Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Using automation to manage donor engagement and fine-tune supply and demand during the first year of the COVID-19 pandemic

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ABSTRACT

Background: COVID-19 disrupted blood center operations starting March 2020 and continues to affect donor presentation and blood availability today. The industry mobilized significant resources to collect COVID-19 convalescent plasma (CCP) to treat COVID-19 patients. At the same time, blood centers continued to collect platelets, plasma, and red blood cells (RBCs) to meet the needs of non-COVID-19 patients. The purpose of this study was to quantify how automation was used to fine-tune supply and demand and increase donor engagement during the first year of the pandemic.

Methods: This was a single-center retrospective study of blood collection and donor presentation at a mid-sized US blood center. Data was evaluated from January 1, 2020 through March 31, 2021. Parameters evaluated included donor presentation, platelets per procedure, concurrent RBC and plasma collections per procedure, operator compliance, total donor appointment count, and donor frequency.

Results: With the cancelation of mobile blood drives, fixed sites increased total apheresis procedures by 37% and increased turns per bed by 46% whereas less products were collected per donor. By collecting only what was needed, platelet expiration rate decreased from 6.8% (pre-pandemic) to less than 4%. Donor engagement as measured by donor frequency increased from 1.6 in January 2020 to 1.8 in March 2021.

Conclusions: Using technological advances such as automated blood collection and information systems, the blood center improved donor engagement and avoided collecting a surplus of any one type of blood product over the course of the pandemic

1. Introduction

Blood collection and blood usage were significantly disrupted by the COVID-19 pandemic [1–4]. Blood product demand became unpredictable, especially in the first months following the March 2020 lock down [1–4]. In the early months of the pandemic, blood drives were canceled, donors stopped presenting, and hospitals reduced elective surgeries [3]. Blood centers were also challenged during the COVID-19 pandemic to collect COVID-19 convalescent plasma (CCP). Government agencies, national and regional blood centers mobilized significant resources to collect an unprecedented 500,000 units of CCP in the US [1,5]. While CCP took center stage, blood centers continued to collect whole blood, platelets, plasma, and red blood cells (RBCs) to meet the medical needs of non-COVID-19 patients.

Unpredictability in blood donor presentation and blood product availability continues to be an issue today. Blood centers and the transfusion medicine community continue to adjust donor recruitment and blood product collection strategies to meet patient needs. The purpose of this study was to quantify how automation was used to fine-tune supply and demand at a regional blood center during the first year of the COVID-19 pandemic, which resulted in increased donor engagement.

2. Materials and methods

2.1. Data collection and analysis

This was a single-center retrospective study to evaluate blood

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collection and blood donor presentation at a mid-sized US blood center during the COVID-19 pandemic. Gulf Coast Regional Blood Center serves over 170 health care institutions with over 320,000 whole blood and apheresis collections per year. The blood center employs approximately 700 employees with 17 fixed site locations and typically holds 7000 mobile blood drives per year.

Data was evaluated from January 1, 2020 through August 30, 2020 for apheresis procedure analysis and March 31, 2021 for donor frequency analysis. Data from focus lists and collections on the Trima Accel Automated Blood Collection System (Terumo Blood and Cell Technologies, Lakewood CO) were accessed through the Vista Information System (Terumo Blood and Cell Technologies, Lakewood CO). Gulf Coast collected donor presentation data using procedure dashboard reports to evaluate the frequency and effectiveness of recruitment programs. Blood donors were not given financial compensation for their donation.

