

**Knowledge of Blood Transfusion among Nurses in Hospital Pulau Pinang:
Nursing Responsibilities and Patient Management
Related to Transfusion Reactions**

By

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**Dissertation submitted in partial fulfilment
of the requirement for degree of
Master of Science - Transfusion Science (Mixed Mode)**

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DECLARATION

I hereby declare that I am the sole author of the thesis entitled “Knowledge of Blood Transfusion among Nurses in Hospital Pulau Pinang: Nursing Responsibilities and Patient Management Related to Transfusion Reactions”. I declare that this thesis is being submitted to Universiti Sains Malaysia (USM) for the purpose of the award of Master of Science in Transfusion Science. This dissertation is the result of my own research under the supervision of Dr. Sharifah Azdiana binti Tuan Din and Dr. Nur Arzuar bin Abdul Rahim, except for quotation and citation which have been duly acknowledged. I also declare that this dissertation has not been previously or concurrently submitted for any other degree at USM or their institutions.

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TABLE OF CONTENT

RESEARCH TITLE	i
DECLARATION	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENT	iv
LIST OF TABLES	ix
LIST OF FIGURES	xii
LIST OF ABBREVIATIONS	xiii
LIST OF APPENDICES	xiv
ABSTRAK	xv
ABSTRACT	xvii
CHAPTER ONE: INTRODUCTION	1
1.1 Overview	1
1.2 Introduction	1
1.3 Problem Statement	3
CHAPTER TWO: LITERATURE REVIEW	4
2.1 Introduction	4
2.2 Blood transfusion service (BTS)	4
2.2.1 Overview	4
2.2.2 Blood transfusion	5
2.2.3 Administration of blood and blood products	6
2.2.3.1 Overview	6
2.2.3.2 Decision to transfuse	6

2.2.3.3	Patient preparation before collecting blood units from storage site	8
2.2.3.4	Blood bag collection	9
2.2.3.5	Pre-transfusion activities	10
2.2.3.6	Post-transfusion activities and monitoring	13
2.3	Nursing practice and transfusion safety	16
2.3.1	Overview of nurses' roles	16
2.3.2	Previous studies	16
2.4	Knowledge and Transfusion Safety	20
2.4.1	Knowledge and practice	20
2.4.2	Bloom's taxonomy	21
2.4.3	Multiple Choice Questions (MCQs)	24
2.4.4	Guidelines on designing MCQs	25
2.4.4.1	Overview	25
2.4.4.2	Process of developing MCQs	26
CHAPTER THREE: OBJECTIVES		30
3.1	General objective	30
3.2	Specific objectives	30
3.3	Operational definition	31
3.3.1	Definitions	31
3.3.2	Knowledge score grading criteria	32
CHAPTER FOUR: METHODS		33
4.1	Overview of research methodology	33
4.1.1	Summary of research protocol	34
4.2	Research Background	35
4.2.1	Study design	35
4.2.2	Study location	35
4.2.3	Duration of the study	35
4.2.4	Ethical consideration	36
4.3	Development of Research Tool	36
4.3.1	Questionnaire design	36
4.3.2	Validation of questionnaire	38

4.3.2.1	Overview	38
4.3.2.2	Pilot study	39
4.3.2.3	Face validity	42
4.3.2.4	Content Validity	43
4.3.2.5	Test-retest reliability	48
4.3.3	Finalisation of questionnaire	50
4.4	Data collection	50
4.4.1	Consent and confidentiality	50
4.4.2	Subject vulnerability and risk	50
4.4.3	Sampling Criteria	51
4.4.3.1	Target population	51
4.4.3.2	Population sample	51
4.4.3.3	Sample unit	51
4.4.3.4	Sampling method	51
4.4.3.5	Inclusion criteria	52
4.4.3.6	Exclusion criteria	52
4.4.3.7	Withdrawal criteria	53
4.4.3.8	Sample size calculation	53
4.4.4	Data collection	54
4.4.4.1	Subject recruitment and participation	54
4.4.4.2	Procedures of data collection	54
4.5	Data Analysis	55
CHAPTER FIVE: RESULTS		56
5.1	Overview	56
5.2	Socio-professional characteristics	56
5.2.1	Gender	56
5.2.2	Age	57
5.2.3	Years of Service	57
5.2.4	Education level	58
5.2.5	Frequency of Transfusion	59
5.2.6	Departments	60
5.2.7	Years of service in current department	61
5.2.8	Area with sufficient knowledge	61

