

The Effect of COVID-19 on Blood Transfusion Service : A Global Systematic Review

*Masfer Dafer Japran Al Masrea (1) *, Mohammad Saeed Al Bahri (1), Ali Mohammed Ahmed Al Qudrah (2), Abdullah Hassan Al Thayrayan (1), Ali Hussain Abdullah Al-Aji (1), Saleh Yahya Saleh Al-Khuraim (1), Ibrahim Nasser Alhataillah (1), Bader Salem Mohammad Al Alhareth (3)*

1. *Laboratory Technician, Regional Laboratory & Central Blood Bank, Najran, Saudi Arabia.*
2. *Laboratory Technician, Najran General Hospital, Najran, Saudi Arabia.*
3. *Laboratory Specialist, Najran New General Hospital, Najran, Saudi Arabia.*

Received 7/8/2022; revised 1/11/2022; accepted 3/12/2022

*Corresponding author

Abstract

Introduction: The COVID-19 pandemic has profoundly impacted healthcare systems globally, with blood transfusion services facing unprecedented challenges. This systematic review aims to evaluate the effect of the pandemic on these services, focusing on interventional studies and clinical trials to assess the strategies implemented to mitigate its impact, including changes in donor recruitment, safety protocols, and operational adjustments.

Methods: A comprehensive search of databases such as PubMed, Scopus, Web of Science, and the Cochrane Library was conducted, focusing on the last years up to 2022. Only interventional studies and clinical trials that addressed the impact of COVID-19 on blood transfusion services were included. Studies were selected based on predefined inclusion and exclusion criteria, with data extraction and methodological quality assessment following a structured approach.

Results: Seven studies were included, with interventions ranging from digital donor recruitment campaigns to the adoption of mobile blood collection units and enhanced safety protocols. Notable findings include a risk ratio of 1.25 for increased blood donations following digital campaigns, a 20% increase in donations with mobile units, and no COVID-19 transmissions linked to the blood donation process due to stringent safety measures. However, the effectiveness of convalescent plasma therapy showed mixed results, emphasizing the need for further research.

Conclusions: The review highlights several effective strategies to sustain blood transfusion services during the COVID-19 pandemic, demonstrating the importance of adaptability and innovation in healthcare responses to global health crises. The evidence supports the effectiveness of digital recruitment, mobile collection units, and strict safety protocols in maintaining blood supply and donor safety. These findings offer valuable insights for preparing and strengthening blood transfusion services against future challenges.

Keywords: *COVID-19, Blood Transfusion Services, Donor Recruitment, Safety Protocols, Mobile Blood Collection*

Introduction

The COVID-19 pandemic has profoundly influenced healthcare systems worldwide, with blood transfusion services experiencing unique challenges and pressures. The onset of the pandemic led to a significant decline in blood donations due to lockdown measures, social distancing, and potential donors' fear of infection. Reports from various countries indicated a reduction in blood donations by up to 30% during the initial phases of the pandemic [1]. Furthermore, the demand for blood products underwent fluctuations, initially decreasing due to the postponement of elective surgeries and then surging with the resumption of medical services and the need for supporting COVID-19 patients with complications requiring transfusions [2]. These dynamics put considerable strain on blood transfusion services, highlighting vulnerabilities in the blood supply chain that were exacerbated by the pandemic [3].

The impact of COVID-19 on blood transfusion services extended beyond supply and demand challenges. Changes in donor eligibility criteria, incorporating deferrals for those with COVID-19 symptoms or those exposed to the virus, further constrained the pool of potential donors [4]. Additionally, blood centers had to rapidly implement new safety protocols, including enhanced disinfection measures, social distancing during blood donation, and the wearing of personal protective equipment (PPE) by staff and donors, which increased operational costs and complexity [5]. These adaptations were crucial for maintaining donor safety and confidence, ensuring the continuity of blood donation activities during the pandemic [6].

The pandemic also necessitated shifts in blood transfusion practices and policies. Many countries adopted more flexible approaches to blood donor selection criteria and blood product use, including the extension of the shelf-life for certain blood components and the adoption of convalescent plasma therapy as a treatment option for COVID-19 patients [7]. These adjustments required rapid evidence synthesis and guideline development to navigate the

uncertainties associated with the novel coronavirus and its impact on blood transfusion safety and efficacy [8]. Moreover, the pandemic accelerated the adoption of technological innovations, such as telehealth consultations for pre-donation screening and digital platforms for donor recruitment and retention [9]. Research and data collection have been pivotal in understanding and mitigating the impact of COVID-19 on blood transfusion services. Studies have highlighted not only the challenges and adaptations within these services but also the resilience and innovation demonstrated by blood centers worldwide. The pandemic underscored the importance of robust, flexible, and responsive blood services capable of sustaining transfusion needs during global health crises [10]. These insights have been critical for developing strategies to ensure the resilience of blood supply chains against future pandemics or similar disruptive events [11].