2.2. Definitions

For the purpose of this study, platelets per procedure (also known as split rate) is calculated as the total number of platelets units collected divided by the total number of completed apheresis procedures. Single-component procedure rate is calculated as the number of procedures where only one blood product (typically a platelet) is collected divided by the total number of completed apheresis procedures. The plasma components per successful procedure is the total number of plasma products collected concurrently with apheresis platelets divided by the total number of completed apheresis procedures. The RBC components per successful procedure is the total number of RBC products collected concurrently with apheresis platelets divided by the total number of completed apheresis procedures. A Focus list is the prioritization of procedure types (e.g., triple platelet, double platelet plus plasma, double platelet plus RBC) programed into the Vista System and transmitted to all Trima apheresis devices. The platelet expiration rate in this study was calculated as the number of successful donations divided by the number of platelets that expired in-house or shipped to further manufacturing as a non-transfusable product. Donor frequency is calculated as the number of donations per donor. Donor eligibility complied with the US FDA and AABB guidelines.

3. Results

3.1. Blood center operations

Between March 2020 and May 2020, the blood center observed a 52% decrease in RBC demand and a 30% decrease in platelet demand. At the same time there was outpouring of donors who wanted to donate blood. During this period, apheresis platelet collections were intentionally continued to maintain donor appointments and donor engagement. Apheresis collections were restricted to single platelet collections after the daily platelet goal had been met. There was a 46% increase in turns per bed comparing pre to post COVID-19 to accommodate the surge of donors. Apheresis procedures increased by 9.3% and components collected increased by 9.5%.

Fig. 1 depicts the disruption in total donor presentation during the first months of the COVID-19 pandemic representing the uncertainty amid canceled blood drives and lock downs. Fig. 1 includes CCP donors as CCP donors were treated the same as regular blood donors and asked to donate different blood products based on inventory needs. Prior to March 2020, donor presentation was steady. There was a small decrease starting March 8, 2020 when media attention towards COVID-19 intensified. There was a sharp increase in donor presentation between March 17 and 20, 2020 when the Surgeon General encouraged citizens to donate blood. After that initial surge, the blood center transitioned to "appointment only" donations to control the number of donors presenting. Slowly, blood donor presentation recovered back to normal levels by July 2020 while still operating by "appointment only".

As operations adjusted to the uncertainties of blood demand and blood donor presentation prompted by the pandemic, the blood center started a CCP collection program. CCP donors were identified and contacted using a variety of marketing channels. CCP was collected as plasma-only procedures on the Trima Accel system. CCP collections started as early as April 2020 ramping up to 800 apheresis plasma procedures per month by December 2020. A total of 3616 apheresis plasma procedures were performed resulting in the production of 11638 units of CCP (200 mL) between April and December to support COVID-19 patients.

3.2. Fixed sites

Mobile blood drives were completely suppressed for a two-week period in March 2020 and then operated on a limited basis. With reduction in blood supply resulting from decreased quantity of mobile

