

Measuring Knowledge of Blood Transfusion: A Survey of Jordanian Nurses

Dr. Belal M. Hijji

Faculty of Nursing
Philadelphia University
P. O. Box 1, Amman, Jordan

Dr. Arwa E. Oweis

Faculty of Nursing
Philadelphia University
P. O. Box 1, Amman, Jordan

Dr. Rasha S. Dabbour

Faculty of Nursing
Philadelphia University
P. O. Box 1, Amman, Jordan

Abstract

Objectives: *To investigate Jordanian nurses' knowledge of blood transfusion.*

Methods: *This was a descriptive study that involved a random sample of registered nurses from four public and university hospitals in Jordan. A modified version of the Routine Blood Transfusion Knowledge Questionnaire (RBTQ) comprising seven sections and 43 items was used.*

Results: *Three hundred and five nurses (95.3%) completed the RBTQ, with a mean knowledge score of 51.3% (SD 7.3). The majority of nurses lacked knowledge with regards to patient preparation prior to blood bag collection, and the importance of proper patient identification and how to perform this. In addition, 279 (92%) reported that they would thaw up blood using invalid and, potentially, harmful methods.*

Conclusion: *This study highlighted serious knowledge deficits which have the potential to threaten patient safety and reduce the effectiveness of the transfusion. Patients are placed at serious preventable risks such as receiving incorrect transfusions and acquiring bacterial infections. Mandatory ongoing blood transfusion training for Jordanian nurses is warranted urgently.*

Keywords: Nurses, knowledge, blood transfusion, survey.

1. Introduction

Blood transfusion is a highly effective and potentially life-saving treatment for many patients (Bradbury & Cruickshank 2000) and an essential component of modern health care. Red cell transfusions are the backbone of blood transfusion therapy as they account for the majority of components issued to patients (Taylor *et al.* 2010). Lack of knowledge of various aspects of blood transfusion by clinical staff, including nurses, continues to be a real threat to patient safety (Taylor *et al.* 2010). For example, errors in practice involving remote checks at nurses' stations (Whitehead *et al.* 2003; Hijji *et al.* 2010) may indicate that nurses are unaware that such checks serve no purpose; they detract from performing proper bedside identification of patient, and contribute to mistransfusion (Whitehead *et al.* 2003; Taylor *et al.* 2010).

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Improper identification of patient as the main cause of mistransfusion (Taylor *et al.* 2010) resulting in significant transfusion mortality (Myhre and McRuer 2000) may indicate similar lack of knowledge. Therefore, for nurses to provide high quality care and function effectively, they must have adequate knowledge that they actually use in practice (Panagiotopoulou & Kerr 2002). Bedside administration of blood is an area which mostly needs improvement (Dzik 2003). This is because transfused patients continued to receive suboptimal care without nurses questioning the evidence base for practice (Rowe & Doughty 2000).

Adequate knowledge is essential for safe practice (King 1981), and one of the current trends in nursing research emphasises the importance of investigating nurses' knowledge of clinical procedures. Thus, the literature is replete with studies investigating nurses' knowledge base of many areas (Juan *et al.* 2004; Brockopp *et al.* 2004; Howell *et al.* 2000; Walsh *et al.* 2005; Lehwaldt & Timmins 2005; Egerod & Hansen 2005; Chen *et al.* 2005; Sevil *et al.* 2005; Duimel-Peeters *et al.* 2005). Published information about nurses' blood transfusion knowledge in Jordan is lacking. Quality of care has been identified by the Jordanian Nursing Council (JNC) (2008) in the national health strategy as a high priority area, and this is where this area fits within Jordan's classifications of research priorities. Therefore, the first step in improving the quality of patient care could be facilitated through investigating and documenting the current state of knowledge of blood transfusion. Thus, the purpose of this study was to investigate the current levels of knowledge of blood transfusion among hospital nurses.

Findings of this study could be used to plan and implement appropriate continuing educational and training programs for nurses and midwives. Also the findings could be used to inform the development of nursing and midwifery curricula in Jordan to include learning opportunities and content focusing on safe and effective practice of blood transfusion. This may, in turn, promote patients' safety and reduce blood transfusion errors. Furthermore, the findings could be used by health system administrators and policy makers to update, refine, and reinforce blood transfusion policies, guidelines and procedures.

2. Phases of the transfusion process

Bishop (2008) indicates that the transfusion process is composed of five interrelated phase; four of which are relevant to routine nursing practice, as described below, and where the safety of transfusion is, amongst others, dependent on nurses' knowledge and skills.

