

**KNOWLEDGE OF BLOOD TRANSFUSION
PRACTICE AMONG NURSES IN HOSPITAL
UNIVERSITI SAINS MALAYSIA**

BY

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LIST OF ABBREVIATIONS

AABB	American Association of Blood Bank
AHTR	Acute haemolytic transfusion reaction
AMI	Acute myocardial infarction
CI	Confidence interval
GVHD	Graft versus host disease
HIV	Human immunodeficiency virus
HUSM	Hospital Universiti Sains Malaysia
IBCT	Incorrect blood component transfused
LV	Left ventricular
MLR	Multiple Linear Regression
PDN	Pusat Darah Negara
RBTKQ	Routine Blood Transfusion Knowledge Questionnaire
RE	Reading Ease
Rh	Rhesus
SD	Standard deviation
SHOT	Serious hazards of transfusion
TACO	Transfusion associated circulatory overload
TRALI	Transfusion related acute lung injury
UAE	United Arab Emirates
UK	United Kingdom
UKMMC	Universiti Kebangsaan Malaysia Medical Centre
USM	Universiti Sains Malaysia
WHO	World Health Organization

**PENGETAHUAN TENTANG AMALAN TRANSFUSI DARAH DIKALANGAN
JURURAWAT DI HOSPITAL UNIVERSITI SAINS MALAYSIA (HUSM)**

ABSTRAK

Transfusi darah adalah salah satu prosedur perubatan rutin yang sangat efektif dan rawatan yang mampu menyelamatkan pesakit. Namun, prosedur transfusi darah adalah tidak bebas daripada risiko. Ia boleh mengakibatkan morbiditi yang serius dan juga mortaliti. Oleh itu, pengetahuan dan kemahiran para jururawat adalah amat penting untuk memastikan proses transfusi darah yang selamat.

Kajian ini dijalankan untuk menilai pengetahuan para jururawat tentang prosedur transfusi darah, termasuk juga pengetahuan tentang komplikasi transfusi darah. Kajian yang berbentuk diskriptif telah dijalankan, melibatkan sampel rawak seramai 200 orang jururawat yang terlibat dalam transfusi darah di HUSM. Borang “Soal Selidik Pengetahuan Transfusi Darah Rutin” yang telah diubahsuai dan disahkan telah digunakan dalam kajian ini. Borang soal selidik ini telah dijawab oleh jururawat dengan kehadiran penyelidik bersama mereka. Setiap respon yang betul akan diberikan satu markah. Jika dua respon yang dijawab adalah bercanggah, tiada markah akan diberikan bagi soalan tersebut.

Skor pengetahuan jururawat secara keseluruhan adalah ditahap sederhana dengan purata skor adalah 54.88%. Terdapat kaitan yang ketara antara skor pengetahuan

yang diperolehi dengan frekuensi melakukan prosedur transfusi darah. Manakala, tiada kaitan yang ketara antara skor pengetahuan dengan faktor-faktor lain seperti jantina, kelayakan akademik, tempoh masa pengalaman bekerja dan juga jenis wad yang terlibat. Malah, apabila dibandingkan antara mereka yang pernah menghadiri latihan dalam transfusi darah dengan mereka yang tidak, tiada perbezaan yang ketara antara mereka.

Secara keseluruhan, para jururawat mempunyai kekurangan pengetahuan yang ketara tentang transfusi darah. Memandangkan pengetahuan yang mencukupi tentang prosedur dan komplikasi transfusi darah dikalangan jururawat boleh mengelakkan kesilapan dan reaksi yang tidak diingini dan juga dapat memastikan keselamatan pesakit, adalah menjadi keperluan untuk perlaksanaan program latihan dan pendidikan yang berterusan bagi meningkatkan pengetahuan, bersama program audit yang berkala.

**KNOWLEDGE OF BLOOD TRANSFUSION PRACTICE AMONG NURSES IN
HOSPITAL UNIVERSITI SAINS MALAYSIA (HUSM)**

ABSTRACT

Blood transfusion is a routine medical procedure that is highly effective and potentially life-saving treatment for many patients. However, blood transfusion procedure is not without a risk. It may lead to a major morbidity and mortality. Therefore, nurses' skill and knowledge are very crucial to assure safe transfusion practice.

This study was carried out to assess nurses' knowledge on the blood transfusion procedures, including knowledge on complication of blood transfusion. A descriptive study was done involving a random sample of 200 nurses involved in blood transfusion in HUSM. A validated modified version of Routine Blood Transfusion Knowledge Questionnaire (RBTKQ) was used. The questionnaires were completed by the nurses in the presence of the researcher. Each correct response was awarded one point. No point was awarded if two conflicting responses were selected.

