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Impact of the COVID-19 Pandemic on Blood Supply: A Comparative Cross-Sectional Study of the Pre-Pandemic and Pandemic Era

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ABSTRACT

Objective. The study aimed to determine the impact of the COVID-19 pandemic on local blood supply management in the Davao Region, Philippines from 2019 to 2021 through the analysis of trends in blood supply in Davao Region, Philippines.

Methodology. Secondary data from two blood centers in the Davao Region for the years 2019 to 2021 were used to determine the trends on blood donation supply. To evaluate trends, the overall number of blood donors and the quantities of various types of blood components in whole blood, packed red blood cells (PRBCs), fresh frozen plasma (FFPs) and platelet concentrate have been compared between pre-pandemic, pandemic periods and as restrictions eased.

Results. A substantial decrease of 51.6% in the number of blood donors was seen during 2021 in comparison with 2019. The trend in collection by blood components also showed a significant trend from 2019 to 2021, whole blood (200.8%), packed RBCs (37.1%), fresh frozen plasma (113.6%). While the platelet concentrate supply declined by 34.9% from 2019 to 2020, an increase of 10.7% was noted onwards to 2021.

Conclusion. The results demonstrate that during the COVID-19 pandemic, there was a major reduction in donation and supply of blood. The challenges faced by blood banks in ensuring a stable and sufficient blood supply are highlighted by the decrease in the number of donors and by the different trends in the supply of blood components. The targeted efforts to promote blood donation and enhance the resilience of the blood supply during and after the pandemic is important.

Key words: COVID-19 pandemic, blood donors, Philippines, fresh frozen plasma, whole blood, packed RBC, platelet concentrate, Davao City

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INTRODUCTION

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) of the *Coronaviridae* family was detected on January 7, 2020, following the discovery of a pneumonia outbreak that had been reported on December 31, 2019, in Wuhan, Hubei Province, China.[1] The World Health Organization (WHO) classified the COVID-19 pandemic new coronavirus outbreak a global pandemic on March 11, 2020.[2] The Filipino community was extremely alarmed as soon as the first patients who tested positive for COVID-19 pandemic were detected.[2] The priority of the healthcare system has changed to treating people who may be contaminated with COVID-19 pandemic and putting plans in place for patients to be tested as directed by the World Health Organization.[3] Due to the perceived contagion risk and progressively difficult circumstances (i.e., easing and tightening of restrictions), this might especially affect blood donation behavior and lead to a decrease in perceived capacity and eligibility to donate blood.[3]

In many regions of the world, blood donation centers have largely shut down.[4] Donors who engage in social isolation or self-quarantine are dwindling. As concerns about the safety of blood linger, drastic public health activities have concentrated on containment and "flattening the curve" while priceless resources are being severely depleted.[6]

Although the virus primarily causes mild to severe respiratory illnesses, the possibility of transmission through transfusion should be considered. Most blood banks or blood centers in China have implemented the following measures to combat the current outbreak: calling back all blood donors and asking them about their current physical condition as well as asking additional questions about whether the donors or their relatives have recently traveled to areas with local transmission (Wuhan or Hubei Province).[7]

According to the Chief Executive Officer of the New York Blood Center, during these times, the outbreak caused companies, schools, and religious organizations to close, interrupting almost 75% of the incoming blood supply.[8] In the United Kingdom, transfusion specialists are responding to erratic patterns of blood component demand, declines in donation rates, and the loss of critical staff due to illness.[8] The blood transfusion services (BTS) in the region of Saudi Arabia are dependent on hospital blood banks, which are in charge of blood supplies and blood testing, at the donor centers of King Khalid University Hospital Blood Bank and King Saud University Students Health Center in Riyadh, direct donation (mostly from patients' relatives), voluntary unpaid donors, and mobile blood drives are the main sources of given blood.[9]

The pandemic had an impact on clinical transfusion as well as pre-transfusion testing in labs in China.[10] The appropriate changes were made to deal with the circumstances. As a result, the availability of blood and blood products continues to be a bottleneck in the clinical work of hospitals, especially for people needing regular blood transfusions due to blood disorders like thalassemia, sickle cell anemia, hemophilia, obstetric patients, cancer patients, and others in dire need, such as victims of accidents, who need blood products on an emergency basis.[10] In all branches of medicine, blood transfusions are a necessary component of medical care. The adequate and safe supply of blood to meet patient needs became a major worry with the spread of the COVID-19 pandemic.[11] Indeed, the pandemic has had a hugely negative effect on the blood community by decreasing the number of donations, thus, influencing blood transfusion services worldwide.[12]