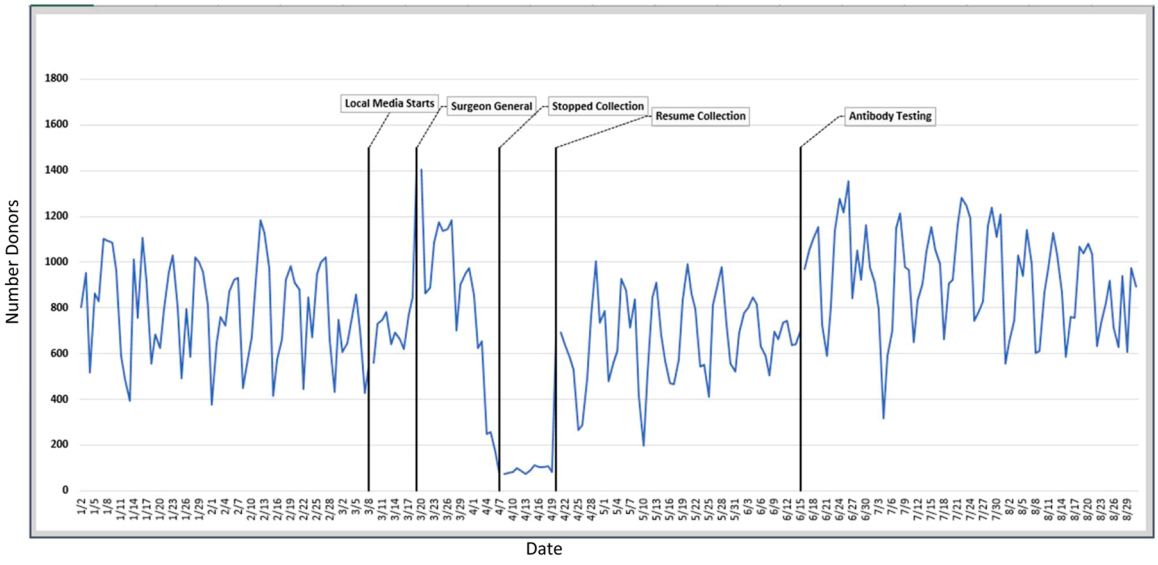

Fig. 1. Daily plot of total number of blood donors (including CCP donors) presenting for donation from January 1 2020 through August 30 2020.

blood drives, the deficit of blood had to be collected at fixed sites. Fig. 2 presents a closer look at daily apheresis collections from March 1 to June 30, 2020. Plasma and RBC collections were suspended for a two-week period (end of March to mid-April 2020) due to canceled elective surgeries resulting in an industry surplus [2,3]. The blood center's goal during this period was to maintain donor engagement, especially for frequent apheresis platelets donors. Donor frequency was maintained by keeping donor appointments and maintaining the same number of donation slots in the blood center's scheduling system. Generally, donor habits and behaviors were not disrupted; there was only one day during this period where no platelet products were collected, which corresponded to the Easter holiday.

While the goal was to maintain apheresis platelet donor appointments and donation habits, collection targets were changed to prevent collecting a surplus of platelets. During this period, apheresis collections were limited to a single platelet unit per donor as reflected in the increase in single-component procedure rate (Fig. 2). Typically, blood centers will maximize the number of blood products collected per donor by apheresis (double platelet or triple platelet collections with concurrent plasma or RBC), however during COVID-19 the blood center made the conscious decision to collect single platelet units to maintain donor engagement. Prior to COVID-19, the single-component procedure rate was maintained below 10%, which ensured that multiple blood products were collected per donor (Fig. 2). Between the end of March to mid-April 2020, the single-component procedure rate increased as high as 60%, meaning that 60% of donors donated a single platelet product. After that, concurrent RBC collections resumed at a higher rate compared to the pre-pandemic timeframe as elective surgeries resumed (Fig. 2). Double RBC collections also resumed at a higher rate in between May and July 2020 to accommodate the surge in elective surgeries (data not shown). Fig. 2 includes the number of collections of concurrent plasma but does not include CCP which was collected during plasma-only procedures on the Trima Accel system.

Fig. 2. Dashboard of apheresis procedures during the period of March 1 2020 to June 30 2020 (a) rate of single-component (typically platelet) collected per successful procedure (b) con-current plasma collected per successful procedure (c) and con-current RBCs collected per successful procedures.

Following the initial focus to maintain apheresis platelet donor engagement in March and April 2020, the blood center strategy shifted to collect only enough products to meet demand. The number of platelet products collected was intentionally set lower than the potential number of platelet products that could have been safely collected from the donor base. Collections 'focus lists' were created, working backward from platelet demand calculated by local demand minus daily percent decrease for in-region hospitals only to determine the number of appointments needed. 'Focus lists' established the priority of product combinations (platelets, plasma, and/or RBC) collected by apheresis from donors based on hospital demand and donor availability. Since the pandemic, on average 10% less apheresis platelet products were collected than what was possible on the Trima Accel system (Fig. 3). By collecting only what was needed, the platelet expiration rate decreased from 6.8% (pre-pandemic) to less than 4%.