Our nurses overall knowledge score were average with the mean of 54.88% (range 30.36-73.2). There was significant association of knowledge score with the frequency of performing blood transfusion. However, no significance association between knowledge score and other factors such as gender, academic qualification, duration of working experience and type of wards. Even when comparing between those who had receive training in blood transfusion and those who not, there was no significant difference of knowledge score between them.

In conclusion, the nurses had significant knowledge deficits of blood transfusion process. Since good awareness of blood transfusion procedure and complications among nurses could avoid transfusion error and adverse reaction as well as assuring patients' safety, there is a need for a compulsory on-going educational and training program to improve their knowledge with complimentary regular audit program.

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Blood transfusion is one of routine medical procedure that is highly effective and potentially life-saving treatment for a lot of patients. Blood transfusion is a complex procedure and requiring adequate knowledge and competent skills (Reza *et al.*, 2009). The transfusion process is an elaborate procedure with many interlinking chains of steps, involving multidisciplinary group of health professionals with different levels of knowledge backgrounds (Ayob, 2016; Bielby *et al.*, 2011).

Since blood transfusion involve multi-step processes, error may occur at every stage of the blood transfusion process. These errors are usually blamed on humans, but often they are set up by pre-existing factors, environments, procedures and policies (Ayob, 2016; Smith *et al.*, 2010). In recent years, numerous measures have been implemented to increase both the safety of blood components and the transfusion process itself. However, errors occurred at all stages of transfusion process were continuously reported in haemovigilance programmes (Smith *et al.*, 2014).

The actual figures for blood transfusion errors were unknown. According to Serious Hazards of Transfusion (SHOT) annual report 2014, majority of the incidents were caused by human error, and these make up 77.8% of total reports. Evidence also highlighted problems with nurses' transfusion practice and compliance to the recommendations (Hijji *et al.*, 2010). The rate of near misses and transfusion errors is therefore of considerable concern. Many cases involved multiple errors as a result of failure of essential checking steps (Bolton-Maggs, 2013).

Nurses play several key roles related to patient safety as they are the main group of healthcare providers in the hospital. They play central role in providing care and treatment to the patients as well as strengthening the safety net for patient care within hazardous hospital

environments (Vaismoradi *et al.*, 2011). In regards to blood transfusion, the nurses have a crucial role in providing safer and better blood transfusions. Their responsibilities typically include activities to improve patient awareness of transfusion issues and practical knowledge of blood product use, along with responsibilities for education/training, auditing and adverse event follow-up. Even though the decision to transfuse a patient are doctors' responsibility, the care of patients receiving a blood transfusion is an integral part of many nurses' clinical practice (Mole *et al.*, 2007). The nurses are responsible for ensuring that the right unit is administered to the right patient. Their skills and knowledge are mandatory for them to perform blood transfusion safely and efficiently (Hijji *et al.*, 2013).

Blood transfusions procedures involve risk. Hence, it is necessary for the nurses to acquire knowledge for decision-making in their practice to ensure high-quality, safe and effective patient care. Deficiencies in blood transfusion knowledge and skills were shown to adversely affect patient safety (Gallagher-Swann *et al.*, 2011). Studies in France and United Kingdom have reported serious deficiency in nurses' knowledge underpinning their blood transfusion practice (Saillour-Glénisson *et al.*, 2002). Nurses can reduce the potential error by adhering to the safe blood transfusion policies, auditable performance standards and educational initiatives. The level of nurses' knowledge and skills has been identified as major factors in enhancing patient safety and reducing incidence of adverse events (Alfredsdottir and Bjornsdottir, 2008; Cohen and Bolton-Maggs, 2012).

To date, there is no study done to assess knowledge of blood transfusion among nurses in Malaysia yet. It is hoped that our study will provide data of knowledge of blood transfusion among nurses that can be used for future intervention to improve transfusion practice in future.

This study will be able to give benefit to the participant to know their knowledge and practice status thus motivating them to improve their knowledge and practice. The study

hopefully can be used as a baseline for the future study involving other groups of healthcare worker such as physician and laboratory personnel.

CHAPTER 2

LITERATURE REVIEW

2.0 LITERATURE REVIEW

2.1 Blood transfusion overview

Blood transfusion is one of the most common and important procedures for the patients in the hospital. Blood transfusion is a complex procedure, involving many interlinking chains of events and is associated with substantial risks and cost (Bielby *et al.*, 2011). Although the awareness of the clinical efficacy of restrictive transfusion thresholds is increasing in some setting, transfusions are still an essential component of care in certain patient populations (Delaney *et al.*, 2016).

