Blood Supply Chain Challenges: Evidence from Indonesia

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Abstract

This paper aims to identify and structure challenges and opportunities for improving Indonesian blood supply chain management. Nowadays, Indonesian blood supply chain is operated by using a decentralization approach. Blood bank is one of the echelons in blood supply chain. A Blood Transfusion Unit (BTU) is a blood bank organized by the Indonesian Red Cross (IRC). An exploratory approach is used to collect empirical evidence in Indonesian blood supply chain. Furthermore, SWOT method is employed to map the identified problems and the improvement opportunities. This research conclude that the main problems in the blood supply chains emerged at the level of the BTU. Many BTUs experienced a high risk of having expired products as well as inventory shortages. The possible causes of those issues are high supply uncertainty, high demand uncertainty, and perishable characteristics of blood bag product. The three factors become challenges faced by BTU of IRC. The solution proposed for the BTU to overcome this challenge is to initiate collaborative actions among the BTUs. This collaboration should be conducted in planning process at operational level. Therefore, the future work is to build collaboration models for improving the blood management system, which consider the uniqueness of social demographic of Indonesia.

Keywords
Blood Supply Chain Management, Challenge, Indonesia.

1. Introduction
Blood management is a highly important issue that has been a center of attention in many countries, because blood is a vital constituent of human body and it is difficult to find its alternatives (Kumar & Rai, 2015). Blood supply chain management (BSCM) has long interrelated sequences, which consist of collecting, producing, maintaining the inventory, and distributing processes to the patients in need (Osorio et al., 2015). It is very urgent to control BSCM accurately because blood and is perishable, which means that it has limited life cycle, and it needs a tight security regulation (Mansur et al., 2018) and this paper try to uncover challenges in Indonesia's BSCM. The effectiveness of BSCM system is expected to optimize the blood stock quantity on a secure level or on the intended service level, whose condition can be shown in the conformity between supply and demand, also the sufficient quality level and cost affordability. To create a reliable BSCM, a precise planning system is required, which takes into account all the resources and service target provided by stakeholders (Ghandforoush, & Sen, 2010). Therefore, good coordination among stakeholders is needed to achieve effective and efficient BSCM performance (Stanger, 2013).

Red Cross and Red Crescent are the international aid agencies, which aim to provide blood needs for humanity missions that already have created networks in most countries worldwide. In Indonesia, the organization in charged for aid agency is the Indonesian Red Cross (IRC). Blood bank management system in each country has its own uniqueness, depending on the and with the adjustment to its demographic, geographic, and economic typology, which then determines the choice between using of centralization or decentralization model (Hosseinifard & Abbasi, 2016). The objective of this research is to capture the challenges and opportunities in developing blood supply chain at IRC organization, which ultimately provides recommendations to enhance the service level.

2. Methodology

Every country has its own challenges in managing blood supply chain. Stanger et al, (2012) stated that the main problem of BSCM in England was how to handle the shortage on blood supply. Blake et al., (2013) mentioned that the main problem of BSCM in Canada was how to speed up the service in responding the demand. Stanger et al. (2012) and Blake et al. (2013) employed simulation method approach to model the existing issues. Lowalekar & Ravi (2017) suggested theory of constraint method to analyze the problems and opportunities improvement for BSCM in India.

To reveal the challenges in blood supply chain in Indonesia, this research uses exploratory approach by performing observations and interviews in seven branches of IRC that manage blood in Indonesia, i.e. the Blood Transfusion Unit of Indonesia Red Cross (BTU of IRC). The research objects are located in three provinces, which are East Java (U1 = Malang Regency, U2 = Mojokerto City, U3 = Surabaya City), Special Region of Yogyakarta (U4 = Yogyakarta City, U5 = Bantul Regency, U6 = Sleman Regency), and Central Java (U7 = Kudus Regency).