The culmination of adjustments made at fixed sites resulted in an increase in total apheresis procedures completed on the Trima Accel system by 37% in 2020 compared to 2019. This corresponded to an increase in Trima Accel utilization from roughly 2000 apheresis procedures per month to 2500–3000 procedures per month in the later months of the pandemic.

3.3. Operator compliance

Prior to October 2020, blood center leadership would communicate the prioritization of what procedures and products should be collected to collections staff on a weekly and sometimes daily basis. The operator could select the optimal procedure offered by the device (typically collecting the most desired blood product types based on donor demographics) or the operator could select a less desirable procedure type. Prior to October 2020, operators had more autonomy into the selection of collection procedure offered on the apheresis device. Prior to the pandemic, the compliance rate (rate at which operators selected the optimal procedure offered by the device) was 80%.

By October 2020, blood center leadership had a clear picture of demand and wanted to collect only what was needed to meet hospital

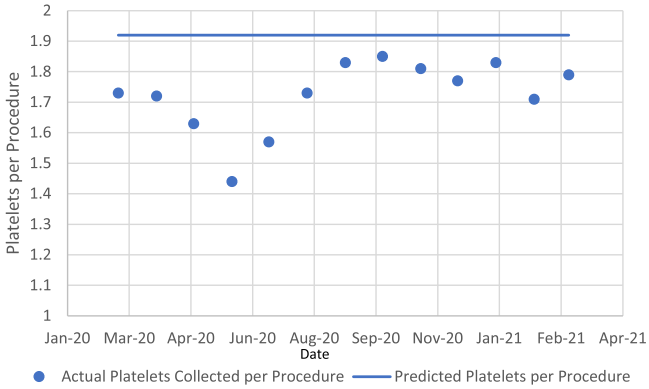

Fig. 3. Actual versus predicted platelets collected per completed apheresis procedure (split rate).

demand. Leadership assumed centralized control of product prioritization and emphasized compliance. Leadership leveraged the Vista Information System ("Vista") to adjust focus lists as needed. Vista transmits focus lists to all Trima Accel devices within the organization instantaneously. For example, in October 2020, triple platelet collections were removed from the focus list to avoid overcollection of platelets.

Proper use of focus lists eliminated the need for leadership to communicate changes in product or procedure priorities to collections staff. Instead, blood center leadership provided clear messaging that collections staff were to collect optimum procedure offered by the device. This eliminated the need for staff to make decisions about collection priorities. Since November 2020, collections staff have achieved almost 100% compliance of operators collecting the optimum procedure offered by the apheresis device.

3.4. Mobile blood drives

There was a 44% decrease in the number of organizations that hosted blood drives in 2020 compared to 2019, corresponding to a loss of 38,652 units (23% of units collected on mobile blood drives). High schools, which routinely host mobile blood drives, decreased participation by 24,780 units and businesses decreased participation by 12,892 units year over year. Leadership responded by increasing community blood drive collections by 12,476 units and church blood drive collections by 10,089 units year over year.

Before COVID-19, 60% of donations (defined as 'needle in the arm' and includes both whole blood and apheresis) were collected in mobile blood drives whereas during early COVID-19, that number dropped to 40%. As of January 2021, 50% of donations are collected in mobile blood drives with the goal to reach 60% again in the future. Despite the disruptions caused by the COVID-19 pandemic, the number of units collected on mobile blood drives was down only 3% in first quarter 2021 compared to first quarter 2020 before the pandemic.

3.5. Donor engagement

Leadership adjusted their donor recruitment strategy to ensure supply met demand while not turning away donors. Mobile donors were recruited to fixed sites through various retention strategies, including tele-recruitment, email communications, texting program, and targeted advertising. Donors were contacted when they become eligible, not just when their associated group would host a blood drive. Donors were converted to donate blood products to meet demand rather than always collecting the same blood products from same donors with a certain blood type. Most donors were eligible to donate something, even new donors who failed to qualify to donate CCP. CCP donors were not treated differently; they were not required to designate interest in donating CCP to pre-qualify before presenting. Donor eligibility, blood type, and product needs were checked when donors arrived irrespective of what the donor intended to donate. Blood donors including CCP donors were not given financial compensation for their donation.