2.1. Patient preparation before blood bag collection

Collecting a blood pack from blood bank should take place only when a patient is ready to receive the transfusion (Saxena *et al.* 2004). Preparation entails an existing well-written medical order (McClelland 2007), an intravenous access is available and patent (Bradbury & Cruickshank 1995), and any pre-medications or other solutions were entirely completed (Saxena *et al.* 2004). Nurses should also provide adequate information to patients (or relatives) about the impending transfusion and have their questions answered (Bryan 2002). The information should focus on the indication for blood transfusion, its risks and benefits (McClelland 2007), and reaction symptoms of (Littenberg *et al.* 1995). Finally, baseline vital signs should be recorded within 30 minutes prior to the initiation of transfusion (McClelland 2007).

2.2. Blood pack collection

Withdrawal 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 (Royal College of Physicians 2005). To prevent this error, the person collecting the blood must ensure that a patient's identification details are identical on the collection slip, blood bag, and the compatibility report form (McClelland 2007). In addition, the blood or blood component unit identification details must be identical on the blood compatibility report form and the compatibility label attached to the unit (McClelland 2007).

Patients who are RhD positive can receive RhD negative products (Craig & Bower 1997) if the collected blood is compatible with theirs. This requires nurses to be aware of the ABO group system (Hearnshaw 2004). Blood bags should be transported to the clinical area using a special blood transport box (Taylor *et al.* 2009).

2.3. Pre-transfusion initiation nursing responsibilities

After delivering a unit of blood to the clinical area, nurses must properly identify, at bedside, the patient intended for transfusion (McClelland 2007).

This is a critical procedure where failure to perform is the most frequent error leading to incorrect transfusion (Serious Hazards of Transfusion (SHOT) 2005). Subsequently, the transfusion should commence as soon as possible (Taylor *et al.* 2009), to avoid the risk of bacterial proliferation (McClelland 2007). If clinically indicated, blood can be warmed using only a well-maintained electronic warmer (McClelland 2007). Finally, nurses should use a blood administration set of appropriate filter size (170-200 micron) (WHO 2002), which can be changed at least every 12 hours according to the latest authoritative guidelines (McClelland 2007).

2.4. Post transfusion initiation nursing activities and issues

Upon commencing a transfusion, nurses are required to infuse blood slowly during the first 15 minutes (Hodgkinson *et al.*, 1999; Nettina, 2001). This is because most severe reactions occur during this period (Murphy *et al.* 2001), and the severity of a reaction is proportional to the amount of blood infused (Janatpour *et al.* 2008). Slow infusion means a rate of 2 ml/ min (Nettina 1996) for an adult and approximately 2 ml/ kg/ hour (Ellis & Bentz 2007) for a paediatric patient. Slow transfusion is indicated in patients with severe chronic anaemia, the elderly (WHO 2002), and those with heart disease (Higgins 2000).

At this phase, nurses should also visually observe the patient for the first 10 -15 minutes (Gray and Illingworth 2004), and record vital signs (Royal College of Physicians 2005). Each transfusion should be completed within a maximum of four hours after its initiation (McClelland 2007). Normal saline (Australian & New Zealand Society of Blood Transfusion Inc. 2004) and morphine 1.0 mg/ml (Birch & Mahoney 2001; Wozniak *et al.* 2001) could be safely co-administered with blood. Other intravenous solutions (Wozniak *et al.* 2001) and drugs, generally, should not be co-administered with blood (McClelland 2007). Nurses should be aware of the signs and symptoms of acute haemolytic transfusion reaction (AHTR) (Bradbury & Cruickshank 2000) and be able to intervene properly if any of these is noted (BCSH 1999). Finally, the presence of an urticarial rash is indicative of mild allergic transfusion where nurses should slow the transfusion rate and inform the medical staff (Bradbury & Cruickshank 1995).

