TTIs over a period of five years, therefore all the blood donors reporting during the study period were included. The serum of blood donors was tested for HBsAg, anti-HCV, anti-HIV 1/2 + p24, and anti-treponemal antibodies on chemiluminescence based assay (Architect SR i2000 Abbott Diagnostics, USA). The diagnosis of syphilis was done by using reverse algorithm testing. The testing algorithm for HBV, HCV and HIV include NAT testing for only serologically negative samples which is a standard practice in blood banks. This NAT testing was done on Roche Cobas 6800. The blood donors with any positive serological marker were counselled and referred to concerned physician/gastroenterologist for further treatment. Pre-donation data of all donors such as donor demographic characteristics including age, gender, type of donor (voluntary non-replacement blood donor; VNRBD or family replacement blood donor; FRD), frequency of donation (first time or repeat donor) and serological status of TTIs was retrieved anonymously by preserving donor identity from blood bank records.

The data analysis was conducted by using SPSS v.23.0 (IBM, Chicago, USA). The descriptive statistics were used for qualitative variables (percentages or frequencies) and quantitative variables (mean and standard deviation).

Results

A retrospective evaluation of the 2,78,774 blood donor's data was performed which showed males constituted the predominant donor pool. Out of total, the males constituted the overwhelming majority with 2,76,099 (99.0 %) blood donations. The mean age of donors was 28.1 ±7.6 years, ranging from 18-70 years. Most of the donors were VNRBD, and the remaining were FRD (95.4% vs 4.5%). About 78.2% of total donations were collected from first-time donors. The majority of the donors were in the youngest age group (20-39 years, 92.2%), and least in the eldest age group (40- ≥ 50 years, 7.7%)(Table-1).

A total of 4274 (1.5%) donors were reactive for anti-HCV, 2624 (0.9%) were HBsAg reactive, 231 (0.08%) were anti-HIV 1/2 reactive and 2962 (1.0%) were reactive for anti-treponemal antibodies. Overall, the percentage seroprevalence of TTIs (one or more) was observed as 3.6% (10,091/2,78,774). The most prevalent TTI was HCV (1.5%) and the least prevalent was HIV (0.08%). In our study, a decreasing trend was observed in the overall seropositivity rates of TTIs from 4.2 to 3.4% over a five-year period (Figure 1). The viral TTIs, including HBV, HCV, and HIV, illustrated fluctuating trends which were not marked throughout the years. However, syphilis seroprevalence showed a slightly declining trend from a prevalence of ≥ 1% in 2016 to <1% in 2020 (Figure 1).

The gender distribution showed males had more TTIs than females (3.6% vs 2.4%). The seropositivity rate of all tested parameters was higher in first-time donors, FRD, and in the youngest blood donors aged 20-39 years as compared to other age groups. Table- 3 showed the distribution of blood donors with seropositive TTI status according to various characteristics.

The co-infections were observed in 237 (2.3%) blood donors. Of these, 87 (36.7%) were co-infected with HBV and HCV, 72 (30.3%) presented with HCV and syphilis co-infection, 42(17.7%) were found to be co-infected with HBV and syphilis, whereas HIV and syphilis co-infection was reported only in 16 (6.7%) donors. The overall seroprevalence of multiple infections was 0.08% (237/2,78,774).

Table 1: *Baseline characteristics of blood donors at regional blood center, Rawalpindi (2016-2020).*

Characteristics	Number of Donors N (%)
Age (years)	
<20	26,986 (9.6)
20-29	1,48,119 (53.2)
30-39	81,950 (29.5)
40-49	18,917 (6.7)
≥50	2,802 (1.0)
Total	**2,78,774**
Gender	
Male	2,76,099 (99.04)
Female	2,675 (0.96)
Total	**2,78,774**
Type of Donor	
FRD	266191(95.5)
VNRBD	12583(4.5)
Total	**2,78,774**
Donation Frequency	
First-time Donor	2,18,151 (78.3)
Repeat Donor	60,623 (21.7)
Total	**2,78,774**