The data retrieval method used is semi-structured interview, which is directed using a set of questions based on the main problems of blood supply chain derived from literature review. The questioners as mentioned at Table 1. The respondents are experts in IRC blood management system who have already worked for the minimum of 10 years as well as having the experience in blood procurement and distribution. The respondent profile was described at Table 2. This research focuses on identifying the existing challenges in BTU of IRC, which is then analyzed by using Strength, Weakness, Opportunity and Threat (SWOT) analysis.

Table 1. Interview Guideline

Section of Interview	Questions
Company Profile	1. What are the types of blood bag produced by the company?
	2. How much is the capacity of each type of product?
	3. How many hospitals are served by the company? (BDRS and Non BDRS)
	4. How sufficient are the human resources and the equipment in fulfilling the service target?
Supply Uncertainty	1. How does BTU of IRC predict and determine the target numbers of blood donors?
	2. What factors do influence the number of blood donors?
	3. What will the BTU of IRC do if the numbers of blood donors are below the target?
	4. What will the BTU of IRC do if the numbers of blood donors exceed the target?
Demand Uncertainty	1. How does the BTU of IRC predict of blood bags demand?
	2. How accurate is the demand prediction?
	3. How many blood bags are demanded per month in the last two years?
	4. What factors influence the blood bags demand fluctuation?
	5. What are the BTU of IRC strategies in producing blood bags?
	6. How does the BTU of IRC determine the daily, weekly, and monthly blood bags stock?
	7. How does BTU of IRC do the scheduling of blood bags to fulfil the demand?
	8. How does BTU of IRC meet a large number of blood bags sudden demand while stocks are limited?
	9. How does BTU of IRC overcome the exceeded blood bags caused by the decreasing numbers of demand?
Perishability	1. What factors affect the blood bags expiration?

	2. How does BTU of IRC monitor the blood bag quality to ensure its utility?
	3. How does BTU of IRC determine the expiration date of blood bags?
	4. How many blood bags expire each month?
	5. What will BTU of IRC do to the almost expired blood bags?

Table 2. Company Profile and Interviewees Information

Company Profile							
	U1	**U2**	**U3**	**U4**	**U5**	**U6**	**U7**
Product	PRC, WB, TC, Plasma	PRC, WB, TC, Plasma	PRC, WB, TC, Plasma, PCR, PCL, AHF, TC Apheresis	PRC, WB, TC, PCL, Plasma	PRC, WB, TC, Plasma	PRC, WB, TC, Plasma	PRC, WB, TC, Plasma
Production Target / month (blood bag)	1200	1400	16000	5000	700	1000	1500
Number of Customer (hospitals)	25	23	60	35	9	24	12
Identity of Respondent							
Position	Public Relation Manager, Operation Manager	Public Relation Manager, Operation Manager	Director, QC Manager	Public Relation Manager, Operation Manager	Operation Manager	Operation Manager	Director, Operation Manager
Work experience (years)	10	20	15	15	8	10	18

3. Result

Even though the numbers of blood derivatives can be developed into more than ten products, but due to the existing demand numbers and technological limitations (BTU Surabaya excluded), there are only four products produced by the BTU of IRC, i.e. Whole Blood (WB), Packed Red Cell (PRC), Thrombocytes or platelet (TC), and plasma. Among those products, PRC is dominantly produced, in which 70% of total production. The challenges that will be met by BTU of IRC cover uncertainty supply, uncertainty demand and product perishability.

1. Supply Uncertainty

The uncertainty numbers of blood donors are one of the challenges in BSCM . The impact of this problem is the overstock of blood bags that increase the possibility of expired stocks or the understock of blood bags, which consequently reduces the BTU service level. Almost all the BTUs experienced a high stock fluctuation every month. The example is BTU of Surabaya City that can be shown in Figure 1.