3. Literature review

Limited published studies addressed nurses' blood transfusion knowledge, and most of the work carried out was observational (Shulman *et al.* 1994 & 1999; Bayraktar & Erdil 2000; Whitsett & Robchaux 2001; Saxena *et al.* 2004; Graaf *et al.* 2009; Hijji *et al.* 2010). Bayraktar and Erdil (2000) reported that nurses had insufficient knowledge about blood transfusion resulting in inadequate practice. Hijji *et al.* (2012) reported that nurses in the United Arab Emirates (UAE) achieved a knowledge score that ranged from 27 to 56 (39-80%) out of a possible score of 70 (100%), with a mean score of 40.8 (58%). The study found that 210 (85%) nurses reported that they had never received any in-service training in this field, with only 35 (14%) reported a perceived need for such training. As the issue of investigating nurses' blood transfusion knowledge is attracting more attention, other studies have been recently published from Iran (Reza *et al.* 2009; Aslani *et al.* 2010). Reza *et al.* (2009) assessed 122 healthcare workers', including nurses, knowledge on proper methods of blood and components transfusion. They found that 26.2% had weak level knowledge; 22.2% had moderate knowledge, while 51.6% good knowledge. In their survey, Aslani *et al.* (2010) reported that most nurses (n = 95, 81.2%) were unaware of the appropriate transfusion time after receiving the blood from blood bank.

4. Aim of the study

The aim of this study was to investigate Jordanian nurses' knowledge of blood transfusion.

5. Method

5.1. Design and settings

This was a descriptive cross-sectional survey using an interviewer-administered questionnaire involving registered nurses who worked on many clinical areas where blood transfusion events were common. These included Intensive Care Units (ICUs), obstetric and gynaecology, accident and emergency, male and female surgery, special care baby unit (SCBU), recovery, male and female medical wards, paediatric medical and surgical wards, haematology department, endoscopy, thoracic department, haemodialysis and peritoneal dialysis, coronary care units (CCUs), oncology, burns, orthopaedic wards, and ear, nose, and throat (ENT) wards. Two teaching (n = 185, 61%) and two public (n = 120, 39%) hospitals from both Amman (n = 162, 53%) and Irbid (n = 143, 47%) participated in the study.

5.2. Ethical considerations

Ethical approval was obtained from the Jordanian Ministry of Health and all participating hospitals. All nurses received a participant information sheet and signed an informed consent; voluntary participation, anonymity, and confidentiality were all guaranteed.

5.3. Sample

The Directors of Nursing provided the lists of 906 registered nurses representing the target population. In order to reach a conservative estimate of the required sample size, it was assumed that 50% of the nurses, in terms of their knowledge, will fall either in the acceptable or in the unacceptable category of performance. Setting α at 0.05 and assuming a confidence level of 95%, the required sample size is 270 nurses (www.raosoft.com/samplesize.html). However, a selection of 320 nurses was made to account for potential non-response, unusable questionnaires, and to increase the representativeness of the sample. All nurses were direct care staff in in-patient areas with more than 3 months of experience. Simple random sampling technique was used to select the sample via the Statistical Package for Social Sciences (SPSS), version 11. SPSS Inc. Chicago, IL, USA). Sample recruitment and data collection (See below) convened simultaneously.

5.4. The measurement tool

We used a modified version of the *Routine Blood Transfusion Knowledge Questionnaire (RBTQK)* that Hijji *et al.* (2012) developed earlier. A detailed account of the processes that were used to develop the RBTQK, ascertain its content validity and reliability, and score its items is provided elsewhere (Hijji *et al.* 2012). However, the authors reported that the RBTQK took long time to complete, with the difficulty of coding the responses nurses provided to eight open-ended items (Hijji *et al.* 2012). We removed one of two items that measured a single objective on nurses' awareness of bacterial contamination. All eight open-ended items were converted to a multiple-choice or multiple-response item formats. Two true-false items were based on a clinical scenario whose objective was to measure nurses' awareness of the clinical indications of blood warming. Both items were converted to a multiple-response item that measured nurses' knowledge of the same content.

Two items (1 MC; 1 true-false) were added to measure nurses' awareness of patient preparation before blood bag collection. Two pilot tests of the questionnaire were undertaken in Jordan using a random sample of nurses unconnected to the main study sites. The nurses indicated that the items were clear, important and understandable but the questionnaire was long. Accordingly, eight items (5 multiple-choice; 1 constructed-response; 2 multiple-response) were removed. The current version of the RBTQK (Appendix 1) included seven sections and a total of 43 items. Of these, 32 are knowledge items (2 true-false; 20 multiple-choice; 10 multiple-response) Section A (8 items) elicits information about nurses' demographics and training. The sections from B throughout F examined nurses' knowledge aspects of blood bag collection from blood bank and patient preparation prior to, pre-transfusion initiation nursing responsibilities, post transfusion initiation nursing responsibilities, and complications related to blood transfusion (33 items). Finally, Section G (2 items) addressed issues related to hospitals' blood transfusion policies and procedures. Using the Flesch Reading Ease (RE) Index, the questionnaire readability was found to be 68.3 suggesting that it is easily understandable (Pande *et al.* 2000).