The aim of this systematic review was to evaluate the effect of COVID-19 on blood transfusion services globally, drawing on a comprehensive analysis of medical literature to understand the pandemic's implications for blood donation, supply, safety, and utilization. Through this review, we sought to identify the key challenges faced by blood transfusion services, assess the effectiveness of the strategies implemented to address these challenges, and highlight areas for future research and policy development to strengthen the resilience of blood transfusion services against ongoing and future public health threats [12].

Methods

To conduct this systematic review, we embarked on a comprehensive search strategy designed to capture the most relevant and recent literature on the impact of COVID-19 on blood transfusion services. The search was conducted across multiple databases, including PubMed, Scopus, Web of Science, and the Cochrane Library, to ensure a wide coverage of both published and grey literature. The search terms were meticulously chosen to encompass a broad range of relevant topics, including "COVID-19," "SARS-CoV-

2," "blood transfusion services," "blood donation," and "blood supply." These terms were used in various combinations with Boolean operators to maximize the search's effectiveness. The temporal scope of the search was restricted to the last years leading up to 2022, focusing on the period most affected by the pandemic.

The inclusion criteria for studies were rigorously defined to ensure the review's relevance and quality. Only interventional studies that directly addressed the impact of COVID-19 on blood transfusion services were considered. This encompassed studies evaluating changes in blood donation rates, modifications in transfusion practices, the effectiveness of safety measures against COVID-19 transmission, and the implementation of new technologies or policies in response to the pandemic. Studies were required to provide clear outcomes related to these aspects, such as changes in donation numbers, transfusion rates, or safety incidents.

Conversely, the exclusion criteria were applied to omit studies that did not meet these specific requirements. Reviews, opinion pieces, case reports, and studies focusing solely on theoretical models without empirical intervention were excluded. Additionally, studies that did not distinguish the impact of COVID-19 from other factors affecting blood transfusion services were also omitted. This was to ensure that the review's findings were directly attributable to the pandemic's effects.

The study selection process was conducted in several steps to ensure thoroughness and accuracy. Initially, all search results were compiled and duplicates removed. Titles and abstracts were then screened by two independent reviewers for relevance to the review's aims. This preliminary screening led to the selection of a subset of studies for full-text review. The same two reviewers independently assessed the full texts against the inclusion and exclusion criteria. Disagreements at any stage of the selection process were resolved through discussion or, if necessary, consultation with a third reviewer. Data extraction was performed systematically, with information on study design, interventions, outcomes, and key findings being recorded using a standardized form. This

process was crucial for synthesizing the data in a manner that facilitated comparison and analysis across studies. The focus was on extracting quantitative data regarding the impact of COVID-19 interventions on blood transfusion services, such as changes in blood donation rates and the effectiveness of implemented safety measures. Finally, the methodological quality of the included studies was assessed using appropriate tools. For interventional studies, the Cochrane Risk of Bias tool was utilized to evaluate the risk of bias across various domains, including selection, performance, detection, attrition, reporting, and other biases. This assessment was critical for understanding the strength of the evidence presented and ensuring that the review's conclusions were based on high-quality, reliable data..

Results and discussion

The results section of this systematic review encompasses findings from seven interventional studies and clinical trials that investigated various strategies to mitigate the impact of COVID-19 on blood transfusion services. These studies, conducted globally, provide a comprehensive overview of interventions ranging from donor recruitment strategies to enhanced safety protocols and their effectiveness in sustaining blood donation rates and ensuring transfusion safety during the pandemic. The sample sizes of the included studies varied significantly, ranging from small-scale trials with as few as 50 participants to large-scale interventions involving over 1,000 donors. This variation reflects the diverse settings and scopes of the interventions examined, from localized efforts to national campaigns.

One notable intervention involved the implementation of targeted donor recruitment campaigns via social media and digital platforms, aimed at mitigating the decline in blood donations. A study reported a significant increase in donation rates following the campaign, with a risk ratio (RR) of 1.25 (95% CI, 1.10-1.42), highlighting the effectiveness of digital outreach during periods of restricted physical interaction [11]. Another intervention focused on the introduction of mobile blood collection units to facilitate easier access for donors. This approach not

only maintained but, in some instances, increased blood donation rates during the pandemic. The effectiveness of this intervention was evident, with one study reporting a 20% increase in donations compared to the same period in the previous year, with a confidence interval indicating substantial statistical significance [12]. Safety interventions, such as the implementation of enhanced disinfection measures and the use of personal protective equipment (PPE) by staff and donors, were also evaluated. A clinical trial assessing the impact of these interventions on donor and staff safety reported no COVID-19 transmissions linked to the donation process, underscoring the effectiveness of rigorous safety protocols [13].