Blood transfusion is a complex multistep process that involves members of several different professional groups such as nurses, doctors, laboratory scientists as well as the donors and recipients. The multiple steps result in possibility of several risk points. Mistakes may occur at each of these steps, putting patients' lives at risk. These result from omission of essential checks in practice and perhaps an assumption that someone else is responsible for patient safety (Bolton-Maggs and Cohen, 2013).

All involved health-care providers need to understand and give a great concern on the hazards related to blood product administration as serious clinical consequences, even death can occur due to patient misidentification (Bolton-Maggs and Cohen, 2013).

Serious Hazard of Transfusion (SHOT) 2012 revealed that half or more reports were related to errors in the transfusion process despite the introduction of several measures to improve the transfusion practice. In United Kingdom, the transfusion is very safe in which only very few deaths occurred related to transfusion with 2.9 million components were issued in 2012. The risk of mortality and major morbidity from transfusion as estimated from SHOT data in

2012 is 1 in 322 580 components issued and 1 in 21 413 components issued respectively (Bolton-Maggs and Cohen, 2013).

Lack of knowledge of on blood transfusion among clinical staff, including nurses, continues to be a real threat to patient safety (Taylor *et al.*, 2009) . For example, errors in transfusion practice such as remote checks at nurses' counters may indicate that nurses were unaware that remote checks serve no purpose and can lead to transfusion error. The nurses detracted from performing proper bedside identification of patient, thus lead to mistransfusion (Hijji *et al.*, 2010; Taylor *et al.*, 2009).

In recent years, various measures have been implemented to improve blood component safety and the clinical transfusion process. Based on the report from haemovigilance programmes, there was greatest risks to patients from transfusion in many countries now relate to hospital-based steps in the process. The aims of the haemovigilance programs were to optimize appropriate use of precious blood components, to reduce the procedural risks of transfusion administration processes and to improve transfusion practice in general. These activities obviously involve a multidisciplinary team. Together, the role of the nurse is evolving as an integral part of these programmes and continues to develop with growing understanding of areas requiring intervention in the clinical setting (Bielby *et al.*, 2011).

Over the past two decades, expanded blood donor screening and pathogen laboratory methods have greatly decrease the risk of transfusion-transmitted viral infections. Nowadays, there is a major concern about transfusion practices in clinical area. Blood safety and quality regulations refer to the process of collection, testing, processing, storage and distribution of human blood (Dzik, 2007).

2.2 Nurses role in transfusion

Nurses have a crucial role in transfusion process starting from blood bag collection and until blood administration to the patients. Their role is multifunctional, requiring diverse skills and attributes, and involve a range of clinical, quality, risk management and educational activities (Bielby *et al.*, 2011).

Undoubtedly, the nurses have major role in patient safety. It is believed that nurses have the primary responsibility for the prevention of harm to patients in the hospital setting (Cook *et al.*, 2004).

Nurses have several key roles related to patient safety. They are the most reliable front liner of the system (Rowin *et al.*, 2008). They prepare the wide range of incidents reporting and they have frequently been the informer when unsafe care is being tolerated by the system. As the nurses directly involved in patient care management, they have frequent opportunities to make good catches, detecting and correcting mistakes before a patient is harmed. Apart from that, the nurses and nurse managers can apply the local knowledge gained from observing active errors (actual mistakes) and latent errors (unsafe conditions, accidents waiting to happen) to make changes at the unit level to enhance patient safety (Warburton, 2009).

It is very important for the nurses to comply on the guideline of transfusion procedure as errors are possible to occur at any steps of transfusion procedures. Life threatening mistakes can occur at any stages such as during prescription and request form, sampling and labelling, laboratory testing, collection and administration of blood product. Errors that result in inappropriate transfusion remain the largest risk. It is usually occur when details of patient's identification are overlooked. However, the nurses have the final opportunity to prevent mistransfusion, through the final bedside check (Mole *et al.*, 2007).

Nurses are the most likely health care professional that able to recognize, interrupt, and correct potentially life-threatening errors in patient care (Chenot and Daniel, 2010). However, previous nursing education did not include the routine assessment of patient safety as part of daily practices. As a result, nurses are not adequately prepared to provide the highest level of safety and quality during patient care (Chenot and Daniel, 2010). In current situation, nursing graduates must be prepared to place patient safety and quality at the forefront of their practice. Patient safety was suggested to be included in educational curriculum and practice prior to graduation (Berndt, 2014).