5.5. Data collection

After obtaining the required approvals, two research assistants were recruited to collect questionnaire data. Both had previous relevant experience; they attended briefing sessions to pinpoint the importance of collecting high quality data and the means to achieve that. The assistants approached the Directors of Nursing in the participating hospitals to facilitate access to their nursing staff. Each research assistant approached in person each individual nurse who was randomly selected to recruit him/ her to the study. Following his/ her agreement to participate and signing the informed consent form, each nurse completed the questionnaire in the presence of the research assistant. Data collection started on November 5th 2008 and was completed by January 31st 2009. Each questionnaire took about 45 to 60 minutes to complete.

5.6. Data analysis

Once collected, data were coded and entered onto the statistical software package (SPSS, version 11) for Windows (SPSS Inc. Chicago, IL, USA). Descriptive statistics including frequency ratings and percentages were calculated for nominal level data such as demographics and individual items within the questionnaire.

Measures of central tendency and dispersion were calculated for knowledge scores. Each correct response was awarded one point; the item on the identification of patient was awarded 5 points because it is a multi-step procedure and a core competency. No points were awarded if a nurse selected two responses that are conflicting in meaning. The maximum score for the current version of the RBTKQ was 56 points.

The distribution of knowledge scores was approximately normal. Based on this, inferential statistics using the *t*-test were performed to test the significance of differences in means between nurses from Irbid and Amman and those who worked in public and university hospitals. The level of significance was set at $P = 0.05$. If nurses responded to an item by 'I do not know', their responses will be treated as incorrect.

6. Findings

6.1. Sample characteristics, involvement in blood transfusion, and training

Three hundred and five nurses (95.3%) completed the questionnaire, of whom 189 (62%) were female. The age of most of them ranged between 21 and 30 years ($n = 241$, 79%). Approximately, two thirds of the nurses ($n = 200$, 68%) were those with five years of clinical experience or less, while 32 (10.8%) had an experience of ten years or more ($n = 32$, 10.8%). Data were missing from 9 nurses. Two hundred forty nine nurses (82%) had a Bachelor of Nursing degree; 13 (4%) had Master in Nursing; while the remaining nurses ($n = 39$, 13%) held diploma in general nursing ($n = 36$), diploma in midwifery ($n = 2$), and bachelor of midwifery ($n = 1$). Data were missing from 4 nurses. During the past 6 months preceding data collection, 272 nurses (89%) administered blood transfusions with a frequency that ranged from 1-4 times to more than 12 times. However, the majority of nurses ($n = 279$, 92.4%) reported that they had never received any in-service training on blood transfusion, with only 100 (33%) of them reporting a perceived need for training in blood administration.

6.2. Blood transfusion overall knowledge scores

Nurses' knowledge scores were scaled to 100% and ranged from 14% to 70% (mean 51.8, SD 7.21) (Figure 1). This means that none of the nurses answered all questions correctly. One hundred and ninety nurses (62%) had a score of 50 or above, while 115 (38%) obtained a score of less than 50%. Some nurses explicitly stated "I do not know" when responding to some items.

6.3. Differences in mean knowledge scores according to hospital affiliation and regions

The *t*-test revealed no statistically significant differences between nurses' mean knowledge scores according to hospital affiliation or regions (Amman vs. Irbid).

6.4. Blood bag collection and patient preparation prior to

Table 1 shows that the majority of nurses lacked awareness of the issue of patient preparation before leaving the ward for blood collection. The results also indicated that 87.5% of nurses would act on incomplete medical order and that 91% lack knowledge of basic ABO terminology.

6.5. Pre-transfusion initiation nursing responsibilities

Table 2 presents findings regarding pre-transfusion initiation nursing responsibilities. Although 214 (70%) that patient identification is the most important nursing responsibility, only 6 (2%) were aware of all steps they must follow to properly identify a patient. Other nurses indicated that they would ask leading questions ($n = 86$, 28%) or use surrogate identifiers ($n = 119$, 39%). Only 24 nurses (8%) knew the best practice of starting the transfusion immediately after bringing a unit of blood to the ward. However, 279 (92%) reported that they would wrap blood bag with blanket, allow it to wait in room temperature, immerse it in hot water, and place it in a microwave. Finally, 194 nurses (64%) selected the incorrect filter size, while 30 (10%) stated "I do not know".