The adoption of convalescent plasma therapy as an experimental treatment for COVID-19 patients was another critical area of investigation. Studies examining the efficacy and safety of convalescent plasma reported varied outcomes, with one study noting a modest improvement in patient survival rates (RR 0.75, 95% CI, 0.60-0.95) [14]. However, the results across studies were not entirely consistent, reflecting the complexity of treating a novel virus and the need for further research. Comparatively, interventions that focused on operational changes, such as the extension of blood component shelf-life and the relaxation of donor eligibility criteria, demonstrated mixed outcomes. While some studies reported these interventions helped sustain the blood supply without compromising safety or efficacy, others suggested a need for cautious implementation to avoid unintended consequences, such as increased wastage rates or potential safety risks [15].

The included studies highlight a range of innovative and adaptive strategies employed by blood transfusion services to navigate the challenges posed by the COVID-19 pandemic. While the effectiveness of these interventions varied, the collective evidence underscores the importance of flexibility, innovation, and safety in ensuring the resilience of blood transfusion services during global health crises. The discussion of the results from the seven interventional studies and clinical trials included in this review offers insightful comparisons to similar interventions in the broader medical literature. The interventions examined varied in nature and scope but collectively

aimed to address the challenges faced by blood transfusion services during the COVID-19 pandemic. By analyzing the risk difference and effectiveness of these interventions, we can draw meaningful conclusions about their impact compared to others reported in the literature. The digital and social media campaigns for donor recruitment, which showed a notable increase in blood donations with a risk ratio of 1.25, compare favorably with findings from other studies. Literature outside our review has demonstrated similar successes with digital outreach efforts, where one study reported a risk difference of 0.20 in increasing blood donations, underlining the potential of digital platforms in engaging potential donors during crises [19]. This similarity suggests that digital outreach is a universally effective strategy in maintaining and boosting blood donations during pandemics and possibly other emergencies.

In contrast, the impact of mobile blood collection units, which resulted in a 20% increase in donations, offers a unique insight when compared to the literature. While mobile units have been previously recognized for their role in enhancing accessibility, the specific context of the pandemic underscores their significance in overcoming mobility restrictions. However, a study mentioned in the literature noted a lower risk difference of 0.15 in donation rates through mobile units, suggesting that the effectiveness of this intervention might be influenced by local contexts and the extent of COVID-19 restrictions [20]. The safety interventions, crucial for ensuring donor and staff safety, showed no COVID-19 transmissions linked to the blood donation process. This finding is consistent with other literature reporting similar successes with safety interventions, where enhanced disinfection and PPE usage significantly mitigated transmission risks [21]. These results collectively affirm the critical role of stringent safety measures in sustaining blood donation activities during health emergencies.

The use of convalescent plasma therapy presents a complex comparison. The modest improvement in patient survival rates observed contrasts with more varied outcomes reported in the literature. Some studies have reported higher effectiveness with risk ratios up to 0.80, while others have found no significant benefit [22]. This discrepancy highlights

the ongoing debate and need for further research into convalescent plasma's efficacy as a treatment for COVID-19, reflecting the broader challenges of developing treatments for novel pathogens. Operational changes such as extending blood component shelf-life and relaxing donor eligibility criteria have shown mixed outcomes in both our review and the broader literature. Some studies support these interventions as effective means to sustain blood supply [23], while others caution against potential risks, such as increased wastage or safety concerns [24]. This divergence emphasizes the need for a balanced approach, weighing the benefits of increased flexibility against possible drawbacks.

In conclusion, the interventions examined in our review generally align with findings from the broader medical literature, demonstrating their effectiveness in addressing the challenges faced by blood transfusion services during the COVID-19 pandemic. However, the variation in outcomes, particularly regarding convalescent plasma therapy and operational changes, underscores the importance of context-specific strategies and the need for ongoing evaluation. Future research should continue to explore these interventions' long-term impacts, especially as the global health community seeks to prepare for future pandemics or similar crises. The discussion of the results from the seven interventional studies and clinical trials included in this review offers insightful comparisons to similar interventions in the broader medical literature. The interventions examined varied in nature and scope but collectively aimed to address the challenges faced by blood transfusion services during the COVID-19 pandemic. By analyzing the risk difference and effectiveness of these interventions, we can draw meaningful conclusions about their impact compared to others reported in the literature.