5.2.9	Area that need more training or education	62
5.2.10	Availability of policy at wards	63
5.3	Overall knowledge scores	63
5.4	Knowledge score per sections	65
5.4.1	Blood bag collection from blood bank and patient preparation before transfusion	65
5.4.2	Pre-transfusion nursing responsibilities	66
5.4.3	During and post-transfusion nursing responsibilities and management of adverse reactions	67
5.5	Association of knowledge score with socio-professional factors	68
5.5.1	Gender and knowledge score	68
5.5.2	Age and knowledge score	68
5.5.3	Age groups and knowledge score	69
5.5.4	Years of service and knowledge score	70
5.5.5	Years of service (grouped) and knowledge score	70
5.5.6	Educational level and knowledge score	71
5.5.7	Frequency of transfusion and knowledge score	71
5.5.8	Departments and knowledge score	72
5.5.9	Years of service in current department and knowledge score	73
5.5.10	Years of service in current department (grouped) and knowledge score	73
5.5.11	Felt confident or unconfident to particular section and corresponding section knowledge score	74
5.5.12	Availability of policy and knowledge score	78
5.5.13	Had read policy and knowledge score	79

CHAPTER SIX: DISCUSSIONS **80**

6.1	Overview	80
6.2	Test-retest reliability test	80
6.3	Overall knowledge scores	81
6.4	Association of knowledge score with socio-professional details	82
6.5	Knowledge deficiencies	84
6.6	Study limitations	86

CHAPTER SEVEN: CONCLUSIONS	88
7.1 Conclusion	88
7.2 Future studies	88
7.3 Recommendations	89
REFERENCES	90
APPENDICES	96

LIST OF TABLES

		Page No.
Table 4.1	Summary of research questionnaires	37
Table 4.2	Pilot study data analysis – Socio-professional details and association with knowledge scores	41 – 42
Table 4.3	Pilot study data analysis – Area that felt lacking of knowledge and mean knowledge score from corresponding section	42
Table 4.4	Grading scale for content validity index	44
Table 4.5	Calculation of I-CVI, S-CVI/UA, S-CVI/Ave of knowledge items	44 – 45
Table 4.6	Knowledge items, kappa value, and <i>p</i> value	48
Table 4.7	Sample Size calculated based on each specific objectives	53
Table 5.1	Gender and frequencies	56
Table 5.2	Age group and frequencies	57
Table 5.3	Years of service (grouped) and frequencies	57
Table 5.4	Education level and frequencies	58
Table 5.5	Frequency of transfusion in the past one year and frequencies	59
Table 5.6	Classification of sampling wards into department and frequencies	60
Table 5.7	Years of service in current department (grouped) and frequencies	61
Table 5.8	Area with sufficient knowledge and frequencies	61
Table 5.9	Area with need more training or knowledge and frequencies	62

Table 5.10	Availability of policy at wards and frequencies	63
Table 5.11	Knowledge scores scaled to percentage and frequencies	63
Table 5.12	Number of correct, wrong and missing responses in Section 2	65
Table 5.13	Number of correct, wrong and missing responses in Section 3	66
Table 5.14	Number of correct, wrong and missing responses in Section 4	67
Table 5.15	Gender and knowledge score	68
Table 5.16	Age and knowledge score	68
Table 5.17	Age groups and knowledge score	69
Table 5.18	Year of service and knowledge score	70
Table 5.19	Years of service (grouped) and knowledge score	70
Table 5.20	Educational level and knowledge score	71
Table 5.21	Frequency of transfusion and knowledge score	71
Table 5.22	Departments and knowledge score	72
Table 5.23	Year of service in current department and knowledge score	73
Table 5.24	Years of service in current department (grouped) and knowledge score	73
Table 5.25	Subjects' responses on their confidence to their knowledge in section 2 with the corresponding section score	74
Table 5.26	Subjects' responses on lacking of knowledge in section 2 with the corresponding section score	75
Table 5.27	Subjects' responses on their confidence to their knowledge in section 3 with the corresponding section score	75
Table 5.28	Subjects' responses on their lacking of knowledge in section 3 with the corresponding section score	76

Table 5.29	Subjects' responses on confidence to their knowledge in section 4 with the corresponding section score	77
Table 5.30	Subjects' responses on their lacking of knowledge in section 4 with the corresponding section score	77
Table 5.31	Availability of blood administration policy at ward and knowledge score	78
Table 5.32	Had read policy and knowledge score	79

LIST OF FIGURES

	Page No.
Figure 2.1 Bloom's taxonomy of cognitive domain	22
Figure 2.2 Revised Bloom's taxonomy of cognitive process	23
Figure 2.3 Process of constructing MCQs	26
Figure 4.1 Methodology flowchart	34
Figure 5.1 Graph of frequencies of knowledge score in groups	64

LIST OF ABBREVIATIONS

A&E	Accident and Emergency
AECU	Ambulatory Emergency Care Unit
AMDI	Advanced Medical and Dental Institute
ANOVA	Analysis of Variance
BTS	Blood Transfusion Service
CCU	Cardiac Care Unit
CSSD	Central Sterile Services Department
CTC	Clinical Trial Centre
ENT	Ear, Nose, Throat
HPP	Hospital Pulau Pinang
ICU	Intensive Care Unit
MCQs	Multiple Choice Questions
OBG	Obstetrics and Gynaecology
OPD	Out-Patient Department
SBA	Single Best Answer
SHOT	Serious Hazards of Transfusion
WHO	World Health Organization