Appointment scheduling management was used to control the flow of donors by location and by device to ensure all donors were processed without collecting excess products. Sixty-four percent (64%) of donors booked their own appointments and donors were generally booking 2–3 weeks in advance. The show rate was 72%. Fig. 4 depicts the total appointment count over the course of 2020.

The primary metric to quantify donor engagement is donor frequency, calculated as donations per donor. Fig. 5 plots the donation frequency as a rolling 12-month average. Donation frequency was 1.6 in January 2020 and reach 1.8 in March 2021, an increase of 12% over the course of the pandemic.

4. Discussion

Gulf Coast Regional Blood Center experienced an outpouring of donors during the COVID-19 pandemic. The primary goal during the COVID-19 pandemic was not to turn away donors, in particular apheresis platelet donors. It has been established that even temporary deferrals hurt future donation behavior [6]. In addition to not turning away donors, appointments were kept to maintain the cadence and habitual behavior of repeat apheresis donors. Leadership also made the intentional decision to collect fewer blood components per donor, which in many cases meant only collecting a single apheresis platelet product. This increased number of turns per bed which increased donor frequency (Fig. 5). In this manner, the blood center was able to maintain donor engagement and avoid collecting a surplus of any one type of blood product.

One primary tool used to ensure that the blood center only collected what was needed was the focus list. Focus lists allow centralized control of the priority of blood products to be collected by apheresis devices. Focus lists were adjusted as needed to match hospital demand. Leadership then provided clear communication that collections staff collected the optimum procedure offered by the apheresis device. The success of this approach was measured by an increase in compliance and a decrease in platelet outdate rate.

Another tool that contributed to the blood center's agility in meeting demand for blood products was use of automation, specifically apheresis. Use of apheresis grew from 16% in 2009 and 35% in 2020. The flexibility of the Trima Accel system, which can collect platelets, plasma or RBC in any combination, helped in the responsiveness of the blood center to collect what was needed including the collection of CCP. During the study period, the apheresis disposable kit use, donor presentation and staff hours remained the same; total number of blood products collected decreased to match hospital demand.

Donor recruitment strategies also evolved to meet the disruption in donor presentation caused by the pandemic. Donors were required to make appointments to control flow, which resulted in almost doubling the total number of appointments compared to pre-pandemic levels.

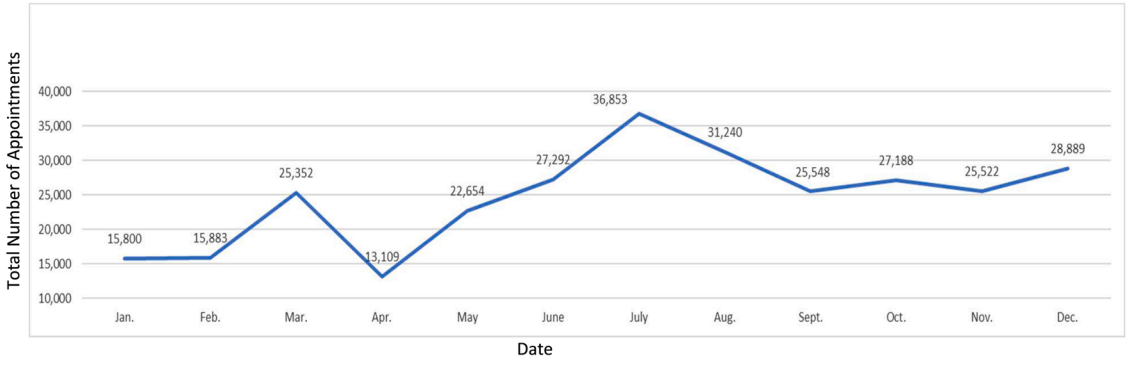

Fig. 4. Total appointment count in 2020.

