

Assessment and comparison of the manual steps required to perform whole blood processing using a semi-automated method versus a fully automated method

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Introduction

The assessment of product quality parameters and operational procedures among healthcare and blood bank centers has increased in recent years. Understanding the insights and differences among medical devices and processing systems to optimize the outcomes is needed.^{[1][2][3][4]}

Objectives

The aim of this study is to perform a value stream mapping of all the manual steps required for an operator to properly use the semi-automated or fully automated method to process whole blood units.

Methods

During August and October 2022, in 3 top Colombian Blood Bank centers, located in Bogotá (Clínica Colsanitas, LaCardio), and Medellín (Hospital Pablo Tobón Uribe - HPTU), an assessment on the different manual steps required by the operator to do whole blood processing was performed.

The study only included the processing methods when they were programed to obtain 3 final units: Red Cell Concentrates (RCC), Plasma Unit (PU), Platelet Concentrate (PC).

For each assessment, there was a single operator in the processing room who performed the whole blood processing with either a semi-automated or fully automated method, and an external viewer that checked and wrote down all the steps done by the operator.

The fully automated method was performed only in HPTU with a leukoreduced processing set, which includes a filter. The main technology used was the Reveos® Automated Blood Processing System.

The semi-automated method was performed in Clínica Colsanitas without leukoreduction and in LaCardio with leukoreduction using a filter for RCC.

The main technologies used in Clínica Colsanitas were the separator CompoMat® 5G (Fresenius Kabi) and the centrifuge Roto Silenta 630 RS (Hettich Lab Technology). In LaCardio they used the separator CompoMat® 5G (Fresenius Kabi) and the centrifuge Sorval® RC 12BP X-23 T4 (ThermoFisher Scientific).

Results

Each blood bank center performed the manual steps in a different way.

The Blood Bank Centers that used semi-automation for processing their whole blood products, Clínica Colsanitas and LaCardio, had similar total manual steps, 58 and 60, respectively.

In LaCardio, due to the leukoreduction process for the RCC that requires a filter, 3 additional steps had to be performed: hanging the RCC; placing the RCC at the table; and sealing the RCC to detach it from the filter.

The Blood Bank Center that used full automation for processing their whole blood products, HPTU, had 32 total manual steps. Furthermore, most of the steps linked to the interaction with the processing device, the Reveos® Automated Blood Processing System, were portrayed in its LCD display. If a step was not performed or done incorrectly, the device did not allow the operator to continue with the whole blood processing.

Conclusions

The fully automated method performed with the Reveos® Automated Blood Processing System should be the preferred option for whole blood processing as it decreases by almost half the quantity of manual steps that the operator must do, optimizing standardization and decreasing the chances for human error and unit waste. Furthermore, the fully automated method ensures that RCC filtration is pre-storage.

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Manual operator steps	Blood Bank Centers		
	Colsanitas	LaCardio	HPTU
Whole Blood Processing system used	Semi-automated	Semi-automated	Automated
Switch on the SML Chiller for the Reveos® Automated Blood Processing System			
Measure the temperature from the bags and/or box			
Write down the temperature measurement			
Check that donor questionnaires are filled correctly and match the whole blood bags			
Prepare and remove objects from the processing table			
Clean and disinfect the processing table			
Place the whole blood bags on the processing table			
Open the excel file to fill it with the data from the blood bags			
Seal and separate the whole blood donor line with the T-seal mobile			
Open the Information Management System (IMS) (Laptop Application)			
Click the desired protocol in the IMS			
Scan operator code and whole blood unit code			
Scan the whole blood bags			
Weigh the whole blood bags			
Write down the weigh on the same blood bags			
Fill in the excel file the weigh of each blood bag			
Switch on the Reveos® Automated Blood Processing System			
Extract the baskets from the centrifuge			
Extract the counterweight bags from Reveos®			
Scan operator code, blood donor code, reference bag type and set code			
Select the Reveos® desired protocol			
Place the whole blood bags in the Reveos® baskets			
Put the whole blood bags in the baskets			
Weight the baskets			
Balance the baskets with tiny plastic pieces			
Balance the weigh among the whole blood bags			
Agitate the whole blood bags			
Switch on the centrifuge			
Preheat the centrifuge			
Place the baskets in the centrifuge			
Place the whole blood bags in the centrifuge baskets			
Close the centrifuge cover			
Select the centrifuge desired protocol			
Click start for the centrifugation process			
Click on the Reveos® display to lower the valves and close them			
Use the canula breaker into the blood bags to allow the blood flow			
Close the Reveos® cover			
Click start for the Reveos® Automated Blood Processing System process			
Switch on the separator (Compomat 5G from Fresenius)			
Open the calibration excel file to register the separator calibration data			
Calibrate the separator			
Fill the calibration excel file with the calibration data			
Open the centrifuge cover after the centrifugation is over			
Place the blood bags into the separator			
Scan the blood bag, the separator, and the operator tag			
Select the separator protocol			
Click start for the separator process			
Extract the processed bags from the Reveos® Processing System			
Extract the fraccionated bags from the separator			
Separate manually the components through breaking the seals done during the Reveos® Processing System			
Discard the buffy coat			
Place the plasma on the processing table			
Place the red cell concentrates (RCC) on the processing table			
Hang the RCC so that the additive solution goes through the filter from the bag set			
Manually mix the RCC with the solution and hang it so the mix goes through the filter			
Place the platelet concentrate on the processing table			
Perform a stripper on the platelet concentrate			
Place the platelet concentrate on a shelf during 3 hours			
Hang the RCC for the filtration process			
Hang the buffy coat during 2 hours			
Hang the buffy coat during 3 hours			
Perform a stripper to the plasma			
Remove the RCC from the hanger and place it on the table			
Seal the RCC to detach it from the filter and the previous bag with a T-seal II			
Perform a stripper to the RCC			
Seal the RCC tubes with a T-seal II to have control pilots			
Place the two tubes from the RCC at each side of the bag for a proper storage			
Place the RCC on a refrigerated shelf (2ºC to 6ºC)			
Remove the buffy coat from the hanger			
Agitate the buffy coat			
Place the buffy coat into the centrifuge baskets			
Weigh the centrifuge baskets			
Balance the weigh among centrifuge baskets			
Place the centrifuge baskets into the centrifuge			
Close the centrifuge cover			
Select the centrifuge protocol			
Click start for the centrifugation process			
Open the centrifuge cover after the centrifugation is over			
Place the buffy coat into the separator			
Scan the blood bag, the separator, and the operator tag			
Select the separator protocol			
Click start for the separator process			
The separator stops and the operator needs to manually extract the air bubbles from the platelet bag			
Click continue for the separator process			
Extract the buffy coat and discard it			
Extract the fraccionated platelet bags from the separator and place them on the balance			
Weigh the platelet bags at the balance			
Write down the weigh			
Seal the tubes to have control pilots			
Inspectionate the platelet bag for air bubbles			
If air bubbles are found, manually push the air bubbles into the end of the tube			
Seal the end of the tube where the bubbles were pushed			
Extract the fraccionated platelet bags from the separator and place them on the processing table			
Register the platelet unit in the excel file scanning the bar code			
Place the platelet bag on a shelf for 2 hours			
Place the platelet bag into the platelet shaker for 24 hours			
Total manual steps	58	60	32

Table 2. Value stream mapping of all operator manual interventions for the semi-automated, buffy coat processing system and the fully automated processing system.