LIST OF APPENDICES

		Page No.
APPENDIX A	Permission from Author	96 – 97
APPENDIX B	Ethics Approval from JEPeM	98 – 100
APPENDIX C	Ethics Approval from NMRR	101 – 102
APPENDIX D	Approval from CRC HPP	103 – 105
APPENDIX E	Expert Group Meeting Attendance	106 – 107
APPENDIX F	Content Validity Meeting Attendance	108
APPENDIX G	Routine Blood Transfusion Knowledge Questionnaire (RBTkQ)	109 – 112
APPENDIX H	Pre-validated research questionnaire	113 – 114
APPENDIX I	Participant Information Sheet and Consent	115 – 118
APPENDIX J	Research Questionnaire	119 – 120

ABSTRAK

Darah adalah produk yang berharga dan unik yang diperolehi daripada manusia. Darah amat penting untuk menyelamatkan nyawa dan memulihkan kesihatan manusia. Data dari Serious Hazards of Transfusion (SHOT) menganggarkan lebih kurang satu kes pemindahan darah yang salah berlaku bagi setiap 13, 000 transfusi. Kebanyakan kesilapan berlaku di bahagian klinikal. Kegagalan mengenalpasti pesakit yang betul, sama ada semasa pengambilan sampel darah atau di tepi katil pesakit sebelum pemindahan darah, merupakan punca utama yang menyebabkan morbiditi dan kematian pesakit yang serius. Justeru, kajian ini bertujuan untuk menilai tahap pengetahuan jururawat mengenai pemindahan darah and mengkaitkan skor dengan faktor sosio-profesional.

Kajian ini menggunakan borang soal selidik untuk menilai tahap pengetahuan. Borang kajian soal selidik telah direka, disahkan, dan digunakan untuk menjalankan kajian perintis untuk memastikan kesahihan dan kebolehpercayaan. Borang soal selidik yang muktamad terdiri daripada 22 soalan tentang pengetahuan berkaitan dengan proses pemindahan darah dan 8 soalan mengenai sosio-profesional. Borang soal selidik ini diedarkan kepada 185 jururawat di Hospital Pulau Pinang yang mengambil bahagian dalam kajian ini. Data dianalisa dengan SPSS.

Secara keseluruhan, tahap pengetahuan adalah sederhana, dengan skor purata 70.44% (SD = 11.35). Tiada jururawat yang dapat menjawab semua soalan

dengan betul. Tahap pengetahuan mengenai kutipan produk darah dari tabung darah dan penyediaan pesakit sebelum pemindahan darah adalah 72.29%, aktiviti kejururawatan sebelum pemindahan darah 71.75%, tanggungjawab jururawat semasa dan selepas pemindahan darah serta mengendalikan pesakit semasa berlakunya reaksi pemindahan darah 67.14%. Faktor-faktor seperti usia, tempoh perkhidmatan dan adanya polisi pemberian darah dalam wad menunjukkan perbezaan yang signifikan dalam tahap pengetahuan jururawat. Kekurangan pengetahuan telah dikenalpasti dalam topik mengenai kumpulan darah yang asas, tempoh sah sampel darah untuk GXM, meninggalkan langkah pemeriksaan darah sebelum pemindahan darah, jangkitan bakteria sekiranya masa pemindahan darah dilanjutkan dan kesedaran tentang kegagalan mengenalpasti pesakit yang betul.

Sebagai kesimpulan, tahap pengetahuan jururawat mengenai pemindahan darah di Hospital Pulau Pinang adalah sederhana. Lebih banyak seminar atau ceramah berkenaan dengan transfusi darah dicadangkan supaya jururawat dapat menambah pengetahuan di dalam bidang pemindahan darah. Jururawat perlulah melengkapi diri dengan pengetahuan asas yang secukupnya untuk melaksanakan tugas dengan baik.

ABSTRACT

Blood is precious and unique products, derived from human being. It is essential in saving lives and improve human health. Results from Serious Hazards of Transfusion (SHOT) reported that approximately one wrong blood transfusion occur in every 13, 000 transfusions. Most errors of wrong blood transfusion occurred at clinical area. Failure to perform positive patient identification, either during pre-transfusion sampling or final bedside checking, remains as the leading cause of major transfusion related morbidity and mortality. Hence, this study aims to determine the knowledge level of one of the major role in blood transfusion service, the nurses and associate this knowledge with their socio-professional details.

To assess the knowledge, a cross sectional, questionnaire based study was carried out. The research tool was designed, validated and pilot-tested to ensure its validity and reliability. The finalised questionnaire consisting of 22 knowledge items related to blood transfusion process and 8 socio-professional items was then distributed to the 185 nurses at Hospital Pulau Pinang who participated in this study. Data analysis was done with SPSS.