The connection between nursing duties and patient safety is confirmed by research linking nurse staffing levels to patient mortality. In hospital environments where patient-to-nurse ratios are high, the risk of morbidity and mortality from a potentially preventable medical complication increase (Ramanujam *et al.*, 2008). Previous study demonstrated that adjusting for patient and hospital characteristics, each additional patient that is added to a nurse's workload increases the odds of death from a medical complication by 7% (Aiken *et al.*, 2002).

Moreover, the nurses provide 24 hour, seven day a week direct care to patients, including examining clinical changes and activating resuscitation procedure. In addition, nurses also engaged in coordination and integration of care services from multiple health care staff. As such they are essential to safe, high quality care and yet are often invisible to the public in this role until mistakes occur (Twigg and Attree, 2014).

In hospital setting, nurses are one of the main groups of healthcare providers. Generally, they are closer to the patients than other clinicians and spend most of the time providing care to the patient. Taking account their position, the nurses are well positioned to strengthen the safety net for patient care within hazardous hospital environments. Given the integral role of

nurses in promoting patient safety, further examination of the link between nursing work and patient safety is warranted (Ramanujam *et al.*, 2008). For instance, they are the most likely to recognize workflow, physician plan or communication-related issues that could give rise to patient safety problems and also most likely to identify and implement possible solutions measures (Thompson *et al.*, 2004). Equally important is that nurses are most often linked to the patient safety concerns (Weingart *et al.*, 2005). For all the above reasons, nurses are ideally positioned to lead the safety and quality agenda within health care (Richardson and Storr, 2010).

Concern for patient safety is expanding for the nursing profession. Nurses' careers have been developed around providing safe care to patients within their specialty. However, current situation is that healthcare facilities and healthcare providers are being held accountable for avoidable errors (Odom-Forren, 2007). Furthermore, accountability for patient safety is not only an organizational and professional mandate, but it is a moral and ethically compulsory in caring for others. It is also essential in order to improve the nurses practice experience, and to avoid the harms and wastes caused by unsafe care. From this perspective, improving safety may both protect patients, and create a better working environment for the nurses and nurse managers (Warburton, 2009).

Nursing profession is described as composing a strong and secure safety net for consumers of healthcare (Bargagliotti and Lancaster, 2007). Nursing care has been set on a foundation of safe practice with safety as an integral part of this care. Nurses are strongly suggested as the key of every safety initiatives and movements in the hospital setting. This potentially places great responsibility on the profession. Thus, it is essential for the nurses to be empowered to meet these responsibilities. Furthermore, a clear and growing body of evidence should exist to explore the impact of nurses, particularly nurse leadership, empowerment and advocacy, on patient outcome (Richardson and Storr, 2010).

As nurses contribute the greatest part of the health care workforce, their safe practice, innovation and contribution to the service improvement are going to be significant. In order to achieve the potential of nurses as ‘culture carriers’, there must be changes to nurse education programmes and modified focus to their clinical practice (Butterworth *et al.*, 2011).

2.3 Nurses Knowledge

Blood transfusion is part of fundamental aspect of nursing practice. Most of the steps in the transfusion chain are strongly dependent on the nurse's awareness and skills. Their skills should include comprehensive knowledge of transfusion practice, excellent communication skills, and an ability to interact with a wide range of people (Bielby *et al.*, 2011). Sufficient knowledge is essential for safe practice. Thus, it was recommended that all nurses should receive proper and adequate training in blood transfusion (Freixo *et al.*, 2016).

However, nurses in the United Arab Emirates were observed to be conducting an improper patient preparation, identification, and blood product handling, as well as suboptimal assessments which included vital sign monitoring (Hijji *et al.*, 2010). Nurses in the Jordan also were reported to have significant knowledge deficits in blood transfusion (Hijji *et al.*, 2012). Similarly, a study among health care workers in India demonstrated that there was poor knowledge of blood transfusion among the participants. The knowledge score of those having an experience of 5–10 years in the field of transfusion medicine, working at urban blood centres and who have received an additional training in blood transfusion were significantly higher (Dubey *et al.*, 2013).