Table 2: *Seroprevalence of TTIs among blood donors per year.*

Year of Donation	Annual Donors	Seroprevalence of TTIs n (%)				Total
		HBsAg	Anti-HCV	Anti-HIV	Anti-TP	N (%)
2016	51284	533(1.0)	883(1.7)	41(0.07)	682(1.3)	2139(4.2)
2017	53036	529(0.9)	873(1.6)	50(0.09)	654(1.2)	2106(3.9)
2018	58230	530(0.9)	862(1.5)	50(0.08)	578(0.9)	2020(3.5)
2019	60457	531(0.8)	824(1.4)	39(0.06)	527(0.8)	1921(3.1)
2020	55767	501(0.9)	832(1.5)	51(0.09)	521(0.9)	1905(3.4)
Total	**2,78,774**	**2624**(0.9)	**4274**(1.5)	**231**(0.08)	**2962**(1.0)	10,091(3.6)

Table 3: *Seroprevalence of TTIs among blood donors in relation to various blood donor characteristics (2016-2020).*

Donor Characteristics	N (%)	Seropositive n (%)	HBsAg n (%)	Anti-HCV n (%)	Anti-HIV n (%)	Anti-TP n (%)
Age (years)						
<20	26,986	774(2.8)	334(1.2)	313(1.1)	13(0.05)	114(0.4)
20-29	1,48,119	4,612(3.1)	1390(0.9)	1818(1.2)	119(0.08)	1285(0.8)
30-39	81,950	3,469(4.2)	688(0.8)	1,572(1.9)	82(0.1)	1127(1.4)
40-49	18,917	1065(5.6)	183(0.9)	501(2.6)	14(0.07)	367(1.9)
≥50	2,802	170(6.0)	29(1.0)	70(2.5)	02(0.07)	69(2.4)
Gender						
Male	2,76,099	10026(3.6)	2617(0.9)	4237(1.5)	231(0.1)	2941(1.1)
Female	2,675	66(2.4)	07(0.3)	37(1.3)	00(0.0)	22(0.8)
Donor status						
FRD	266191	9752(3.6)	2538(0.9)	4125(1.5)	222(0.08)	2867(1.1)
VNRBD	12583	339(2.6)	86(0.6)	149(1.2)	09(0.07)	95(0.7)
Donation Frequency						
First time donor	2,18,151	9438(4.3)	2514(1.1)	4021(1.8)	203(0.1)	2700(1.2)
Repeat donor	60,623	653(1.1)	110(0.2)	253(0.4)	28(0.04)	262(0.4)