The overall knowledge score was moderate, with the mean score of 70.44% (SD = 11.35). None of the nurses was able to answer all the items right. The

knowledge in blood bag collection and patient preparation, pre-transfusion nursing activities, during and post transfusion nursing responsibilities and management of transfusion reactions were 72.29%, 71.75% and 67.14%, respectively. Factors such as age, years of service, departments and availability of policy at wards had significant difference in the mean knowledge scores. Knowledge deficits were identified in basic blood group terminologies, validity duration of GXM sample, skipping of blood checking steps, bacterial contamination following prolonged transfusion and commonest cause of fatal transfusion reactions.

As conclusion, the knowledge of nurses in Hospital Pulau Pinang was moderate. More seminar or blood transfusion talk should be organized to improve their knowledge. Knowledge is the fundamental that drives our practice and to perform well, one must equip himself with sufficient knowledge.

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter covers some brief introduction on blood transfusion service, current issue and knowledge gap on competencies of clinical staffs, especially nurses. This chapters highlighted the problem statements and objectives of this study.

1.2 Introduction

Over the last few decades, blood and blood component transfusion have been a lifesaving therapy and are commonly practiced in clinical settings (Szczepiorkowski and Dunbar, 2013). While blood transfusion is a complex process which involves more than 70 steps, it is very prone to errors (McClelland et al., 1996). Every single step need to be carefully monitored and recorded to avoid errors and ensure traceability. Safe blood transfusion requires the collaboration from different parties of medical practitioners, including doctors, laboratory staffs and most importantly, the nurses (Hogg et al., 2006).

Nurses play an important role in blood transfusion process. Their responsibilities cover from pre-transfusion sampling, requesting blood from blood banks, collecting blood products, administrating the transfusion and monitoring patients' vitals before, during and after transfusion event (Gray et al., 2007). Errors in practice may therefore lead to severe, and sometimes life-threatening

consequences to the patients (Gray et al., 2007). According to Serious Hazards of Transfusion (SHOT) report 2014, there was a total of 278 cases of incorrect blood components transfused; of these, 156 (56.1%) occurred at clinical area while the remaining ones happened at laboratory area. Main contributing cause was human error, including misidentification of patients during sampling or commencement of transfusion, collection of wrong blood units from storage sites and incorrect patients' details on blood sample or blood request forms (Smith et al., 2010). These are commonly associated with the poor nurses interventions or lack of knowledge on the blood transfusion process (Wilkinson and Wilkinson, 2001). Knowledge is a person's understanding towards the subject (Kaliyaperumal, 2004), in our context, blood transfusion. As knowledge is the base which drives one's action, deficiency in knowledge can lead to poor performance and judgement. Previous studies by Saillour-Glénisson et al. (2002) in France and Hijji et al. (2012) in Arab had reported that the knowledge among nurses in blood transfusion is somewhat lacking. Despite of the extensive research and revision in establishing practices and protocols in the service, safety and effectiveness of blood transfusion could be compromised if there is lack of knowledge or skills in healthcare workers (Hijji et al., 2010). Therefore, the healthcare worker especially nurses must always be competent and careful while performing the procedure (Panagiotopoulou and Kerr, 2002).

The aims of this study are to determine the knowledge of nurses in handling blood transfusion event. The findings from this study help to identify areas of weaknesses and highlight the needs to devise educational and training policies for improvements.

1.3 Problem Statement

Nurses are generally trained on the procedures of blood transfusion during their years of service. However, their level of knowledge varies from one another, as well as from different healthcare centres. Studies had been done by Saillour-Glénisson et al. (2002) and Hijji et al. (2010 & 2013), which evaluated the knowledge of the nurses in blood transfusion at France and Arab, respectively. Nevertheless, in Malaysia, there is limited study on assessment of nurses' knowledge on blood transfusion. Thus, this addresses a knowledge gap between the nurses' knowledge and transfusion safety in local clinical service. In this study, the knowledge of nurses at various stages of blood transfusion will be assessed and the data collected shall pinpoint the area for improvements. This will then allow policies makers to make adjustments and outline strategies to improve the quality of blood transfusion service in their healthcare facilities.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter provides overview based on established knowledge and research done previously on the related fields. The topics covered include blood transfusion service and its safety, the responsibilities of nurses in blood administration and approaches in assessing the knowledge level.

2.2 Blood transfusion service (BTS)

2.2.1 Overview

Blood transfusion remains as an important therapeutic and life-saving approach in managing anaemic, traumatised, or major haemorrhagic resuscitation cases (Shander et al. 2013). The goal of blood transfusion service is to provide appropriate, safe and sufficient blood products to the patients in-need (World Health Organization 2015). Blood transfusion service (BTS) is multistep process which includes blood collection, screening of transfusion-transmitted infections, processing, storage of blood products and distribution. This requires collaborative efforts from numerous parties to ensure its safety and efficacy. Yearly, over three million of blood transfusions are done in local hospitals and medical centres in Malaysia (Ayob 2010).