In the Philippines, the first case of COVID-19 pandemic was detected in January 2020 and a total of 460,000 infections were reported by the end of 2020.[13] On March 15, 2020, the virus made its way to the Davao Region after the first instance of the illness was identified in Davao del Norte, Tagum City.[14] By that time, Davao City and all the provinces have at least one verified COVID-19 pandemic case each. As a result, several strategies were maintained to restrain and slow the virus's spread. These might involve wide-scale lockdowns, intervals of quarantine, regular hand washing, and social seclusion. Although the number of cases has undoubtedly decreased in 2020 as a result of these policies, they have also had an impact on the supply and demand of the economy as well as the availability of medicine and other necessities for health. Blood supply is one component that must be measured because of the need for this supply to all other processes. Assessing and managing blood supply is a critical component of the pandemic response, as it helps ensure that healthcare systems can meet the increased demand for blood products and maintain the safety and integrity of the blood supply chain. Effective blood supply management is essential for saving lives and providing necessary medical care during public health crises like the COVID-19 pandemic.[15]

It is important to carefully monitor the supply of blood during these uncertain times to prevent significant interruptions in blood reserves, which could have severe ramifications for healthcare systems.[16] Blood services are finding it difficult to keep their inventory in check during the current COVID-19 pandemic since it is a perishable good with a very limited shelf life.[4] Since local settings have adopted comparable blood donation practices from other nations, it is critical to assess the blood supply.[17] There is currently limited information available regarding the early impact of COVID-19 pandemic focusing on blood donation in the Philippines. As a result, the current investigation was undertaken.

This study aims to determine the impact made by the COVID-19 pandemic on blood supply. The results of this study will fill in any information gap and will lead to the understand the importance of availability of blood products to clients of Davao Blood Center Philippine Red Cross - Davao City Chapter. Furthermore, this study intends to derive crucial lessons for blood supply management both now and in the future. Moreover, the outcome of this study can be used by concerned institutions in making a contingency plan in times of emergency, calamity or pandemic in the Davao Region and the Philippines in general.

METHODOLOGY

The study utilized a double-center retrospective study to determine the impact of COVID-19 pandemic on blood supply. Secondary data were collected from the Philippine Red Cross - Davao City Chapter and Davao Blood Center for the years 2019 to 2021. The collected data included the following: Number of Whole Blood, Number of PRBCs, Number of FFPs, and Number of Platelet concentrate.

The study included the blood collected, screened, and fit for distribution. This also included the blood collected as Whole Blood and processed into Packed Red Blood Cell, Platelet Concentrate, and Fresh Frozen Plasma. Excluded in the study were the blood collected that did not pass the quality standards of the blood facility for distribution. This study does not also include the blood collected that is reactive for the serologic tests done in the blood facility as well as Plasmapheresis.

After obtaining ethical approval from the Davao Center for Health Development Joint Research Ethics Committee (DCHD JREC) of the Southern Philippines Medical Center, the study was conducted by the principal investigator. A retrospective blood collection records review from the year 2019 to 2021 was done for the data collection. The principal investigator ensured the completeness of the record. The type of blood products such as packed red blood cell (PRBC), number of fresh frozen plasma (FFP), and number of platelet concentrate (PC) were noted for

comparison across the study groups. All data were encoded in Microsoft Excel for tabulation and organization.

All data were tabulated for organization and were analyzed using statistical tool SPSS. Categorical variables were summarized using frequencies, ratios, and proportions, along with the 95% confidence interval. Continuous variables were summarized using mean and standard deviation. Qualitative variables were computed using Pearson Chi-square and Fisher's exact test and reported as frequency (%). Quantitative variables were compared using non-parametric Mann-Whitney or Kruskal-Wallis test and reported as mean and standard deviation. A p-value of 0.05 was set as significant.

RESULTS

The total number of donors, whole blood, PRBC, FFP, and platelet concentrate distribution from 2019 to 2021 in Davao Blood Center and Philippine Red Cross - Davao City Chapter, Blood Center was recorded (Table 1).