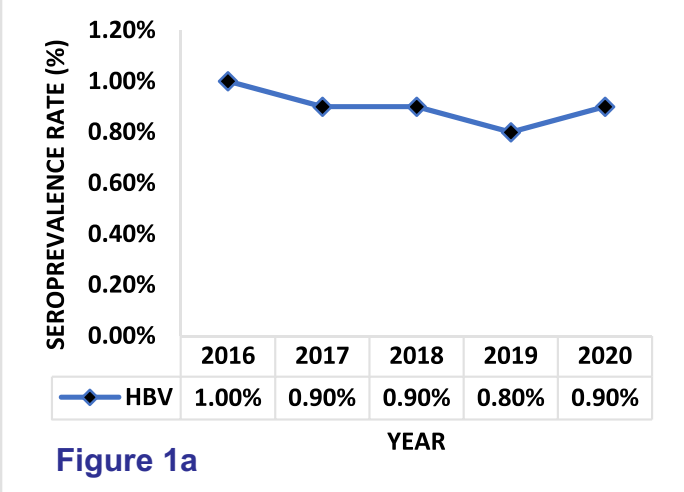

Figure 1a

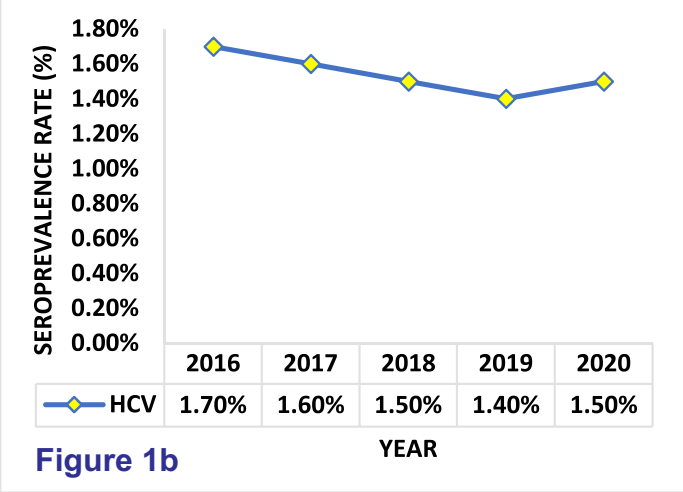

Figure 1b

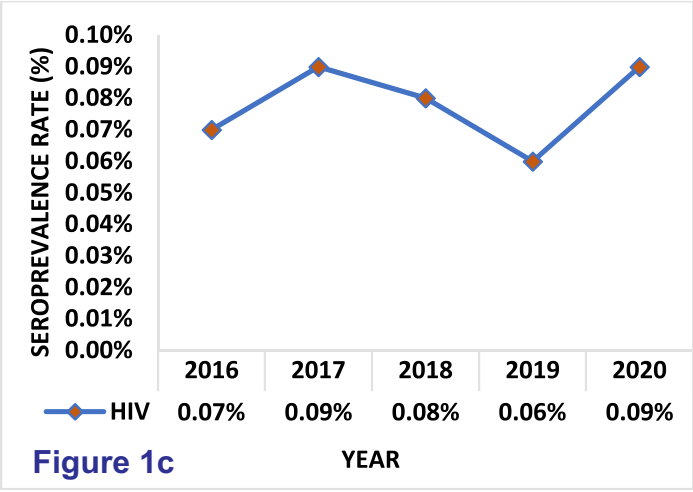

Figure 1c

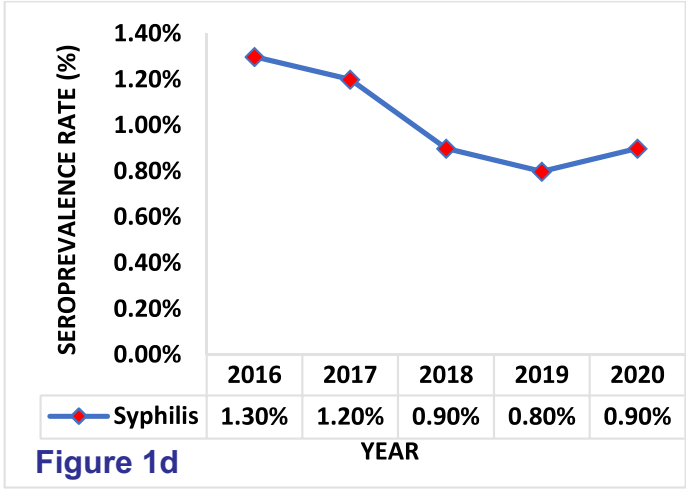

Figure 1d

Figure 1a,b,c,d: *Trends of seroprevalence of TTIs among blood donors at regional blood center over a period of five years (2016-2020).*

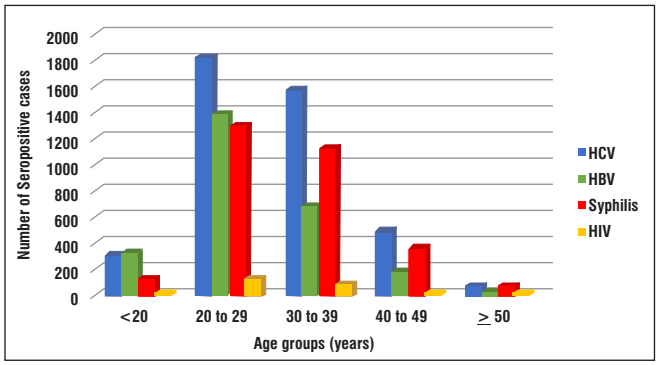

Figure 2: *The distribution of seropositive cases in relation to various age groups.*