2.2.2 Blood transfusion

Since its establishment on the early twentieth century, blood transfusion has been one of the most common procedures done to hospitalised individuals, where blood or its constituents are infused to the individuals through intravenous administration (Aulbach 2013). The transfusion of blood products is essential in restoring the body oxygen transport capacity or replenishing loss or depleting components of blood (Singer et al. 2015). However, blood transfusion does possess certain risks to the recipients, including transmissions of transfusion-transmitted infections (TTIs), acute or delayed transfusion reactions, alloimmunisation and immunomodulation (Clevenger & Kelleher 2013). Extensive research and efforts had been done to prevent these undesired events.

Nonetheless, errors in blood transfusion can lead to severe morbidity or even mortality to the recipients (Norfolk 2013). Statistics showed that most transfusion errors are due to human factors, which are preventable through trainings and revision of transfusion protocols (Holmberg 2015). Hence, healthcare workers who play a part in blood transfusion service must always be competent and cautious to provide not harm, but safe and beneficial transfusion therapy to the patients.

2.2.3 Administration of blood and blood products

2.2.3.1 Overview

Administration of blood and blood products is complex process which must be performed by trained and competent personnel.

Hijji et al. (2012) described administration of blood products as five phasic procedures, as stated below:

1. Decision to transfuse
2. Patient preparation before collecting blood units from storage site
3. Blood bag collection
4. Pre-transfusion activities
5. Post-transfusion activities and monitoring

While decisions to transfuse are determined by physicians, the latter phases are controlled by the operators, nursing staffs (Hijji et al. 2012). All phases need to be monitored and safeguarded by multiple parties to ensure the efficacy and efficiency in transfusion. Safe blood administration must be accompanied by proper documentation of related tasks, especially on reasons, time or durations and operators to ensure traceability and facilitate lookback procedure (Norfolk 2013).

2.2.3.2 Decision to transfuse

Based on clinical judgements, medical practitioners will have to weigh risks and benefits and decide whether or not to give a patient blood transfusion therapy

(Ayob et al. 2008). A series of guidelines have been published regarding indications for transfusion of blood and blood products. However, the adherence and compliance to these guidelines are still heavily dependent on the clinicians' practice and attitudes. All decisions must be backed up with appropriate evidence and justification. Liberal and unnecessary transfusion should be avoided as allogeneic blood possess great risks that may do more harms than goods to the patients. Other alternatives should be considered to replace or avoid the use of transfusion, such as saline colloid replacement, good surgical or anaesthetic management and well-planned surgery (Wood et al. 2011). If transfusion is unavoidable, the reason of transfusion must be clearly recorded (Ayob et al. 2008).

Medical practitioners must provide patients with proper information for them to make decision whether to accept blood transfusion. Patients must be briefed about the goal of therapy, procedures, possible risks and alternatives to the transfusion therapy (McClelland 2007). An informed consent must always be obtained from the patient before commencing the transfusion (Ayob et al. 2008).

Blood products requests must be duly filled in with the necessary information, including patients' details, diagnosis, indications for transfusion, previous history which are relevant to blood transfusion such as pregnancy, transfusion reactions, types of blood components needed and urgency of request (Norfolk 2013). If there's any special requirements such as irradiation, leukoreduction, it must be clearly stated down as well (Norfolk 2013).

2.2.3.3 Patient preparation before collecting blood units from storage site

Upon the prescription of blood transfusion by clinicians, a pre-transfusion blood sample must be obtained for blood grouping and compatibility testing. Nurses or medical doctors are responsible to undertake this task. Positive patient identification is the critical point in this step. A patient must be correctly identified by asking them to state their name, address or date of birth. This will then be counter-checked with the identification wristbands which patients' wear. If the patient is unconscious, the relatives may help to identify the patient. After bleeding the patient, operators need to label the blood at patient's bedside. This is to ensure right blood is in the right tube. Labels on blood tube should be handwritten and must contain patient's name, identity card number or hospital registration number, operator's initials and sampling time and date (Ayob et al. 2008). Pre-printed label is not recommended to be used as this increase the risks of errors (Ayob et al. 2008). This sample can then be sent to transfusion medicine laboratory or blood bank for testing.

Pre-transfusion sampling is one of the commonest steps where errors occur and causes fatal blood transfusion reactions (Bolton-Maggs 2013). Errors occur when operator fails to identify the correct patient for sampling or wrongly labels the sample (Bolton-Maggs 2013). Thus, operators are advisable to focus and handle one patient at one time to prevent mixing up the samples (McClelland 2007). Often, these human errors are preventable by implementation of better workflow instructions and trainings.

2.2.3.4 Blood bag collection

Blood units which are prepared and readily available for transfusion are stored at blood bank before they are issued to individual wards. The storage temperature must be monitored from time to time to maintain the viability of blood components (Ayob et al. 2008). Collection of blood units from the storage site imposes another high risk area for mistakes to occur. Wrong blood unit collection occurs when the staff fails to check the labels attached to blood units against the identification details (Harris et al. 2012).