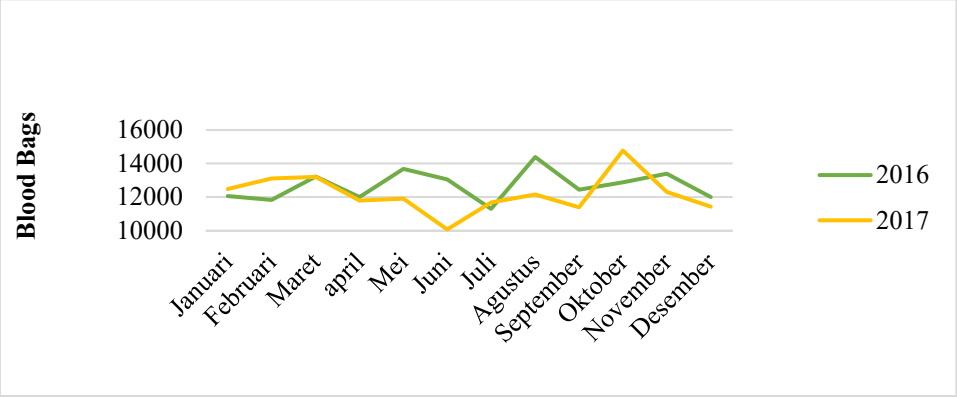

Figure 1. Numbers of Blood Donors in BTU of Surabaya City

Generally, the condition of donor fluctuation for other BTUs experience the same phenomenon and it can be seen from the value of deviation standard as Figure 2.

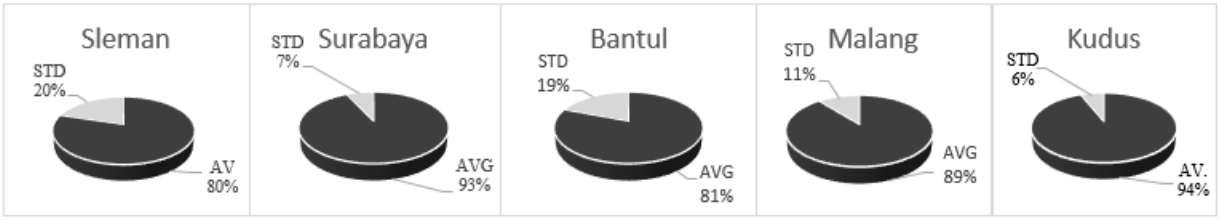

Figure 2. Deviation standard of blood supply

Based on the interview results, the blood bags fluctuation impacts in each BTU can be describe as Table 3.

Table 3. Impacts of Uncertainty Blood Bags Supply on Blood Bank Availability

BTUs	Stock Availability		Statements
	Over	Under	
U1	√		*(+)"In order to fulfil the target, there is no difficulty at all because there are blood donor communities in each district. Therefore, our supply tends to be overstock"*
U2	√		*(+) "When there are blood donor programs from corporations, the schedule may not fit but it cannot be changed. Therefore, our supply may be overstock"*
U3	√		*"Because of the high sense of social sensitivity of the citizens, we tend to have overstock of blood bags so we send some of them to other BTUs."*
U4	√		*"Ever since 2015, we have problems in distributing the blood bags because we often have over stock."*
U5		√	*"Almost every month we ask for more supply from the BTU of Yogyakarta City to fulfil the demand."*
U6	√		*"We often ask the other BTU (Gunung Kidul Regency to take some of our supply)."*
U7		√	*"We rarely experience the over stock, and we often ask for more supply from the other BTUs."*

2. Demand Uncertainty

Another problem that emerged in BTUs is the difficulty in predicting blood bags demand from the hospitals. It happens because of the stochastic demand and is often referred to as uncontrollable demand. Some of the BTUs (U1, U2, U4, U5, U6, and U7) provided statements regarding the demand accuracy, specifying that 90% of accuracy prediction is considered as a good thing. Even the BTU of Surabaya City stated that 80% of accuracy prediction is good. The data of demand fluctuation is presented as Figure 3.