Discussion

The overall seroprevalence of TTIs according to results of this study was 3.6% which was less as compared to the prevalence of these diseases in the general population. In this study an overwhelming majority of blood donors were males (99 %) with a mean age of 28 years. The FRD constituted the bulk (95.4%) of donors as compared to VNRBDs (4.5%) which points towards non voluntary blood donors in contrast to international practices.[5] These FRDs can be an additional source of TTIS due to non-voluntary nature of their donation. The first-time donors were 78.2% which showed that blood centers were unable to develop and maintain a pool of VNRBD due to various reasons.[6] The trends of these diseases were stable and no decline was observed despite the fact that HBV is vaccine preventable and newer effective treatments against HCV have become available. The only declining trend was observed in syphilis.

Overall, 3.6% seroprevalence rate for one or more TTIs was observed which was lower than 5.1% reported in a previous regional study from 2010-2012.[7] Similarly, 4-5% seroprevalence rates were shown in studies conducted from 2004 to 2011 from southern and northern regions of Pakistan.[8] The findings of above-mentioned studies corroborate and contrast our current investigation regarding highest HCV infection among other reported TTIs and relatively lower rate of overall seroprevalence respectively. About 2.5% blood donors were found to be reactive in a 3-year study from India.[9] A very low prevalence (1.7%) of TTIs was recorded in a study conducted on Turkish blood donors with HBV being more prevalent which is discordant with the current findings.[10] This could be due to the difference of prevalence of these diseases in the general population. Additionally, majority of donor pool (77%) was comprised of voluntary donors who influence the rate of TTIs to a greater extent.

A similar low TTI rates (2.1%) were reported in an 8-year study conducted on 154038 donors from South West China with overall decreasing trend in prevalence of TTIs.[11] A significantly higher rate for syphilis (0.9%) was observed among other TTIs in female Chinese donors which is attributed to low socio-economic conditions. However, in our study, syphilis was the second most prevalent TTI and more common in males. Another study from southern Iran demonstrated the lowest rate (0.25%) of TTI seropositivity with overall decreasing trend in prevalence rates for tested viral markers from 2004-2014.[12] These findings are in sharp contrast to our study results. However, the study did not include testing of anti-treponemal antibodies and depicts the effectiveness of conducting educational programs regarding transmission routes, prevention of TTIs and implementation of strict donor selection criteria. The results of a five-year retrospective study conducted in Philippines illustrated 4.2% rate of prevalence which was higher than that found in the present study.[13] Moreover, HBV prevalence (2.9%) was detected to be the highest followed by syphilis infection (0.6%). Geographical variation in the prevalence of TTIs is usually observed among different countries and within the regions of the same country which also reflects the burden among blood donors as they are representative part of general population. Hence, populations with high prevalence of viral and bacterial infections may also reveal more positive cases on serological testing. This was best evident from studies conducted in different African countries such as Ethiopians and Nigerians blood donors which showed 6.0% and 15.0% seropositivity rates respectively.[14,15] In developing countries like Pakistan with fragmented blood transfusion system, viral hepatitis was more common than retroviral infections. An estimated chronic carrier rate for HBV was 2-3% whereas the prevalence was 6.2% for HCV.[16,17] Our study illustrated overall 1.5% anti-HCV (n=4274) rate among blood donors within the reported time frame which was the highest among other tested TTIs. This rate was somehow lower than the results of previous local studies. The lower prevalence was attributed to the implementation of

stringent donor selection criteria, training sessions on donor recruitment, verbal screening in addition to questionnaire screening by well-educated and trained staff and the commitment to continuously improve the blood safety. With the availability of very effective new HCV antiviral treatments, the possibility of eliminating HCV from populations is becoming a reality. This will have a direct affect leading to reduced infections in blood donors as well in future.

