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Managing Blood Safety and Availability: A Preliminary Investigation of the Blood Supply Chain Dynamics in Indonesia

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Abstract. This paper reports the findings from our preliminary investigation into the blood supply chain in Indonesia. The aim is to obtain factors influencing blood safety and availability, and ultimately to better understand its dynamics. A single embedded case study was adopted as a research design. Data were collected using six semi-structured interviews, walkthroughs, and written documents available from a blood centre and four associated hospitals in Yogyakarta. Template and within-case analyses were then used to analyse the data and, subsequently, to identify and categorise themes emerging from the data. Governmental and organisational policies, costs, donor management, stock management, and facilities are the main factors emerging from the data. These factors are interrelated and, collectively, they influence blood safety and availability across the blood supply chain.

1. Introduction

Managing blood safety and availability remains a challenging problem for the blood supply chain in Indonesia. In 2013, it was found that 3% of the total donated blood were contaminated by infectious diseases [1]. It is not uncommon to find some hospitals and blood centres (i.e. the Indonesian Red Cross – PMI) being out of stock when particular blood groups are needed. That condition could be even worse during national holidays when PMI could only supply 30% of the stocks needed every day [2]. PMI once claimed that on average it could only supply 70% of the national blood demand [3]. This uncertainty in blood safety and availability can lead to an increasing risk of losing patients' lives due to transfusion transmissible infections and delay of transfusion process.

Despite the urgency in providing reliable blood supply chain operations, the root causes of blood safety and availability problem in Indonesia have not been fully understood. Whilst lessons can be learnt from the extant blood supply chain literature (e.g. inventory optimisation, supply management, and distribution scheduling of blood products – [4]), context specific studies are still required to understand the dynamic of the blood supply chain operations and how it influences blood safety and availability in a unique setting of Indonesia. To address this gap, this paper attempts to answer the following research questions:

1. What are the contributing factors of the blood safety and availability problem in Indonesia?
2. How are the factors interrelated and how does the interrelation influences blood safety and availability in Indonesia?

1.1. The blood supply chain research in developing countries

A number of studies have been conducted to understand blood safety and availability problem in developing countries. Some studies have discussed the safety side of the blood supply (see [5] and [6]), driven by some issues of infectious diseases, such as HIV and dengue spreading out during blood transfusion process and through facilities in hospitals. [7], [8], and [9] discuss safety transfusion procedures and regulation to obtain quality blood that is free from infectious diseases in Sub-Saharan Africa, Latin America, and Montenegro respectively. Intriguingly, [10] observe blood safety practices and transfusion facilities in public, private, and military hospitals in Afghanistan and find that only 52.4% of the hospitals meet the international safety standard. [7] add that the safety standards and transfusion process cannot be easily adopted from developed countries so that some adjustments need to be applied according to local conditions in developing countries.

Some issues of blood supply reliability were also addressed in some literature in developing countries. [11], for example, examines major challenges faced by Caribbean countries, such as human resources, replacement donors, local culture, regulation, as well as supports from external organisations to ensure the sufficient supply of safe blood. [12] further observe that only about 60% of the hospitals in Afghanistan have a regular power supply, test kits, and refrigerator to store bloods, so that safety and supply of blood is still a challenging problem in this country.

Given these insightful findings on the contributing factors of blood safety and availability problem in developing countries, the interrelation between the factors and how it influences blood safety and availability has not been clearly explained. Building on the extant literature, this paper contributes by understanding the dynamic of the blood supply chain in Indonesia and proposing an initial conceptual framework with avenues for future research in this area.

2. Methodology

We use a single embedded case study as a research design. The case consists of one blood centre and four associated hospitals in Yogyakarta Indonesia. This case is chosen due to data access and is in line with the convenience approach to case selection (see [13]; [14]). Qualitative data were collected using six face to face semi-structured interviews, walkthroughs, and written documents available from the sites. We interviewed one Blood Donation Manager and one Staff of Blood Management General Affairs at the blood centre, one Deputy Laboratory Manager at PR Hospital, one Blood Bank Manager at AK Hospital, one Blood Bank Staff at BT Hospital, and finally one Midwife at SD Hospital. These are key informants responsible for ensuring blood safety and availability (BSA) in their own facilities. With the informants' consents, the interviews were tape-recorded, lasting for 30 minutes to 2.5 hours.

The interviews were started with general questions on the role of informants and the extent to which they were involved in managing BSA in the blood centres or hospitals. Subsequently, the informants were asked to describe how they (representing the blood centre or hospitals) managed BSA in their sites. To gain rich data and to prevent the informants' bias, our questions focussed more on the process and factual information rather than opinions (see [15]). Whenever possible, walkthroughs were conducted and written documents were collected. This triangulation of data collection methods ensures the validity and robustness of the research process [16].

The collected data were analysed using template and within-case analyses. Template analysis was used because it allows a flexibility of coding structure and iterative process of applying, modifying, and re-applying the initial template, therefore making the coding process efficient [17]. Template analysis was started by coding the transcribed qualitative data from the blood centre. Some themes (i.e. contributing factors of the BSA problem) identified from the coding process were then categorised and used as a template for analysing data from the hospitals. Within-case analysis was then conducted by analysing the final template and identifying the significance of the emerging themes.