The p-values of all components are less than 0.01 showing a highly significant result. There was a significant result in terms of total donors, whole blood, PRBC, FFP, and platelet concentrate distribution from 2019 to 2021 in Davao Blood Center. For the number of Total donors, there was a drop of 33% from 2019 to 2020 or equivalent to a reduction of 10,802 donors. For the number of Whole Blood, there was a drop of 147% from 2019 to 2021 or equivalent to a reduction of 3,015 donors. For the Number of PRBCs, there was a drop of 26% from 2019 to 2021 or equivalent to a reduction of 7,787 donors. For the number of FFPs, there was a drop of 37% from 2019 to 2021 or equivalent to a reduction of 1,442 donors. For the number of Platelet concentrate, there was a drop of 15% from 2019 to 2021 or equivalent to a reduction of 2091 donors (Table 2).

The total donors, whole blood, PRBC, FFP, and platelet concentrate distribution from 2019 to 2021 in the Philippine Red Cross - Davao City Chapter reflected a p-value of less than 0.01 proving a highly significant result. For the number of Total donors, there was a drop of 264% from 2019 to 2021 or equivalent to a reduction of 7,408 donors. For the number of whole blood, there was a drop of 317% from 2019 to 2021 or equivalent to a reduction of 2,980 donors. For the number of PRBCs, there was a drop of 247% from 2019 to 2021 or equivalent to a reduction of 4,131 donors. For the number of FFPs, there was a drop of 6235% from 2019 to 2021 or equivalent to a reduction of 3,055 donors. For the number of platelet concentrate, there was a drop of 233% from 2019 to 2021 or equivalent to a reduction of 3920 donors (Table 3).

The p-values of all components are less than 0.01 showing a highly significant result on the total donors, whole blood, PRBC, FFP, and platelet concentrate distribution from 2019 to 2021 from both blood centers in Davao City. For the number of total donors, there was a drop of 201% from 2019 to 2021 or equivalent to a reduction of 5,995 donors. For the number of PRBCs, there was a drop of 37% from 2019 to 2021 or equivalent to a reduction of 11,918 donors. For the number of FFPs, there was a drop of 114% from 2019 to 2021 or equivalent to a reduction of 4,497 donors. For the number of platelet concentrate, there was a drop of 39% from 2019 to 2021 or equivalent to a reduction of 6,011 donors (Table 4).

In Davao Blood Center, for 2020, it is noted that among the years indicated, 2019 had the greatest number of blood donors, followed by 2021, and the least number of donors in 2020. In the Philippine Red Cross - Davao City Chapter, Blood Center in 2020, the highest number of donors was registered, followed by 2020 and 2021 respectively. Before the pandemic, the highest number of donors was registered in 2019, followed by 2021 and 2020 respectively. The earliest phase of the pandemic saw the lowest number of donors.

Table 1. Total donors, whole blood, PRBC, FFP, and platelet concentrate distribution from 2019 to 2021

Davao Blood Center			
Characteristics	**2019**	**2020**	**2021**
Number of Total Donors	43,289	29,276	32,487
Number of Whole Blood	5,061	1,840	2,046
Number of PRBCs	38,228	27,436	30,441
Number of FFPs	5,351	3,307	3,909
Number of Platelet concentrate	15,916	12,101	13,825
Rank	1	3	2
Philippine Red Cross - Davao City Chapter, Blood Center			
Characteristics	**2019**	**2020**	**2021**
Number of Total Donors	10,209	3,520	2,801
Number of Whole Blood	3,919	1,359	939
Number of PRBCs	5,804	1,953	1,673
Number of FFPs	3,104	1,657	49
Number of Platelet concentrate	5,601	1,910	1,681
Rank	1	2	3
Total From Both Facilities			
Characteristics	**2019**	**2020**	**2021**
Number of Total Donors	53,498	32,796	35,288
Number of Whole Blood	8,980	3,199	2,985
Number of PRBCs	44,032	29,389	32,114
Number of FFPs	8,455	4,964	3,958
Number of Platelet concentrate	21,517	14,011	15,506

Table 2. Comparison of blood supply inventory at Davao Blood Center from January 2019 to December 2021

Table	2019	2020	2021	p	2019 vs 2020	2020 vs 2021	2019 vs 2021
Number of total donors	43,289	29,276	32,487	<0.01	-32.4%	11.0%	-25%
Number of whole blood	5,061	1,840	2,046	<0.01	-63.6%	11.2%	-147.4%
Number of PRBCs	38,228	27,436	30,441	<0.01	-28.2%	11.0%	-25.6%
Number of FFPs	5,351	3,307	3,909	<0.01	-38.2%	18.2%	-36.9%
Number of Platelet concentrate	15,916	12,101	13,825	<0.01	-24.0%	14.2%	-15.1%