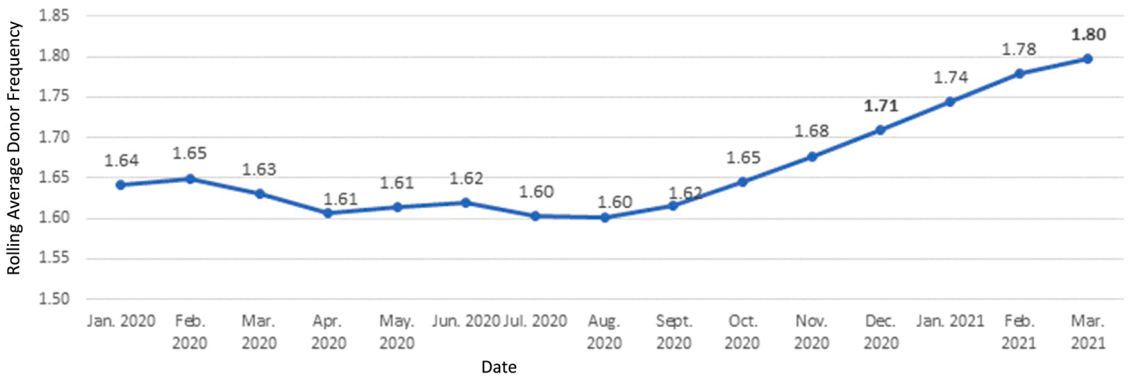

Fig. 5. Rolling average of donor frequency calculated as donations per donor.

Also, donors were converted to donate what was needed instead of what they expected to donate when they presented. This was a crucial change in philosophy leading to successful conversion of donors to only collect what was needed. Conversion is part of the culture; all individuals who interact with the donor have a responsibility to convert donors based on blood product needs. Improvements to donor engagement strategies resulted in an increase of 9.5% in donor frequency.

This study included analysis of data captured during the first year of the pandemic. As we approach the third year of COVID-19, blood centers continue to struggle with donor presentation and maintaining an adequate blood supply [7]. Despite pandemic related challenges, Gulf Coast Regional Blood Center continues to see an increase in donor presentations, and products collected. The center increased donor presentations from 2020 to 2021 by 1%, and product collections by 1.23%. Mobile blood drives reached a record high count in 2021 at 7600 drives. The center is currently working on increasing the average size of blood drives and onboarding more high school participation that was lost during the first two years of the pandemic. Once accounting for 28% of mobile collections, blood drives at businesses continue to struggle at 18% of collections, as many employees continue remote work. The collection distribution between mobile blood drives and fixed sites remains a 50/50 split, however, with businesses and high schools returning to the program, the center expects to see a shift in distribution by the end of 2022. Hospital usage remains steady with an 8% increase year over year.

As an independent blood center who faces challenges related to size and geographical footprint when it comes to purchase power and competitive threats, independence was the key to success. Being nimble and having the flexibility to quickly make decisions regarding in-house testing, collections models, marketing strategy, and manufacturing operations allowed for a greater community response that helped save lives.

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CRediT authorship contribution statement

Theresa Pina: Conceptualization; Data curation; Formal analysis; Methodology; Validation; Project administration; Writing – review & editing. **Marc Lewis:** Conceptualization; Data curation; Formal analysis; Methodology; Validation; Project administration; Writing – review & editing. **Charity Garrison**: Data curation; Formal analysis; Investigation; Software; Writing - review & editing. **Anna Razatos**: Formal analysis; Visualization; Writing – original draft.

Declaration of interest

CG and AR are employees of Terumo Blood and Cell Technologies which manufactures the Trima Accel Automated Blood Collection System and the Vista Information System.

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