3. Findings

The following key contributing factors of BSA problem have emerged from the data:

1. *Governmental and organisational policies.* We find that there are conflicting policies applied in the blood centre and one of its associated hospitals. For example, the Ministry of Health has allowed one hospital in the area to have its own blood transfusion unit capable of collecting, manufacturing, stocking, and distributing blood products to patients in need. However, this policy has created a mismatch between demand and supply of blood in the area. When a particular group of blood is out of stock, the hospital is reluctant to go to the blood centre and ask for the required blood. Instead, the hospital attempts to encourage people to donate their blood directly to the hospital. As a consequence, the blood donors are trapped into thinking that there is a low blood availability in the area. In fact, the blood stock levels in the blood centre remain high and often wasted due to lack of demand from the hospital.

2. *Costs.* We find that some hospitals are concerned with the costs of providing safe blood products. The blood centre has standard costs for each blood pack and claimed that they are not taking any profit out of "selling" the blood to hospitals. However, some hospitals are still trying to negotiate to reduce the costs, creating a deadlock and therefore hindering the collaboration between the two.

3. *Donor management.* We find conflicting policies between the blood centre and hospitals on donor management. For example, some hospitals allow their patients to use replacement donors (i.e. blood donated by the patients' relatives). On the other hand, the blood centre encourages patients to use regular or voluntary donors of which the safety and quality of the blood have been assured. The blood centre finds that replacement donors frequently provide dishonest information about their health conditions and violate the standard of transfusion practices, therefore contributing to the potential blood safety problem later in the process.

4. *Stock management.* We find that there is a lack of integrated planning on the need for blood in the hospitals. Some hospitals prefer to have a certain level of stock every day and therefore placing orders to the blood centre on an ad-hoc basis. As a consequence, the need for blood is difficult to predict. Whilst the blood centre has encouraged the hospitals to provide a proper short-term or medium-term ordering plan, the condition remains unchanged.

5. *Facilities.* Finally, we find that the lack of cold chain facilities is a key reason for the perennial problem of blood safety and availability. For example, some hospitals do not have blood banks so that they must rely on the blood centre to store the ordered blood and maintain the safety of the blood, reducing the storage capacity of the blood centre. When the blood products are finally delivered to the hospitals, they are not directly transfused. During the transit time, the ordered blood products are usually stored in a non-temperature-controlled fridge together with other medications. This increases the probability of having cross-contamination and reduces the blood quality.

4. Discussion

Our findings concur with the extant blood supply chain literature in developing countries (i.e. [10]; [11]) that regulations, transfusion facilities, and donor management are the key factors influencing BSA. However, we argue that there are interrelations between the factors found in this research. For example, the conflicting policies between the government and the blood centre affect the stock management and cost structure of the blood management process. The blood centre suggests that the government should not allow hospitals to have their own blood transfusion units when the blood centre is able to provide enough blood for the hospitals. Current policies have resulted in different standard prices for blood

packs. In addition, allowing the hospitals to have their own blood transfusion units can potentially trigger a gaming behaviour where the hospitals treat blood as sellable commodity and charge patients with higher prices.

We also find an interrelation between blood supply chain facilities, stock management, and costs. The hospitals with blood bank usually have limited capacity to store the blood in a cold chain environment so they have to order blood whenever needed from the blood centre, making it difficult to strategically manage the stock levels. The hospitals with no blood bank facilities often reserve blood unexpectedly and use the blood centre's facility to store blood. Sometimes the hospitals do not take all the ordered blood products and leave them in the blood centres until they get expired. This practice has resulted in unnecessary wastage in the blood centre. Due to these unscheduled orders, when the need for blood is unpredictably higher, the hospitals have to go to and pick up the blood from the blood centre more frequently. This potentially results in a high transport costs particularly when the hospitals are in a far distance from the blood centre.

Finally, we find an interrelation between donor management and organisational policy. Generally, the blood centre does not deliver the ordered blood products to the hospitals. Whilst some hospitals use courier service or deploy their own staff to pick up the ordered blood, some hospitals allows the patients' family to donate and/or pick up the ordered blood by themselves. This is contrary to the blood centre's policy; to ensure blood safety, patients' relatives are not allowed to get involved into the blood supply chain operations. In practice, however, the blood centre still accommodates the hospitals' conflicting policy.

5. Conclusion

Using a single case study of blood supply chain in Yogyakarta, this paper unravels the contributing factors of the blood safety and availability problem Indonesia. We conclude that there are interrelated factors influencing blood safety and availability, representing the dynamic of the blood supply chain operations in Indonesia. As the nature of the case study research, analytical rather than statistical generalisation should be applied with care. Whilst we acknowledge that there is an element of subjectivity in this qualitative research, transparency of the research process and triangulation of data collection and analysis methods reduce our bias.

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