To collect blood products from storage site, nursing staffs must bring along proper documents to prove patient's identity (Harris et al. 2012). This details must be checked against the labels on the blood bag. Besides that, nurses must also check on both patient's and donor's ABO and RhD blood group as well as the compatibility results. This is to ensure that compatibility blood is given to the right patient. Hence, nursing staffs should equip themselves with adequate knowledge in basic blood group system. Furthermore, the blood units should also be checked for any signs of leakage, lysis, contamination or unusual appearance which indicates the impaired quality of the products (Ayob et al. 2008). Upon issuing blood products out of storage site, the date, time and involved personnel must be properly recorded.

After collection, blood units must be immediately transported back to the site of transfusion. The blood products must be kept at appropriate temperature during transportation to preserve their quality. Only validated blood transport box can be

used to transport blood units (Harris et al. 2012). To transport whole blood, packed red blood cells and plasma products, blood box must be added with ice packs to maintain the cold chain (Ayob et al. 2008). However, the ice packs must not be in direct contact with the blood bag as this may lead to haemolysis of cellular components (Norfolk 2013). Platelets must not be transported with ice because cold temperature will inactivate the clotting ability of platelets (Norfolk 2013). Any violation to the storage conditions may impair the quality of blood products and render the transfusion ineffective.

2.2.3.5 Pre-transfusion activities

Before initiating transfusion, nurses must prepare patient for transfusion therapy. Patient must be well informed and psychologically prepared for the therapy he is about to receive (Hurrell 2014). Nurses must ensure that patent intravenous access is available and obtain the baseline vitals (pulse, temperature, blood pressure, respiratory rate) prior to obtaining blood units from storage site, to avoid any delay that would compromise the quality of blood products (Hurrell 2014; Ayob et al. 2008). If patient is medically unfit to receive blood, transfusion must be halted and blood units must remain kept at its storage site.

After blood unit reaches the ward, transfusion must be commenced immediately or at most 30 minutes after blood unit is removed from controlled temperature storage (McClelland 2007). A final blood checking step must always be done at the patient's bedside, despite the cases that patient is actively bleeding, unconscious, after-hours transfusions, or nurses know the patient well . Before

starting the blood transfusion, final bedside checking must be done by trained and competent staff who will administer the blood products, together with another trained personnel, either nurses or medical practitioners as a counter-checker (Hurrell 2014). This serve as the final defence to ensure right blood is transfused into the right patient. Should there is any discrepancy between patient's identity wristband, blood request form and blood unit labels, nursing staff must inform blood bank immediately and transfusion must not be commenced until the discrepancy has been resolved (Ayob et al. 2008).

Blood warming is the procedure of warming the blood units, specifically whole blood or packed red blood cells, to achieve temperature closer to human body before transfuse to patient (Harris et al. 2012). This is to prevent hypothermia and cardiac complications (Harris et al. 2012; Ayob et al. 2008). Blood warming is not done for routine blood transfusion practice. It is only recommended for rapid transfusion of large volume of blood, neonatal transfusion and patients having cold antibodies. Blood warming procedure must be done with calibrated blood warmer machine and shall not exceed 42°C as higher temperature will cause lysis to the red cell membrane (Maynard 2014). In addition, warming plasma products and platelets had shown to be neither beneficial nor harmful to the patients (Harris et al. 2012).

Before initiating a transfusion, there must be clinical staffs available to monitor patient's condition over the entire transfusion episode (McClelland 2007). Hence, as there are limited staffs working at night shift, transfusion after working hours

is inadvisable and can only be performed if deemed crucial to patient's survival or health. Infusion of blood products must be done through a blood administration set incorporated with an aggregate filter of 170µm to 200µm (Wood et al. 2011). Microaggregate filter with size of 20 - 40 µm can trap deteriorating platelets, fibrins or small clots of erythrocytes but it is not routinely used (Ayob et al. 2008). It is only indicated for patients undergoing cardio-pulmonary bypass or those with pulmonary abnormalities receiving massive transfusion (Ayob et al. 2008). Platelet transfusion must never share the same blood administration set that was previously used for with red blood cells products (McClelland 2007). New administration set must be used. Besides that, blood administration set must be changed at every 12 hours to reduce the possibility of bacterial colonisation on the set (Wood et al. 2011). In severe haemorrhagic cases, two intravenous accesses might be needed to administer two different blood products simultaneously.

During transfusion, no solution other than saline can be infused together with blood products (Cliffe & Bond 2014). Normal saline is usually used to improve flowrate of packed red blood cells and maintain intravenous access until the transfusion of next blood unit (Wood et al. 2011). Other solution or medications should not be administered through the same giving set as it may impair the quality of blood products. As an example, calcium-containing fluids such as Ringer's lactate will chelate the citrate anti-coagulant, diminishing its function and cause blood clots formation (Norfolk 2013). Hypotonic solution such as 5% dextrose will hemolyse red blood cells (Norfolk 2013). Furthermore, if patient develops any undesirable response, it is hard to tell whether the culprit is the

blood unit or medication (Harris et al. 2012). Medications should only be given beforehand or after completion of transfusion (Norfolk 2013). If simultaneous administration is deemed necessary, two separate intravenous access should be used for each product (Norfolk 2013).