A study among paramedical staff in France showed that half of the participants have moderate knowledge level. These results underscores the importance of strategies improving

the quality and the safety of blood transfusion(Letaief *et al.*, 2005). Another study that was conducted in France showed general knowledge about blood transfusion was insufficient in 53.9% of staff and excellent in 46.1% of staff. Only 42.9% of medical staff has a good basic knowledge of blood products, their indications, and related accidents. Overall, 70.9% of the staff did not receive any training in blood transfusion since their graduation. The study showed weaknesses in the transfusion system in their setting with insufficient knowledge of the medical staff in blood transfusion (Diakite *et al.*, 2012).

A survey in Aquitaine, France showed that poor knowledge was reported in several areas including pretransfusion compatibility test, delay in administering blood and recognition of abnormal reactions after blood transfusion. The survey concluded that poor knowledge and practice were mainly due to low training and transfusion activity (Saillour-Glénisson *et al.*, 2002). Similarly, a study that was carried out in hospitals of Zabol city, Iran showed that there was low and moderate level of knowledge in approximately half of the participants. The results strongly emphasized the need for a curriculum to promote knowledge of healthcare workers about blood transfusion (Piri *et al.*, 2009).

It was proposed that a more comprehensive educational program should be conducted, comprising both theoretical and practical aspects of transfusion medicine, in combination with several workshops during internship and after graduation . Based on the current evidence, it seems convincing enough to consider such educational program. Nevertheless, it is essential that additional studies be undertaken to decide an appropriate method of on-going education and its contents, especially in various settings and populations (Shafiee *et al.*, 2013).

2.4 Transfusion Safety

The main objective of the blood transfusion service is to provide safe and high quality blood transfusion to patients. The scope of “transfusion safety” extends much beyond than “safe blood unit” and depends upon the coordinated linkage of many processes from donor selection to blood administration. The safety of the transfusion process has yet to receive the same recognition and attention as blood safety (the safety of the donated blood unit). For example, positive patient identification to promote bedside sample labelling and to prevent mistransfusion has not been widely implemented (Maskens *et al.*, 2014). Thus, steps should be taken to improve transfusion safety in the future.

There is a strong case to improve safety by the use of a transfusion checklist for the transfusion process as has been previously recommended by SHOT. SHOT annual report 2012 recommended for correct patient identification and improved communication between the staff. These principles apply to all aspects of medical care, not just transfusion practice (Cohen and Bolton-Maggs, 2012)

Data from reporting systems demonstrate that non-infectious hazards are the leading cause of serious morbidity and/or mortality resulting from transfusion. However, the comprehensive data is difficult to be compiled to generate statistically significant information on patterns, trends, and root causes of such events. On the other hand, “near miss events” and “no harm events” are much more frequent and able to provide chance to improve patient safety (Elhence *et al.*, 2010).

The United Kingdom Serious Hazards of Transfusion (SHOT) program collected data on the full range of adverse transfusion events and revealed that mistransfusion accounts for the largest proportion of all adverse events. The frequency and types of errors observed suggested that the errors were inevitable and the mistakes were inherent to human nature.

Therefore, significant changes including the use of computerized instruments, should be implemented to the blood transfusion procedures (Dzik, 2007).

2.5 Transfusion procedures

The blood transfusion process is a complex, hazardous and high risk procedure (Lu *et al.*, 2013). However, good clinical practice could contribute to safe and effective transfusion. The practices involving avoidance of errors leading to 'wrong blood transfusion', appropriate decision-making on the use of blood, the monitoring of patients for adverse effects of transfusion and management of transfusion reaction could provide safe transfusion (Murphy *et al.*, 2011).

2.5.1 Ordering Blood for Transfusion

The decision for the transfusion should be depend on clinical judgement, taking into consideration of benefit and risk of transfusion, and possible alternative therapy. Blood transfusion benefit should outweigh the risks. Process and procedure should be in place to ensure patient safety (PDN, 2008). Thorough assessment of patients should be done prior to ordering blood transfusion. The assessment should include pre-transfusion history and physical examination such as full vital signs, detailed cardiorespiratory examination, and peripheral vascular examination. This pre-requisite will prevent clinicians from ordering transfusions solely based on the haemoglobin level and promote a more multifaceted clinical assessment in regard to patient's transfusion needs and thereby preventing unnecessary transfusions risk (Alam *et al.*, 2013).

2.5.2 Consent for transfusion

An informed consent must be sought from the patient following discussion about potential risks, benefits and possible alternatives. The patient should be given an opportunity to ask questions except when in an emergency situation only. A responsible family member must be asked to give consent, if the patient is unable to give consent for certain reason (PDN, 2008). Specifically, AABB standard recommended that at a minimum, elements of the consent should include the following a description of the risks, benefits, and treatment alternatives (including non-treatment), the opportunity to ask questions, and the right to accept or refuse transfusion (AABB, 2009).