6.6. Post transfusion initiation nursing activities and issues

Table 3 presents findings regarding the post transfusion initiation nursing activities and issues. The findings indicated that only 49 nurses (16%) knew the routine activities that they should perform after initiating a unit of blood. Two hundred thirty nine nurses (79%) reported using a gravity-flow administration set as opposed to 63 (21%) who used an infusion pump, of whom 51 (81%) worked in university hospitals. Uncertainty among nurses surfaced with regards to slow initiation of transfusion on adult and pediatric patients, and frequency of vital signs recording.

Twenty two nurses (7%) explicitly acknowledged their lack of knowledge by stating “I do not know” with regards to slow initiation of a transfusion. The number of nurses who erroneously reported that blood could safely be administered with 5% dextrose water was 52 (17%), with lactated ringer was 55 (18%), and with frusemide 20 mg/ 2 mL was 184 (60.3).

Table 4 presents nurses’ awareness of complications, and issues related to policies and procedures, of blood transfusion. Very few nurses (n = 3, 1%) were aware of the four nursing interventions that could minimise the risk of a patient experiencing acute transfusion reaction. One hundred and three nurses (34%) three correct interventions. The answers that nurses provided to the item that tested what their decision would be with regards to a unit of blood that was kept for 90 minutes after delivery to the ward revealed that, approximately, 151 (50%) would transfuse the blood. Nurses’ uncertainty re-emerged in relation to the clinical picture of acute hemolytic and mild allergic transfusion reaction and subsequent nursing management of.

7. Discussion

Nurses’ knowledge scores and training

Overall, nurses had significant knowledge deficits of many aspect of blood transfusion, as evidenced by the very low mean score they achieved. These results are worst than reported earlier from the United Arab Emirates (Hijji *et al.* 2012). Preventing and recognising a transfusion reaction requires nurses to have adequate knowledge (Bayraktar & Erdil 2000); and the current status of knowledge among them is not helpful in this regard. Most nurses (n = 279, 92.4%) reported that they never had any post-qualifying training in blood transfusion. Insufficient knowledge was attributed to deficiency in orientation or training (Shulman *et al.* 1999; Saillour-Glenisson *et al.* 2002)

Nevertheless, the United Kingdom SHOT Scheme (2001) and Taylor *et al.* (2010) stressed the point that training and education are essential for all staff involved in the transfusion procedure. In 2000, the Scottish Blood Transfusion Service developed a standardised training program for all healthcare providers including student nurses to promote safe practice (Smith *et al.* 2010). Following their study on the impact of the program on knowledge retention in student nurses, Smith *et al.* (2010) concluded that the program equipped the students with the required knowledge that would enable safe care if it is successfully integrated into practice. The implication is that the current level of knowledge among Jordanian nurses could be due to inadequate educational provision during basic undergraduate training. Therefore, a central theme for nursing education in Jordan is the development of clinical skills and competencies. Within this context, the Jordanian Nursing Council (No date) [<http://www.jnc.gov.jo/english/publications/professional%20standerd.pdf>] published standards for accreditation of practice settings for student training. The JNC introduced indicators to ensure that structure and governance reflect institutional commitment to maintain quality and enhance clinical learning environment that facilitates students learning.

The present situation in Jordan whereby untrained nurses administer blood transfusions is serious enough; it could have contributed to fatalities among patients, because lack of training contributed to committing errors (Taylor *et al.* 2010). In the UK for example, the guidance “Right Patient, Right Blood” issued by the National Patient Safety Agency (NPSA) (2006) required all staff involved in blood transfusion to undergo formal regular competency assessment. And that is why the National Health Service (NHS) trusts do not allow nurses to be involved in the transfusion process without receiving appropriate documented training (South Staffordshire Primary Care Trust 2008). Ensuring safe and effective practice is not easy-to-achieve goal; incidents of incorrect transfusions were reported from the UK despite the existence and enactment of the NHS Better Blood Transfusion program and the NPSA guidance (Gray *et al.* 2008).

Until such a proposed training becomes a reality, Jordanian nurses should not maintain the status quo of the current situation, as they are professionally responsible to practise safely, and to ensure that their knowledge and skills are kept up to date (Taylor *et al.* 2010). To this end, and in the pursuit of professional practice, behavioural change is required. Jordanian nurses need to educate themselves through accessing online resources on blood transfusion (Table 5), and learning about aspects relevant to their practice. However, knowledge, on its own, does not guarantee safe practice unless other personal (positive attitudes) and organisational (time, nurse to patients ratio, materials) barriers were effectively addressed.