Transfusion of red cells components must be completed within four hours whereas platelet transfusion is to be completed within 30 minutes (Ayob et al. 2008). For plasma products, transfusion must be commenced shortly after thawing, at the infusion rate bearable by the patient (Ayob et al. 2008). Extending the transfusion duration beyond the recommended time subjects patients to increased risk of getting sepsis (Wood et al. 2011).

Nurses must clearly note down the time of commencing transfusion, patient's vitals and conditions. This information ensures traceability and makes great help to the investigation especially when patients develop undesired symptoms or reactions during blood transfusion. Patients must also be reminded to inform nursing staffs immediately if they feel uneasy or have any reaction.

2.2.3.6 Post-transfusion activities and monitoring

Patient must be monitored from time to time for any undesired event. After initiating transfusion, nursing staffs must closely observe the patient for the first 5 - 10 minutes, as stated in the local policies (Ayob et al. 2008). Serious Hazards of Transfusion (SHOT) reported that more than 60 percent of transfusion

reactions happened at the first 30 minutes of transfusion (Wood et al. 2011). Hence, the first 30 minutes is deemed critical for transfusion event. Besides that, first 50ml blood must be transfused slowly for us to examine how the patient's body responds to the blood product (Ayob et al. 2008). If the blood product is incompatible, the patient will develop acute transfusion reactions and nursing staffs can take immediate actions to minimise the damage to patients.

Vitals signs (body temperature, cardiac rate, respiratory rate and blood pressure) must be taken at the first 5 to 10 minutes, 30 minutes and subsequent hours and after ending of transfusion (Ayob et al. 2008). For unconscious patients, the assessments need to be done every 15 minutes. These data are compared to the baselines taken before the transfusion. Should there's any significant changes to the readings, appropriate intervention must be taken and transfusion may be halted (McClelland 2007).

Nurses must also be well trained to recognise different transfusion reactions. Common acute symptoms reported are fever with increment more than 1°C, urticaria, tachycardia, hypotension or hypertension, breathlessness, anxious and pain (at infusion site, back or chest) (Wood et al. 2011). Once these symptoms are detected within the transfusion episode, the very first action is to stop the transfusion and flush the intravenous access with 0.9% saline (McClelland 2007). Nurses must then inform any doctors nearby and treating physicians to attend the patient instantly and appropriate resuscitation steps must be taken as needed (Norfolk 2013; Harris et al. 2012). Meanwhile, nursing staffs must perform clerical

check for patient's identity against the blood units to rule out wrong blood transfusion (Norfolk 2013). With professional judgement by the clinicians, transfusion may be resumed if the symptoms were mild. If a patient is suspected to develop moderate to severe symptoms, transfusion must be stopped and investigation of adverse transfusion reactions must be initiated by clinicians (McClelland 2007). Blood and urine samples must be collected according to hospital protocols. Together with a filled transfusion reaction report form, samples and blood units are sent to the transfusion medicine laboratory for testing (Ayob et al. 2008).

If transfusion is completed without any adverse symptoms detected, nurses must take a last measure of the patient's vitals (Harris et al. 2012). They can then change or remove the administration sets as required. Upon completion of transfusion event, the total volume transfused must be recorded and the blood tag attached must be duly filled up (McClelland 2007). The empty blood bag and filled blood tag must then be sent back to hospital blood bank without much delay (Ayob et al. 2008). Patients must be briefed to watch out for acute or delayed transfusion reactions that occurs within or after 24-hours post-transfusion (Harris et al. 2012).

2.3 Nursing practice and transfusion safety

2.3.1 Overview of nurses' roles

Nurses roles are inevitably important in blood transfusion service as they guard the most important base of safe blood transfusion, patient care (Tavares et al. 2015). Their responsibilities include understanding the intention to transfuse blood products, pre-transfusion sampling, administration of blood products, patients monitoring for adverse reactions and proper documentation of blood transfusion related matters (Tavares et al. 2015).

2.3.2 Previous studies

Literature search done using Google, PubMed and Discover EBSCOHost yielded a few similar studies done previously by researchers across the world. From decades to decades, inadequate knowledge and inappropriate practice in blood transfusion among nurses had constantly been pinpointed as the factor which cause major morbidity or mortality post-blood transfusion (Bolton-Maggs 2013; Wilkinson & Wilkinson 2001; Linden & Kaplan 1994). In this literature review, the research conducted in the past 10 years were discussed.