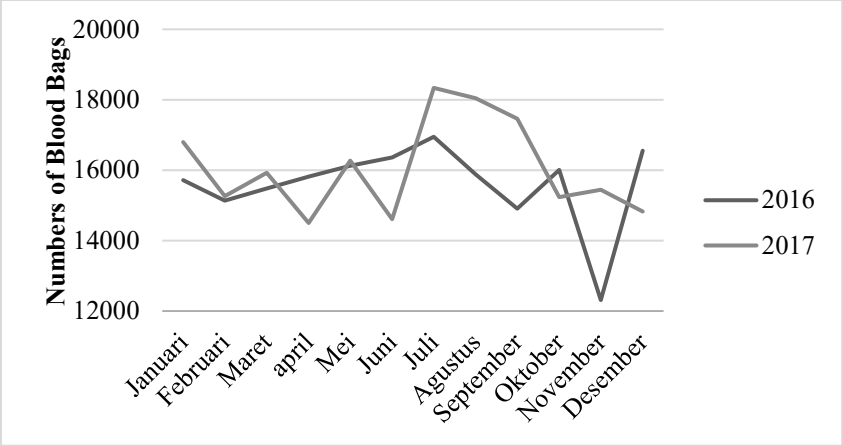

Figure 3. Numbers of Blood Donors in BTU of Surabaya City

The blood demand fluctuation in each blood bank can be seen from the deviation standard of demand, as described at Figure 4.

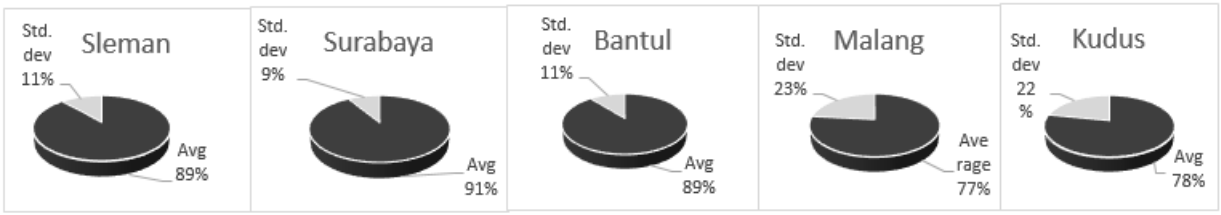

Figure 4. Deviation standard of blood demand

3. Product Perishability

Besides causing opportunity loss, blood bags expiration contributes to financial disadvantages to the BTUs; it is because of the high production cost and the disposal cost for expired products (Mansur et al, 2018). The percentage rates of expiration level in each BTU compared to its production level per month (X_{un}) mentioned at Table 4.

Table 4. Percentage Rate of Expiration Level

BTUs	Percentage rates of expiration (X_{un})
U1	5 % ≤ X_{U1}
U2	10% ≤X_{U2}
U3	10% ≥X_{U3}
U4	10% ≥X_{U4}
U5	2% ≤ X_{U5}
U6	10% ≤X_{U6}
U7	2% ≤ X_{U7}

4. Discussion

Blood supply chain management model in Indonesia could be categorized as decentralized mode, in which each district carries out an independent planning and distribution system. Based on the exploratory study, the analysis could be resumed as follows:

The Strengths and Weaknesses of the Indonesian blood supply system

Strengths:

1. The decentralization model eases the access of donors in donating their bloods. (S1)
2. It facilitates the consumers to get the blood supply because each city has BTU/ blood bank. This reduces trouble in accessibility caused by the poor condition of the road and the possibility of congested traffic, which can delay the blood supply. (S2)

3. High sense of social responsibility of the Indonesian citizens can be the factor to get blood supply easily.(S3)

Weaknesses:

1. The non-regular blood donors are still dominant compared to the regular donors; it can cause high supply of blood bags fluctuation. (W1)
2. The planning system in each BTU is still considered low in response to the market needs, as each consumer has specific characteristics in term of age range, quality, and cost. (W2)
3. There is no good coordination among the stakeholders, for example between hospitals and the BTU or among the BTUs. It may cause the stock runs out or the increasing risk the expiration rate.(W3)
4. The number of population in each city or regency and the education level gap may cause some BTUs experiencing over stock while the others experiencing under stock.(W4)
5. The technology gap among the BTUs in production process may cause different quality of the products that can affect the society trust to BTUs and impede the coordination among BTUs.(W5)