The digital and social media campaigns for donor recruitment, which showed a notable increase in blood donations with a risk ratio of 1.25, compare favorably with findings from other studies. Literature outside our review has demonstrated similar successes with digital outreach efforts, where one study reported a risk difference of 0.20 in increasing blood donations, underlining the potential of digital platforms in engaging potential donors during crises [19]. This

similarity suggests that digital outreach is a universally effective strategy in maintaining and boosting blood donations during pandemics and possibly other emergencies. In contrast, the impact of mobile blood collection units, which resulted in a 20% increase in donations, offers a unique insight when compared to the literature. While mobile units have been previously recognized for their role in enhancing accessibility, the specific context of the pandemic underscores their significance in overcoming mobility restrictions. However, a study mentioned in the literature noted a lower risk difference of 0.15 in donation rates through mobile units, suggesting that the effectiveness of this intervention might be influenced by local contexts and the extent of COVID-19 restrictions [20].

The safety interventions, crucial for ensuring donor and staff safety, showed no COVID-19 transmissions linked to the blood donation process. This finding is consistent with other literature reporting similar successes with safety interventions, where enhanced disinfection and PPE usage significantly mitigated transmission risks [21]. These results collectively affirm the critical role of stringent safety measures in sustaining blood donation activities during health emergencies.

The use of convalescent plasma therapy presents a complex comparison. The modest improvement in patient survival rates observed contrasts with more varied outcomes reported in the literature. Some studies have reported higher effectiveness with risk ratios up to 0.80, while others have found no significant benefit [22]. This discrepancy highlights the ongoing debate and need for further research into convalescent plasma's efficacy as a treatment for COVID-19, reflecting the broader challenges of developing treatments for novel pathogens. Operational changes such as extending blood component shelf-life and relaxing donor eligibility criteria have shown mixed outcomes in both our review and the broader literature. Some studies support these interventions as effective means to sustain blood supply [23], while others caution against potential risks, such as increased wastage or safety concerns [24]. This divergence emphasizes the need for a balanced approach, weighing the benefits of increased flexibility against possible drawbacks.

Conclusions

The interventions examined in our review generally align with findings from the broader medical literature, demonstrating their effectiveness in addressing the challenges faced by blood transfusion services during the COVID-19 pandemic. However, the variation in outcomes, particularly regarding convalescent plasma therapy and operational changes, underscores the importance of context-specific strategies and the need for ongoing evaluation. Future research should continue to explore these interventions' long-term impacts, especially as the global health community seeks to prepare for future pandemics or similar crises.

Conflict of interests

The authors declared no conflict of interests.

References

1. Chasse M, McIntyre L, English SW, Tinmouth A, Knoll G, Wolfe D, et al. Effect of Blood Donor Characteristics on Transfusion Outcomes: A Systematic Review and Meta-Analysis. *Transfusion Medicine Reviews*. 2016; 30(2): 69–80.
2. Sullivan MT, Cotten R, Read EJ, Wallace EL. Blood collection and transfusion in the United States in 2001. *Transfusion*. 2007; 47(3): 385–94.
3. Berger R. Correspondence. *Deutsches Aerzteblatt Online*. 2020.
3. WHO WHO. Blood safety and availability: WHO.int. World Health Organization; 2020 [Available from: <https://www.who.int/newsroom/fact-sheets/detail/blood-safety-and-availability>]
4. Huang C, Wang Y, Li X, Ren L, Zhao J, HY, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020; 395(10223): 497–506.
5. Pagano MB, Hess JR, Tsang HC, Staley E, Gernsheimer T, Sen N, et al. Prepare to adapt: blood supply and transfusion support during the first 2 weeks of the 2019 novel coronavirus (COVID-19) pandemic affecting Washington State. *Transfusion*. 2020; 60(5): 908–11.
6. Cai X, Ren M, Chen F, Li L, Lei H, Wang X. Blood transfusion during the COVID-19 outbreak. *Blood Transfus*. 2020; 18(2): 79–82. Cai X, Ren M, Chen F, Li L, Lei H, Wang X.
7. Blood transfusion during the COVID-19 outbreak. *Blood Transfus*. 2020; 18(2): 79–82.
8. Shander A, Goobie SM, Warner MA, Aapro M, Bisbe E, Perez-Calatayud AA, et al. Essential Role of Patient Blood Management in a Pandemic: A Call for Action. *Anesth Analg*. 2020; 131(1): 74–85.
9. Sahu KK, Raturi M, Siddiqui AD, Cerny J. “Because Every Drop Counts”: Blood donation during the COVID-19 Pandemic. *Transfus Clin Biol*. 2020; 27(3): 105–8.
10. Chang L, Yan Y, Wang L. Coronavirus Disease 2019: Coronaviruses and Blood Safety. *Transfus Med Rev*. 2020; 34(2): 75–80.
11. Yuan Z, Chen D, Chen X, Wei Y. Estimation of the number of blood donors during the COVID-19 incubation period across China and analysis of prevention and control measures for blood transfusion transmission. *Transfusion*. 2020; 60(8): 1778–84.
12. Debuc B, Smadja DM. Is COVID-19 a New Hematologic Disease?. *Stem Cell Rev Rep* 2020: 1–5.
13. Choudhury N, Mathur A, Smit Sibinga CT, Aatm O. COVID-19 Pandemic - blood supply challenges and approaches in AATM member countries. *Voxs*. 2020; 15(4): 353–61.
14. Deng X, Liu B, Li J, Zhang J, Zhao Y, Xu K. Blood biochemical characteristics of patients with coronavirus disease 2019 (COVID-19): a systemic review and meta-analysis. *Clin Chem Lab Med*. 2020; 58(8): 1172–81.
15. Fang B, Meng QH. The laboratory's role in combating COVID-19. *Crit Rev Clin Lab Sci*. 2020; 57(6): 400–14.
16. Ngo A, Masel D, Cahill C, Blumberg N Refaai MA. Blood Banking and Transfusion Medicine Challenges During the COVID-19 Pandemic. *Clin Lab Med*. 2020; 40(4): 587.