Implications of knowledge deficits

Blood bag collection and patient preparation prior to

The issue of assessing and ensuring the readiness of the patient to receive a blood transfusion is not at nurses' forehead. Fifty three percent of nurses reported that they would assess the availability and patency of intravenous access line after blood bag collection as opposed to 39% in a UAE study (Hijji *et al.* 2012). Yet, 67% of the sample would administer a prescribed premedication, as opposed to 84% of nurses in the UAE (Hijji *et al.* 2012) after blood delivery to the ward. In either case, the implication is that this might eventually delay the initiation of the transfusion which could result in bacterial contamination of the unit (McClelland 2007). In practice, 43% of nurses initiated the transfusion within a range of 35–138 minutes (mean 54 minutes) after blood bag collection (Hijji *et al.* 2010). Another finding was that 87.5% of nurses in this study would act on an incomplete blood transfusion order. The implication is that nurses may take fallible decisions that are within the medical domain and for which they are not yet prepared; this may bear unnecessary risks to patients.

Pre-transfusion initiation nursing responsibilities

Proper identification, at bedside, of a patient intended for transfusion is critical to the prevention of new errors and detection of those that could have taken place earlier (Harris *et al.* 2009). Improper identification of patient is the main cause of incorrect transfusions (Harris *et al.* 2009) that results in patient mortality and morbidity. Nurses, therefore, hold full responsibility for patient identification as a core competency. Yet, only 30% of nurses considered that patient identification is the most important action prior to transfusion initiation. This finding indicates that patient identification occupies the least priority. As such, only 2% of the nurses knew the correct steps they must perform to identify the patient. Failure to comply with this simple task has been reported in other studies (Hijji *et al.* 2012; Saillour-Glénisson *et al.* 2002; Parris and Grant-Casey 2007) and may explain why nurses' practice of this aspect was deficient (Hijji *et al.* 2010). In the UK, Stainsby *et al.* (2005) described a workshop to investigate local safety improvement initiatives in patient identification and 'bedside' checking. The workshop presentations outlined a variety of technological (Barcoding, red label system, photo identification) and nontechnological (Continuing education and training) solutions that were selected by an expert panel for further evaluation and possible development.

Increasing the risk of bacterial proliferation is a recurrent theme at this phase. This is because 218 (72%) claimed that each unit of blood needs to be warmed prior to administration using traditional, invalid, and risky methods. This is a longstanding and widely spread misconception held by nurses and was earlier reported from Turkey (Bayraktar & Erdil 2000) and the UAE (Hijji *et al.* 2012). What nurses need to know is that they must stop this habitual practice (McClelland 2007) and realise that there are clinical indications for blood warming (WHO 2002) which are known only to 1% of them. Nurses should never use hot water and microwave to warm blood as this could result in hemolysis which could be life-threatening.

Post transfusion initiation nursing activities and issues

The majority of nurses (79%) used traditional gravity-flow administration sets, for which there is anecdotal evidence of unreliable infusion time and clotted intravenous catheters (Houk & Whiteford 2007). These authors found that electronic infusion pumps are safe, time-saving, and cost-effective. The results of this phase have also highlighted knowledge deficits that may threaten patient safety and compromise quality of care. Uncertainty among nurses surfaced with regards to slow initiation of transfusion and frequency of vital signs recording. Only 99 nurses (33%) who worked on adult patient areas and 117 (51%) on pediatric wards knew the correct flow rate to initiate the transfusion at. Every nurse should be aware that most severe reactions occur during the first 15 minutes of setting up a transfusion (Atterbury & Wilkinson 2001), and the severity of a reaction is proportional to the amount of blood infused (Tylor *et al.* 2005). Without proper knowledge, however, nurses may initiate a transfusion at a rate either slower or faster than recommended. The outcome of this could be either prolongation of the transfusion duration with an increased risk of bacterial contamination (McClelland 2007) or the occurrence of severe transfusion reaction (Janatpour *et al.* 2008). Another finding was that only 2% of nurses provided the correct responses about the frequency of recording vital signs at this phase. This finding indicates that nurses were not aware of the WHO (2002) recommendations; it could be a reflection of lack of consensus and confusion in the literature about this aspect (See McClelland 2007; Atterbury & Wilkinson 2000; Bryan 2002; Bradbury & Cruickshank 2000; Richards and Giuliano 2002; Harris *et al.* 2009).