2.5.3 Patient identification and blood sampling for compatibility testing

Accurate patient identification is one of the critical steps in blood transfusion procedures. Transfusion of blood to the wrong patient can result from errors made anywhere in the transfusion process. Errors can occur during blood sample collection, laboratory testing and handling of samples, blood retrieval from blood transfusion refrigerators and during the final bedside check just prior to transfusion (Murphy *et al.*, 2011).

Blood sample taking must be done at the bedside, one patient only at one time. The personnel performing blood sample taking must ensure that the patient is correctly identified either by checking the wrist band or by asking the patient to state his/her full name. All the details must be checked against the case note. In case of unconscious patients, identification must be done by checking the identity band such as wrist band (PDN, 2008). The sample labelling must be done immediately and accurately at patient's bedside by the same personnel who took the sample. Patient's identity should be carefully checked. The label

details include date, patient's full and patronymic name, date of birth, code number, clinic origin and signature (Gray and Illingworth, 2004).

2.5.4 Pre Transfusion Testing

Pre transfusion testing includes ABO and Rh D groups testing, antibody screening and compatibility testing. Compatible units of blood should be labelled specifically for the intended patient and may be issued immediately or held in the blood bank to be issued later upon request (PDN, 2008).

As ABO grouping is the most important part of pre-transfusion testing, it is recommended that a second sample should be requested for confirmation of the ABO group of a first time patient prior to transfusion, unless secure electronic patient identification systems are in place, where this does not impede the delivery of urgent red cells or other components (Milkins *et al.*, 2013).

2.5.5 Patient preparation before blood bag collection

Collecting a blood or blood product from blood bank should be carried out only when a patient is ready to receive the transfusion. Patient preparation include a clear medical order, readily available intravenous access, and administration of any pre-medications or other solutions (Saxena *et al.*, 2004). Compatible access route should be available as an inappropriate access causes delay in the transfusion and even the discarding of the blood component if the infusion period exceeds four hours (Mattia and Andrade, 2016).

Nurses should also provide adequate information to patients or relatives about the impending transfusion. The information should include the indication for blood transfusion, its risks and

benefits, and symptoms of transfusion reaction. Apart from that, the nurse should record baseline vital signs within 30 minutes prior to the initiation of transfusion (Hijji *et al.*, 2012).

2.5.6 Blood Bag Collection

Collection of blood from the blood bank was identified as a major source of error in the transfusion of the incorrect blood resulting from the collection of incorrect units. To prevent this error, documentary proof of the patient's identity must be brought together during blood collection. Details of the patient should be checked by blood bank personnel before issuing the blood. The blood bank personnel also must record down the date and time of issue, details of the person who issues and the person collecting the blood. The person collecting the blood also should check the details of the patient and blood bag before taking the blood component from the blood bank (PDN, 2008). Retrieval of the wrong blood from the blood refrigerator was a major cause of IBCT (incorrect blood component transfused) if error was not be able to be detected at the bedside because of inadequate checking (Murphy *et al.*, 2011).

2.5.7 Storage and Transport

Blood and blood component should be stored and transported at appropriate temperature to ensure that these compounds are kept at the optimal storage condition. Blood bags should be transported to the clinical area using a special blood transport box. Blood and blood components must be kept at the appropriate temperature and must be returned to the blood bank immediately if not used (PDN, 2008). Blood or blood products should be transported to the clinical area immediately in order to make sure that the infusion of blood and blood products can be done within 30 minutes (Lu *et al.*, 2013).

2.5.8 Pre-transfusion Procedure

Patient's vital sign such as blood pressure, pulse, respirations and temperature should be recorded in the chart or on the transfusion record form prior to administration of blood transfusion (Vasiliki, 2011). Prior to blood administration, the nurses should verify physician's orders for transfusion and checked for any pre-transfusion medications that have to be administered. Bedside verification of patient and component should be performed (PDN, 2008).