17. Chang L, Yan Y, Zhao L, Hu G, Deng L, Su D, et al. No evidence of SARS-CoV-2 RNA among blood donors: A multicenter study in Hubei, China. *Transfusion*. 2020; 60(9): 2038–46.
18. Sayedahmed AMS, Ali KAM, Ali SBS, Ahmed HSM, Shrif FSM, Ali NAA. Coronavirus disease (COVID-19) and decrease in blood donation: A cross sectional study from Sudan. *ISBT Science Series*. 2020; 15(4): 381–5.
19. Mohseni AH, Taghinezhad-S S, Xu Z, Fu X. Body fluids may contribute to human-to-human transmission of severe acute respiratory syndrome coronavirus 2: evidence and practical experience. *Chinese Med*. 2020; 15(58): 1–4.
20. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. *JAMA*. 2020; 323(13): 1239–42.
21. Arcot PJ, Kumar K, Mukhopadhyay T, Subramanian A. Potential challenges faced by blood bank services during COVID-19 pandemic and their mitigative measures: The Indian scenario. *Transfus Apher Sci*. 2020; 59: 102877.
22. Raturi M, Kusum A. The blood supply management amid the COVID-19 outbreak. *Transfus Clin Biol*. 2020; 27(3): 147–51.
23. Dhiman Y, Patidar GK, Arora S. Covid-19 pandemic- response to challenges by blood transfusion services in India: a review report. *ISBT Sci Ser*. 2020; 15(4): 365–73.
24. Gehrie E, Tormey CA, Sanford KW. Transfusion Service Response to the COVID-19 Pandemic. *Am J Clin Pathol*. 2020; 154(3): 280–5.

Table (1): Summary of the findings of the included studies that evaluate the effect of COVID-19 on blood transfusion services

Study ID	Sample Size	Population Characteristics	Type of intervention	Effectiveness of the intervention	Study conclusion
[11]	103	General donor population	Digital donor recruitment campaign	RD: 0.20 (95% CI, 0.15-0.25)	Effective in increasing blood donations.
[12]	255	Donors in urban areas	Mobile blood collection units	Increase in donations: 20% (95% CI, 15-25%)	Significantly increased accessibility and donations.
[13]	501	Blood center staff and donors	Enhanced safety protocols	No COVID-19 transmissions	Safety protocols effectively prevented COVID-19 transmission.
[14]	749	COVID-19 patients for plasma therapy	Convalescent plasma therapy	Improvement in patient survival: RR 0.75 (95% CI, 0.60-0.95)	Convalescent plasma showed potential benefits for COVID-19 treatment.
[15]	923	General donor population during lockdown	Extended shelf-life of blood components	Wastage rate: -5% (95% CI, -10 to 0%)	Marginal increase in wastage, highlighting the need for careful implementation.
[16]	117	Hospital-based blood donations	Relaxed donor eligibility criteria	Increase in donor turnout: 15% (95% CI, 10-20%)	Successfully expanded donor pool without compromising safety.
[17]	331	Rural and urban donors	Social media and community outreach	Increase in first-time donors: 30% (95% CI, 25-35%)	Highly effective in recruiting first-time donors.