Nurses were also found to have serious knowledge deficits of the preventive practices that need to be simultaneously considered to minimise the risk for patient developing acute transfusion reaction. However, they are required to be aware of all elements that they apply in practice to achieve this goal. Administering compatible blood is required; but, on its own, is insufficient to prevent a transfusion reaction if the duration of transfusion is prolonged or if incompatible solutions are co-administered with blood.

Acute transfusion reactions may occur in 1% to 2% of patients and may be fatal (WHO 2002). What would make a difference to a patient's life is a vigilant nurse who has the ability to promptly recognise and successfully manage an emergent hemolytic transfusion reaction. However, this may not be possible because only 16% of nurses were aware of the clinical picture of AHTR and 45% of the sample knew nursing management of this condition.

8. Strengths, limitations, and recommendations for policy, practice, and research

This was the second and largest survey of nurses' knowledge of blood transfusion in a Middle Eastern country that achieved an excellent response rate. Along with a sample that is large and randomly selected, the results could be generalised to nurses in other hospitals in Jordan. One of the limitations is that nurses might have reported a knowledge that they did not, actually, use in practice. We also excluded nurses who worked in operating theatres. Another limitation is that content validity of the RBTKQ could have been reduced due to shortening its content, and the fact that our efforts to validate the questionnaire following the changes that were made were unproductive.

The findings indicated that young nurses, generally, staff hospitals, while the more experienced ones leave the country. This situation warrants more attention by the Jordanian professional bodies and policy makers to ensure retention of experienced nurses.

In addition, the findings identified varying levels of knowledge deficits of all aspects of blood transfusion. There is a need for a compulsory ongoing educational programme for all Jordanian nurses involved in the administration of blood. This should be followed by surveys or observations to assess their impact on nurses' knowledge and practice of blood transfusion. These are essential and corrective steps to be undertaken in order to protect patients' safety, reduce preventable blood transfusion complications, and improve the effectiveness of the transfusion process. Further research should be carried out why nurses are non-compliant with the correct way to identify patients intended for blood transfusion and to examine the evidence base of existing guidelines for blood transfusion and whether nurses use them.

9. Conclusion

This study has identified a problem that needs immediate attention. Alternatively, poor knowledge places Jordanian patients at risk of misidentification and acquiring bacterial infection. Without rectifying the current situation, patients' right to receive good quality care will continue to be violated resulting in poor patient outcomes.

Contributions: Study design: BH, data analysis: BH, manuscript preparation: BH, AO & RD.

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Figure 1: Jordanian Nurses' knowledge scores

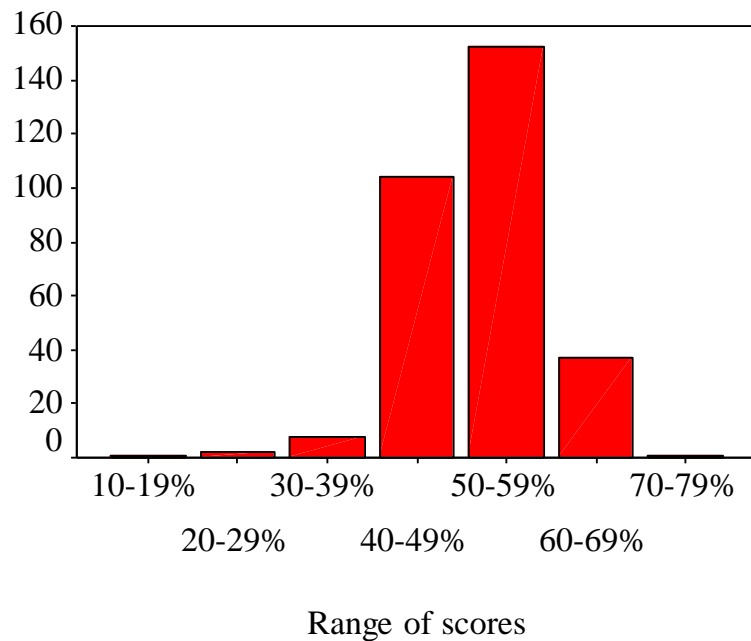


Table 1: Nurses' knowledge related to blood bag collection and patient preparation prior to