In Pakistan, the HIV was concentrated mainly in high-risk individuals such as commercial sex workers and injecting drug users which were not a routine part of blood donor pool.[18] The present study showed 0.08% HIV-positive cases which showed a relatively gradual increase from 0.01% HIV-positive donors reported by Ghani et al in the same region.[19] There is difficulty in truthful disclosure of risky behavior by blood donors at the time of donation due to social stigma, especially in the case of FRDs. This emerging threat to blood safety needs an integrated and cross-disciplinary preventive approach to curb its spread. Also, positive healthcare seeking behavior of those donors detected HIV positive by screening assays must be ensured and encouraged to prevent the spread of the disease in the general population.[20]

Syphilis is one of the most common sexually transmitted disease (STD) caused by bacterium Treponema pallidum and is an additional risk factor for HIV infection. According to a global report on STD, 90% of the cases occurred in the developing countries.[21] When compared to the earlier studies conducted by Nazir et al in 2013 and Arshad et al in 2016 in Pakistan, the present seropositivity rate (1.0%) was on the lower side respectively.[22] Hence, downward trend in syphilis infection depicts control in rising syphilis infection over the study period. This trend can also be attributed due to relatively cheap and readily available treatment for the disease. In such cases specific antibodies usually remain positive, whereas nonspecific antibodies disappear indicating treatment success.

The present study revealed that the highest proportion of blood donors were males. The less contribution of females than males towards blood donation could be explained by many physiological factors such as anemia, menstruation and pregnancy which could be a possible reason of their deferral during pre-donation selection and consistent with many literature studies previously done.[23] The consistent highest seropositivity rate in males may suggest greater exposure of males to the various behavioral risk factors as they constitute majority of the working class and were more socially interactive. The risk factors included use of unsterilized razors for shaving, tattoos, drug abuse and multiple sex-partners.[24]

Regarding donation frequency, the repeated donors showed less percentage of TTIs as compared to first-time donors. This could be due to post-donation counselling on TTIs preventive measures and avoidance of risk factors. One of the possible reasons about increased prevalence in first-time donors might be blood donation benefits including screening for TTIs to assess their health status at no cost. Voluntary blood donors were more preferable as they showed markedly reduced TTI prevalence than replacement donors according to WHO. Nonetheless, voluntary donations accounted for only 4.5% of the total donations from 2016-2020 in our study. Therefore, efforts are needed to increase the voluntary donations through donor awareness programs by considering the most accessible and reliable awareness platforms such as social media and internet. Despite the effectiveness of this strategy, at present FRD cannot be discouraged in order to avoid shortage of blood donations. Only when a sustainable pool of voluntary donors has been established, only then the FRD can be phased out.[25]

The differences in the sample size, proportion of volunteer to family replacement donors, serological algorithmic approach, validation and storage of the test kits, methods employed for screening, study duration and strength of donor assessment in the pre-donation setting and the prevalence of TTIs in the general population might be the plausible reason for the difference in seroprevalence rate of TTIs reported in different studies. Moreover, serological detection is just a surrogate maker of TTIs prevalence among blood donors which may overestimate the burden.

The limitations of this study were that it was a single center study and the overwhelming majority of blood donors were males with very few females.

Conclusion

To conclude, seroprevalence of four major TTIs was evaluated between the year 2016 and 2020. A decreasing trend in the seroprevalence from 4.2 % to 3.6 % was observed over a five-year period. The HCV remained highest throughout the period, a gradual increase in HIV and a decrease in syphilis was observed.

These trends can be used to employ mitigating strategies at the level of blood banks and as well as general population to decrease the overall burden of TTIs in blood donors. Also, newer technologies like pathogen reduction and inhibition can also be introduced to strengthen blood safety.

Ethical Approval: The Ethics Review Committee of Armed Forces Institute of Transfusion Rawalpindi approved the study vide certificate number: AFIT-ERC-21-004.

Conflict of Interest: The authors declare no conflict of interest.

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Authors' Contribution:

MAR: Conception & design, analysis & interpretation of data, drafting of article, critical revision for important intellectual content, final approval

AJA: Conception & design, analysis & interpretation of data

IAK: Analysis & interpretation of data, drafting of article

TG: Acquisition of data, Conception & design, analysis & interpretation

NS: Analysis & interpretation of data, proofreading

MAR: Conception & design, analysis & interpretation of data,

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