Table 3. Comparison of blood supply inventory at Philippine Red Cross - Davao City Chapter from January 2019 to December 2021

Characteristics	2019	2020	2021	p	2019 vs 2020	2020 vs 2021	2019 vs 2021
Number of total donors	10,209	3,520	2,801	<0.01	-65.5%	-20.4%	-75.6%
Number of whole blood	3,919	1,359	939	<0.01	-65.3%	-30.9%	-317.4%
Number of PRBCs	5,804	1,953	1,673	<0.01	-66.4%	-14.3%	-246.9%
Number of FFPs	3,104	1,657	49	<0.01	-46.6%	-97.0%	-6234.7%
Number of platelet concentrate	5,601	1,910	1,681	<0.01	-65.9%	-12.0%	-233.2%

Table 4. Comparison of blood supply inventory in Davao City from January 2019 to December 2021

Characteristics	2019	2020	2021	p	2019 vs 2020	2020 vs 2021	2019 vs 2021
Number of total donors	53,498	32,796	35,288	<0.01	-38.7%	7.6%	-51.6%
Number of whole blood	8,980	3,199	2,985	<0.01	-64.4%	-7.2%	-200.8%
Number of PRBCs	44,032	29,389	32,114	<0.01	-33.3%	9.3%	-27.1%
Number of FFPs	8,455	4,964	3,958	<0.01	-41.3%	-20.3%	-53.2%
Number of platelet concentrate	21,517	14,011	15,506	<0.01	-34.9%	10.7%	-38.8%

DISCUSSION

The COVID-19 pandemic has had a significant impact on the supply of blood.[18] Studies have shown that during the pandemic era, there has been a decrease in blood donations, which has resulted in a shortage of blood supply in many parts of the world.

It is worth noting that blood centers have implemented various measures to ensure a safe and adequate blood supply during the pandemic. These include the implementation of social distancing measures, the use of personal protective equipment, and the screening of potential donors for COVID-19 pandemic symptoms.[17]

Indeed, the pandemic has been a major factor in the decline in blood donations around the world. Governments and health authorities have taken steps to prevent the spread of COVID-19 pandemic, including the implementation of social distancing measures. These measures have led to the cancellation or postponement of many blood donation drives, which are usually held in public places such as schools, workplaces, and community centers. This had a negative impact on the number of donors available to the public, as many people have been deterred from donating due to the potential risk of contracting the virus. Additionally, restrictions on travel have also contributed to a decrease in donations, as individuals who usually donate blood while traveling or during vacation periods have been unable to do so. The COVID-19 pandemic brought about a range of changes to healthcare systems around the world, including the introduction of new eligibility criteria for blood donors and the temporary deferral of blood donation for those diagnosed with or in close contact with the COVID-19 pandemic patients.[19] This policy was intended to ensure the safety of donors and recipients, as well as to prevent the spread of the virus. Moreover, the pandemic caused shortages of supplies and equipment in some healthcare facilities, further limiting their capacity to collect and manage blood donations.

In many parts of the world, the pandemic had a significant impact on the supply of blood. One of the main reasons for this is the fear of contracting the virus, which has discouraged people from donating blood. Additionally, many blood drives and donation centers have been canceled or postponed due to restrictions on public gatherings and social distancing guidelines, further reducing the number of blood donations.

As mentioned, blood donations have decreased significantly because of reduced blood drives, social distancing measures, and general hesitation from donors due to concerns about the virus. This problem on shortage of blood supply has affected many areas, making it difficult for healthcare providers to meet the demand for blood transfusions. Moreover, patients with severe COVID-19 may require blood transfusions as part of their treatment, particularly if they experience severe complications such as acute respiratory distress syndrome (ARDS).[8]

Many other patients with various medical conditions also require blood transfusions, such as those undergoing cancer treatment or surgery. The shortage of blood supply has created challenges for healthcare providers in effectively managing their patients' conditions, which can have significant implications for patient outcomes.

