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C. Laroque, J. Himmelspach, R. Pasupathy, O. Rose, and A.M. Uhrmacher, eds

BLOOD CENTRE INVENTORY ANALYSIS USING DISCRETE SIMULATION

Felipe Baesler

Universidad del Desarrollo
Av. Sanhueza 1750
Concepción, CHILE

Matías Nemeth

Universidad del Desarrollo
Av. Sanhueza 1750
Concepción, CHILE

Alfonso Bastías

Universidad del Desarrollo
Av. La Plaza 700
Santiago, CHILE

Cristina Martínez

Centro de Sangre de Concepción
Barros Arana 1111
Concepción, CHILE

ABSTRACT

This paper presents a simulation study of a regional blood centre in Chile. The objective was to compare different inventory policies in order to improve two main indicators, minimization of wastages and shortages. In order to analyze and propose these inventory policies, a discrete event simulation model was created using the simulation software Arena 12.0. The model replicates the activities that are performed along the chain including donation arrivals, testing, production, inventory management and dispatching. Twelve scenarios were analyzed, each one representing different inventory policies composed of a combination of optimum inventory level and reorder point. The best results are obtained when 7 days of inventory is considered as optimum level with a reorder point of 6 days. The simulation of this scenario shows that it is possible to decrease unsatisfied demand and wastage of red cell units in a 2.5% and 3% respectively in comparison to the current situation.

1 CASE STUDY

The Concepción Blood Center concentrates production throughout the region of Bio-Bio in Chile, donations reach the order of 35,000 units a year. These donations are processed in the center and transformed mainly into three components, red cells, plasma and platelets. The Blood Center receives donations from 4 hospitals in the region, from the Donor's House and from mobile collections that every day are made in different places. The blood components are stored in inventory and them delivered to more than 20 different sites, including hospital and clinics.

1.1 Simulation Scenarios and Results

A simulation model was created including all the activities associated to the blood supply chain. More than 100 probability distributions were fitted to represents the randomness of all the activities, number of donations and number of units demanded each day. The main objective of this project was to analyze different inventory policies based on optimal inventory and reorder point levels, in order to minimize components wastage due to expiration and to minimize the unsatisfied demand.. Twelve scenarios with differ-

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ent settings for these two parameters were considered. A third parameter was added which defines the amount of extra effort that the reposition donation process has to do in order to increase the amount of blood collected. The optimum inventory and reorder point levels were represented using the indicator, number of days of demand for a particular component and the extra effort in reposition donors was set in two levels, 10% and 20%.

Table 1 shows the results of the 12 scenarios. For example, scenario (7-7-10) represents an inventory policy with parameters, optimum inventory set in 7 days, reorder point set in 7 days and extra donations set in 10%. Figure 1 shows the multiobjective view of the problem, presenting the dominated and the non dominated solutions. Since a tradeoff exist between both objectives, the best solution has to be one of the alternatives that form part of the Pareto Frontier conformed by the squares.

Table 1: Red Cells Simulation Results

Scenario	Units Expired	Unsatisfied Demand
7-7-10 (As-Is)	453,08	1091,34
7-7-20	476,34	934,28
6-6-10	450,8	1110.1
6-6-20	461.5	964,94
5-5-10	452,93	1069,24
5-5-20	465,79	1002,41
7-6-10	441,61	1058,28
7-6-20	480,7	1029,62
7-5-10	449,08	1076,64
7-5-20	489,59	1033,34
6-5-10	444,53	1074,17
6-5-20	497,37	1042,83

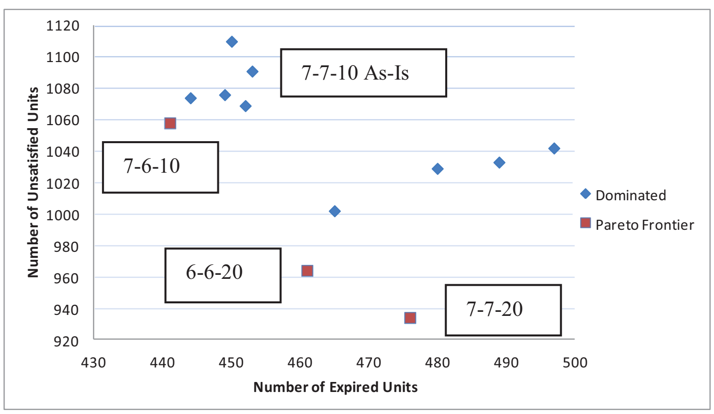

Figure 1: Pareto Frontier

If we compare the As-Is scenario with the Pareto Frontier, the only alternative that dominates this situation is the scenario 7-6-10. In other words this scenario outperforms the As-Is situation in both objectives, concluding that the scenario 7-6-10 should be selected as the best policy for red cells inventory management decreasing the unsatisfied demand and wastage of red cell units in a 2.5% and 3% respectively.

2 CONCLUSIONS

This paper showed that discrete event simulation is a good tool to model and analyze blood supply chains. The results obtained from the simulation experiments were used to analyze the problem from a multi-objective point of view, finding the dominated and non dominated scenarios necessaries to obtain the Pareto Frontier.