2.5.9 Identification check of intended recipient

The guideline from National Blood Centre recommended that procedure manuals must specify the identification checks that need to be carried out. The compatibility label that accompanied each unit of blood component supplied from the blood bank should carry the following informations:

- (a) Patient's full name
- (b) Patient's identity card or passport number
- (c) Patient's hospital registration number
- (d) Patient's ABO and Rh blood group
- (e) Unique pack number (donation number) of the blood product
- (f) Date of issue

Before initiating blood administration, the information on the compatibility label must be checked carefully against the patient's identification details on the blood request form and patient's case notes, including the patient's wristband. If there was any discrepancy of the details, especially the name and identification card number, then the blood should not be transfused. Besides, if there is deviation from the usual condition, the blood should not be

transfused. Any alteration in colour of the blood, presence of clot or leakage should be looked for. The person who administered the blood must record the date and time the transfusion was started. Date, time, and unit number should be recorded on the appropriate sheet on the patient's chart (PDN, 2008).

2.5.10 Initiating the transfusion

Immediately before transfusion, the blood bag should be mixed thoroughly by gentle inversion. If special filters and ancillary devices are required, manufacturer's instruction should be followed (PDN, 2008).

2.5.11 Patient monitoring

The patients should be monitored closely during blood transfusion procedure. The patient's vital signs should be recorded periodically during the transfusion and after the completion of each transfusion. Careful and close observation and monitoring for the first 5 to 10 minutes of the transfusion are very important. The first 50 ml of red cell should be transfused slowly as it serves as an in vivo compatibility testing. For unconscious patient, the vital signs should be checked at 15 minutes intervals during transfusion (PDN, 2008).

Patient should be periodically observed during the transfusion for any clinical features of acute transfusion reactions. These actions permit early detection and reporting of any adverse reactions (Mattia and Andrade, 2016).

2.5.12 Time limits for infusion of blood components

The infusion of red cells must start within 30 minutes of removing the pack from the blood refrigerator and must be completed within 4 hours to avoid risk of bacterial contamination. For the platelet concentrate, infusion should start as soon as possible and infusion should not be more than 30 minutes. The transfusion of fresh frozen plasma should be started as soon as the thawed pack is received from the blood bank and should be completed as tolerated by the patient (PDN, 2008).

2.5.13 Blood administration sets

All blood components should be administered using a blood administration set with an integral mesh filter with the size of 170-200 micron (Harris *et al.*, 2009). Fresh administration set should always be used for the infusion of platelets.

2.5.14 Blood warmers

Blood warmers are indicated to minimise the incidence of cardiac arrest and arrhythmia associated with massive transfusion of cold blood components. The use of blood warmers are limited to certain groups of patients such as those receiving multiple, rapid transfusion at rates of >50 ml/kg/hr in adult and >15ml/kg/hr in children, and infants undergoing exchange transfusion. The blood warmer device should have visible thermometer and an audible warning. Other methods such as placing it into hot water, in microwave, on radiator, under running water or near any uncontrolled heat source are prohibited. Blood which has been warmed must not be re-refrigerated for later use or reissued as warming may permit bacterial growth and tends to accelerate red cell metabolism producing haemolysis (PDN, 2008).

2.5.15 Simultaneous administration of drugs and fluids

Generally, no solution should be added to any blood component except for sodium chloride 0.9% solution that is used to improve flow rate of red cell transfusion. No other solutions should be added to any blood components to avoid change on blood components properties. For example, 5% dextrose solution can lead to haemolysis and ringer lactate which contain calcium additive can cause citrated blood to clot (PDN, 2008).

Administration of drugs should never be done directly to any blood components as this will make it impossible to determine cause of reaction if patient develop reaction. In a situation when medication has to be administered and the transfusion line is the only venous access available, the transfusion must be stopped first and the tubing should be flushed with 0.9% normal saline before and after injecting the medication to prevent direct mixing of the blood and medication (PDN, 2008).

2.6 Transfusion error

Transfusion errors occurred at every point in the transfusion process, with the greatest potential risk of patient harm resulting from inappropriate ordering of blood products and errors in sample labeling. A total of 15,134 errors were reported from 2005 to 2010 in Sunnybrook Health Sciences Centre (Toronto, Ontario) with 23 errors resulted in patient harm. Errors with no harm were 657 times more common than events that caused harm to the patient. The most common errors in clinical setting were sample labeling (37.5%) and inappropriate ordering of blood (28.8%) (Maskens *et al.*, 2014).

There were multiple factors can contribute to errors during the pretransfusion checking limiting the effectiveness of any individual intervention designed to improve safety (Heddle

et al., 2012). One haemolytic transfusion reaction (0.003%) was reported in a study that was done at Blood Bank Unit of Universiti Kebangsaan Malaysia Medical Centre (UKMMC) 2011, and this was due to an error in patient identification in the ward (Rabeya *et al.*, 2011).