The comparative study between the pre-pandemic and pandemic era in a cross-sectional design has highlighted the significant impact of the pandemic on the blood supply. The study has shown that the number of blood

donations has decreased significantly during the pandemic era as compared to the pre-pandemic era. However, it is important to note that this shortage of blood supply is not limited to any specific region but is a global issue that needs to be addressed.[8]

In terms of the collection of different blood components, the pandemic has had varying effects. For instance, the collection of whole blood has seen a decline during the pandemic. The reduction is mainly due to the reduction in blood donation activities caused by restrictions on public gatherings and social distancing guidelines. Hence, decrease in the overall supply of whole blood.

Moreover, the collection of packed red blood cells has also declined during the pandemic era. The widespread outbreak of the virus and subsequent public health measures, such as lockdowns and social distancing, have significantly impacted blood donation drives, resulting in decreased donor participation and reduced availability of blood products such as packed red blood cells. Platelet concentrate collection has also seen a decline, but not as drastically as whole blood. Platelets have a shorter shelf life than red blood cells and need to be used within 5 days of collection. As such, the reduction in platelet donations has resulted in a critical shortage of this component in some regions, making it challenging for healthcare providers to manage patient conditions effectively. Lastly, the collection of fresh frozen plasma has exponentially declined from pre-pandemic to pandemic levels.

In the Philippines, the COVID-19 pandemic has had a significant impact on the blood supply. This study particularly focuses on the Davao Region and is no exception to the effects of the pandemic on the supply of blood. Blood donations have decreased significantly due to social distancing measures, quarantine restrictions, and the reluctance of donors to go to blood donation centers over fears of contracting the virus. To address this issue, the Department of Health has implemented various measures to encourage blood donation, such as setting up blood donation booths in public places, implementing mobile blood donation drives, and launching information campaigns to educate the public about the importance of donating blood.

In the Davao Region, local government units and blood centers have also taken action to mitigate the impact of COVID-19 pandemic on blood supply. The Davao Blood Center, which covers the majority of blood supply in the region, for instance, has implemented a scheduling system for blood donation to ensure that there are enough donors to meet the demand for blood. The Philippine Red Cross-Blood Center has also implemented safety protocols, such as disinfecting equipment and providing personal protective equipment to donors and staff.

Despite these efforts, the blood supply in the Davao Region and the rest of the Philippines remained limited. This can have significant consequences for patients who require blood transfusions for various medical conditions, including COVID-19. The shortage of blood supply can make it difficult for healthcare providers to effectively manage patient.

Overall, the impact of the COVID-19 pandemic on the blood supply has been significant, and more research is needed to understand the long-term effects of the pandemic on blood donation.

CONCLUSION AND RECOMMENDATIONS

This study conforms with most literatures that there is significant decrease in blood supply between the pre-pandemic year of 2019 against the pandemic year of 2020. Moreover, a steady increase is seen as restrictions ease by the year 2021.

The study has gathered valuable information that could have a significant positive impact on blood service facilities, particularly during times of pandemics. First, the study has provided crucial insights and data that can be used by blood service facilities. This information is likely to be related to the challenges faced during pandemics, particularly in regard to blood collection. Such data can be vital for understanding the implications of pandemics on blood supply and the various factors that may affect blood donation rates. Second, by utilizing the information obtained from the study, blood service facilities can make informed decisions and develop strategies to effectively handle blood collection processes during pandemics. This could involve identifying potential obstacles and finding innovative solutions to overcome them. Moreover, contingency plans for blood collection should be constructed. With the insights gained from the study, blood service facilities can create contingency plans specifically designed to tackle issues related to blood collection during pandemics. These plans might include ways to engage with potential donors, ensuring the safety of both donors and staff, and addressing any logistical challenges that might arise during such times. The primary objective of developing contingency plans is to prevent any significant decline in the availability of blood. This is crucial as the demand for blood may increase during pandemics due to medical emergencies, while the willingness of donors to donate might decrease due to fear or restrictions. Lastly, the findings of this study could be used to establish a standardized protocol that blood service facilities can follow during pandemics or similar calamities. This protocol would be based on best practices identified through the study, ensuring a consistent and efficient response to maintain a stable blood supply. The findings could help in offering a data-driven approach to cope with the unique challenges presented during the pandemic. By developing contingency plans and implementing a standard protocol, these facilities can work toward maintaining a stable blood supply even in times of crisis, ultimately saving lives and ensuring better healthcare outcomes for patients.

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AUTHOR DISCLOSURE

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