Opportunities and threats identified in the Indonesian blood supply system

Opportunities:

1. Large numbers of population can be used as reserved supply of blood bags, especially in emergency situations.(O1)
2. The possibility among BTUs to have coordination to collaborate in planning and operational stages. (O2)
3. Rapidly developed technology can be an advantage to improve management models to be more innovative to keep the blood bags availability and monitor the blood life cycle.(O3)

Threats:

1. There is a new competitor to BTUs, as a result of the government new policy that some hospitals can receive blood donation and production process. It will make the BTUs no longer the only organization that allowed managing blood system in Indonesia. (T1)
2. The new technology in blood production process may make some of the production equipment owned by the BTUs become obsolete and cannot be used any longer.(T2)

The major challenges experienced by the BTUs are the demand uncertainty, supply uncertainty and perishable characteristics of blood bag product, that will lead to the outdated inventory and stock out risk. Based on SWOT analysis, the weaknesses that related to W1, W2, W3, W4 and W5 are presumed as the main causes for outdated inventory and stock out inventory. BTUs need to find precise solution to settle it, by considering correlation between weakness factor and relevant opportunity as defined in the Table 5.

Table 5. Correlation Weakness and Relevant Opportunity

Weakness	Opportunity	Propose Action
W1	O1,O2	Planning Collaboration
W2	O2, O3	Planning and Operational Collaboration
W3	O2	Planning and Operational Collaboration
W4	O2	Planning and Operational Collaboration
W5	O3	Planning and Operational Collaboration

The collaboration strategy between BTU can be an alternative to overcome the problems faced in the blood supply chain. The collaboration could be performed by horizontal collaboration among BTUs or vertical collaboration between BTUs and hospitals. Since all BTUs are experiencing the same issues, good horizontal collaboration is required to overcome the problems. Collaboration has many benefits to improve organization performance, such as demand sharing, resource sharing, also risk sharing (Simatupang & Sridharan, 2012; Simatupang & Sridharan, 2005; Mansur, et al 2018). Designing integrated inventory system among the BTUs is one of the collaboration strategies to improve blood supply chain performance. Demand and capacity sharing approach is the possible operational technique to be applied. This operational technique is proposed because each BTU has unique demand and capacity. The demand and capacity gap of each BTU will be solved if there is strong cooperation among the BTUs. However, to improve collaboration in BTUs, there are several constraints such as:

1. Some BTUs are still hesitant to formalize the collaboration, even though all BTUs are under the IRC, they are independent organizations that take care of their own viability, such as the staffs' salary, development cost, etc. It may become a concern that the collaboration will bring negative impacts to the organization.
2. There is no a collaboration model yet, that can meet the organization necessity, which is a potentially independent social organization.

To initiate this collaboration among the BTUs, these are several steps to be considered:

1. Improving the awareness of each BTU about vision and mission in delivering excellent service.
2. Building mutual trust among BTUs to support information sharing.
3. Designing appropriate collaboration strategy to gain optimum inventory performance.
4. Conducting evaluation and corrective action from the applied collaboration strategy.

5. Conclusion

Blood management system in Indonesia, which is handled by the BTUs, follows a decentralization model. It needs some improvements especially in managing the inventory system. The special challenges to be solved are overcoming the stock out and expired products. Collaboration among the BTUs can be used as an alternative to improve the management, particularly in planning and operational stages. Nowadays, there are still several constraints in implementing the collaboration, both technical and non-technical. Steps that need to be done in building collaboration between BTUs are building awareness about business risks, building trust between BTUs, designing collaboration systems, and evaluating systems to make improvements. Further research is expected to build a flexible collaboration model among the BTUs in order to commit to the obligations as individual organization as well as improve collaboration. The simulation approach may help to design collaboration model to accommodate the complexity of blood management problems.

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