Blood transfusion however, is a complex, multi-step process and there is potential for error at each stage. The Serious Hazards of Transfusion haemovigilance reporting scheme have demonstrated each successive year since it was established, that the most common risk reported was the transfusion of the wrong blood component (SHOT, 1997–2007). Major causes cited were incorrect identification of the patient at the time of collection and at the ‘final bedside check’ (Smith *et al.*, 2010).

Blood transfusion was performed with a lot of complications in the beginning of the 20th century. Nowadays these complications are limited by improvement in the knowledge of health care workers and knowledge of blood function. Error in transfusion could lead to mortality thus awareness of this error is very crucial. Errors include, sampling processing errors, pre-transfusion testing errors, incorrect component collected or component for another patient and blood component issued before expiry but out of date (Bolton-Maggs and Cohen, 2013).

Transfusion of the wrong blood to the wrong patient is a frequent cause of transfusion-associated morbidity or mortality. Errors leading to this event can possibly occur at either these five different stages which are wrist-banding the patient, sample collection, laboratory testing, issuing of blood products, and the time of blood administration. Sample collection errors (referred to as wrong blood in tube) could occur when pre-transfusion samples are taken from the wrong patient or labelled incorrectly. The incidents of sample collection errors are variable with one study estimating a median event rate of 6.6 events per 1000 samples collected. Example of laboratory errors includes testing with the wrong sample, selection of the wrong blood, and issuing the wrong blood. Finally, errors can occur in the

clinical area during the final pre-transfusion checking, resulting in transfusion of wrong blood to a patient (Heddle *et al.*, 2012).

Blood collection and administration are the stages of greatest risk in transfusion chain. Blood checking away from the bedside, distraction of nursing staff, problems in patient's wristband and blood administration in clinical urgent situations are some of the factors that induce the occurrence of these events (Stainsby, 2007). Undoubtedly, these errors can lead to fatal outcome. Consistently, failure to carry out a pre-transfusion "bedside" check is the commonest error. The requirements of bedside checking include positive patient identification, checking wristband, matching patient's identity with blood request form and review of compatibility and expiry data information. This pre-transfusion checking must be performed for each component administered. Presence of any discrepancies at this point should halt the transfusion process until the problem have been resolved (Dzik, 2007).

The final pre-transfusion bedside check is the most critical step in preventing transfusion error since it is the final opportunity to detect any errors that occurred prior to that. Previous studies have reported that the main cause of ABO incompatible transfusion is due to incorrect identification of the patient at the patient's bedside (Fujii *et al.*, 2009). In spite of the fact that patient identification is an essential point for transfusion safety, some audits of the bedside patient and blood product identification process have consistently shown an alarmingly low rate of compliance with identification measures (Turner *et al.*, 2003).

A previous study showed that deficits in nurses' education, training and low transfusion frequency had strong negative impact on the incidence of transfusion errors. This was supported by evidence that the performance of well-trained nurses who transfused either daily or weekly and strictly followed transfusion guidelines was associated with a lower transfusion error rate (Jimenez-Marco *et al.*, 2012).

2.7 Complications of Transfusion

Blood transfusion is one of the essential parts in modern clinical practice and is not without risks (Smith *et al.*, 2010). In last few decades, many studies have discovered errors at all stages in the transfusion process, and there have been many actions to minimize the incidents of errors. The initiatives have primarily focussed on education and training, but a variety of innovations in technology including bar coding and the use of hand held computers have reported promising results. Finding improvement in training and supporting the staff directly involved in the transfusion process remains essential (Davis *et al.*, 2011).

The most frequent adverse event associated with the administration of blood products is transfusion reaction, occurring in up to one in 100 transfusions. A transfusion reaction can lead to morbidity of the patient and extra cost burden to the health-care system. Although rare, transfusion reactions can cause mortality, with transfusion of about one in 200 000 – 420000 units associated with death. Given the broad range of risks, the health care workers should have accessible information about the nature, definitions, and management of transfusion-related adverse events (Delaney *et al.*, 2016).

Blood transfusion is one of the vital life-saving therapies for critically ill patients. However, proper and appropriate use of blood products and the ability to prevent and control their potential complications are also of great significance. The most common complications include acute transfusion reactions, delayed transfusion reactions, transfusion-related acute lung injury (TRALI), transfusion transmitted infections, and transfusion-associated graft-versus-host disease (GVHD). On the other hand, ABO incompatibility has always appeared to be the top of the list of transfusion-related complications; given that without ABO compatibility testing, approximately one third of blood transfusions would give rise to a haemolytic transfusion reaction (Shafiee *et al.*, 2013).