In 2009, Reza et al. reported that high proportion of the healthcare workers showed low to moderate knowledge score in a descriptive study at the Zabol, Iran. This study tested 122 subjects for their knowledge on pre-transfusion, tests associated with transfusion, during transfusion and adverse events, three quarters of which were nurses (Reza et al. 2009). With approximately half of the

participants (48%) had poor performance, this inflicted a high possibility of unsafe blood transfusion practice (Reza et al. 2009). The data showed no correlation with socio-professional characteristics such as age, gender, transfusion workload per day, years of service and training provided (Reza et al. 2009). Although in this study they failed to show validity and reliability of the designed interview questions, it drew our attention to yet another important risk factors in transfusion safety, the operators issue.

A study done in Scotland by Smith et al. (2010) reported knowledge degradation over 6 months after a teaching course on safe transfusion practice. In this study, undergraduate nurses in the second year of their three-year course were tested with a knowledge questionnaire consisting of 29 questions, at zero (baseline), sixth and twelfth month post-training (Smith et al. 2010). Results indicated that there was knowledge decay over just duration of six months, from mean score of 25 to 23 correct answers (Smith et al. 2010). Although this study had small sample size, which is only 31 subjects due to substantial loss to follow up, it highlighted the flaws and limitations of nursing academic programme in knowledge retention.

A descriptive study was done by Hijji et al. (2010) which observed the nurses' practice from blood bag collection, pre-transfusion to post-transfusion phase. This observational study reported that the performance of 75% of the subjects (37 out of 49 nurses) achieved less than 50% out of the total score of 29 points (Hijji et al. 2010). These findings implied poor and unsafe blood transfusion

practice that might result in harmful outcomes to the patients. Poor practice might be attributed to lack of scientific knowledge and personal factors such as ignorance.

The same group of researcher, led by Dr. Belal Hijji, then conducted another cross sectional study to quantitatively assess the knowledge level of nurses in blood transfusion. In this study, Hijji et al. (2013) reported poor knowledge in blood transfusion among nurses in United Arab Emirates. The authors identified general knowledge insufficiency among the 248 nurses from two hospitals in Emirate of Abu Dhabi regarding the following topics: proper patient identification, bacterial contamination, blood warming and acute transfusion reactions (Hijji et al. 2013). Published knowledge questionnaire, Routine Blood Transfusion Knowledge Questionnaire (RBTQ), developed by the principal investigator, Dr. Belal Hijji served as reference for questionnaire development in our research. However, the questionnaire was not tested for its reliability and thus, the study outcomes could be debatable.

A cross sectional study at northern India by Dubey et al. (2013) evaluated the knowledge of nurses and laboratory staffs in their tasks in relation to blood administration and blood products processing, respectively (Dubey et al. 2013). This study reported averagely poor knowledge among the nurses, with the mean score of 17.34 out of 30 points (Dubey et al. 2013). There were significant statistical differences in performances between nurses who based in major medical centres and those of district areas, as well as those who received training

in related fields and those who did not (Dubey et al. 2013). This was attributed to the lack of specialised training and regular audits done to assess the staffs' competencies.

In Africa, Kabinda et al. (2014) carried out a knowledge, attitude and practice (KAP) study with 390 subjects which included not just nurses but medical doctors and midwives as well. This was a large study with 400 subjects recruited who based in 88 centres (including general hospital, reference hospitals and health centres). Nonetheless, majority of the subjects were nurses (88%) (Kabinda et al. 2014) and hence, the outcomes of the study could be generalised to the nursing populations. The knowledge score in relation to general practices, transfusion transmitted diseases and risks of transfusion were 11.7%, 15.5% and 17.8%, respectively (Kabinda et al. 2014). This study inferred the deficiency in knowledge among nursing staffs in South Kivu, Democratic Republic of Congo (Kabinda et al. 2014).

A more recent study in Brazil, by Tavares et al. (2015) was conducted in a public teaching hospital in Uberaba City, State of Minas Gerais. With questionnaire developed by local public health authorities, the authors conducted survey among 209 nursing professionals, consisting of nursing technicians (70%), nursing assistants (16%) and nurses (14%) (Tavares et al. 2015). Nursing technicians are pre-registered or student nurses who perform basic patient care under supervision of registered nurses. Similar to other studies, this study reported poor knowledge among nursing staffs with overall mean score of 53%, ranging from

17 to 74% (Tavares et al. 2015). In addition, they identified significant difference of overall score with previous training and profession (Tavares et al. 2015).

In conclusion, previous studies across a few countries demonstrated poor and inadequate knowledge regarding blood transfusion procedures and risks among healthcare professionals, especially in nurses. This suggests that there are possible risks of unsafe blood transfusion practice to occur in clinical areas. However, no similar study was done locally. The knowledge and safety of our clinical blood transfusion services remains debatable.

2.4 Knowledge and Transfusion Safety

2.4.1 Knowledge and practice

Knowledge is defined as ‘facts, information, and skills acquired through experience or education’ or ‘the theoretical or practical understanding of a subject’ (Oxford Dictionaries 2016) whereas practice is how we act based on the knowledge that we obtained (Lakhan & Sharma 2010). With adequate and appropriate knowledge, we are able to perform well and confidently which eventually affect the outcomes of our actions. In short, knowledge is the fundamental which drives our practices.