Item and correct answer	Correct	
	N	%
Checking patency of IV after blood bag collection. (False).	143	47
Collecting of blood pack from blood bank should take place before the administration of any prescribed pre-medication. (False).	100	33
Decisions to be taken by the nurse with incomplete order (refuse to collect and administer the blood).	38	12.5
Information to ensure collecting the right blood from blood bank. (Patient's identification details are identical on the blood bag and blood request form).	154	51
Blood bag transport method. (Validated special box).	140	46
Knowledge of basic ABO terminology. (Check details with another nurse then transfuse the unit).	26	9
Three aspects of information giving to patient. (Reasons for blood transfusion, risk of blood transfusion, and reaction symptoms).	140	46
Baseline vital signs recording. (Within ½ hour before transfusion).	273	90

Table 2: Nurses' knowledge level regarding pre-transfusion initiation nursing responsibilities ¹

Item and correct answer(s)	Correct	
	N	%
Most important nursing action before starting the transfusion. (Patient identification).	91	30
Clinical indications for blood warming. (Exchange transfusion for infant, rapid transfusion, patient with cold agglutinins)	4	1
Best time to start the transfusion if delivered to the ward at 4 PM. (4:10 PM)	117	38
Blood handling after delivery to ward. (Start immediately). (n = 2)	24	8
Steps for patient identification. (Ask patient to state name and DOB, patient's identification details are identical on ID band, and blood request form)	6	2
Omitting the final bedside identity check. (Never acceptable). (n = 4)	210	70
Suitable filter size of transfusion set. (170-200 micron)	71	24

¹ The number of nurses out of 305 whose response(s) to any item were missing will appear in brackets after the correct response(s).

Table 3: Nurses' knowledge level regarding nursing responsibilities after transfusion initiation

Item and correct answer(s)	Correct	
	N	%
Three activities for nurses to perform routinely after starting the blood transfusion. (Setting up the flow rate, documentation of relevant information, and observation for transfusion reaction). (n = 1)	49	16
The rate to initiate a transfusion on an adult patient ² . (Not more than 120 ml/hour). (n = 4).	91	33
Regulation of transfusion flow rate. ³	Manual	239
	Via electronic pump	63
Maximum duration of using a blood administration set for continuous multiple transfusions. (12 hours)	15	5
The rate to initiate a transfusion at on an infant ⁴ . (Not more than 0.5 mL/ kg/ hour)	117	51
Maximum duration for completing a unit of blood. (4 hours)	137	45
Indications for slow blood transfusion. (Patients with heart disease, severe anaemia)	49	16
Agents compatible with blood. (normal saline 0.9%, morphine 1.0 mg/ mL)	23	8
Vital signs recording after starting a transfusion at 2:00 PM. (2:05 and 2:15, at 3:15, at 4:15, and at 5:00). (n = 5).	6	2
Timing and duration when it is essential to physically observe a patient for possible transfusion reaction. (First 10-15 minutes)	136	45

Table 4: Nurses' knowledge level regarding complications and policies and procedures of blood transfusion

Item and correct answer(s)	Correct	
	N	%
Nursing interventions that could minimise the risk of developing transfusion reaction. (Administering compatible blood, starting transfusion within 20 minutes, total duration of administration 4 hours, avoid incompatible drugs/ solutions)	3	1
Complication of rapid administration of cold blood. (Cardiac arrhythmia)	193	64
Signs and symptoms of acute haemolytic reaction (AHTR). (Tachycardia, chest pain, hypotension, nausea/vomiting)	48	16
Nursing management of AHTR. (Stop blood transfusion, KVO with N/S, check V/S, notify the doctor and begin emergency treatment)	137	45
A unit of blood was kept in nurses' station for 90 minutes without starting the transfusion, what should the nurse do?(Not to start the transfusion, notify the blood bank and return the blood). (n = 1)	151	50
The usual presenting complaint of a mild allergic transfusion reaction. (Urticarial rash)	138	46
The first action the nurse should take with mild allergic transfusion reaction. (Slow the transfusion rate and notify the doctor)	26	9
The commonest cause of fatal transfusion reaction. (Identification error of patient)	87	29
Availability of a written policy for the administration of blood.		
Yes	254	83
No	37	12
I do not know	13	4
If yes, have you read the policy?		
Yes	217	85
No	37	15

² This item was not applicable to 22 nurses³ This is not a knowledge item⁴ This item was not applicable to 76 nurses

Table 5: Recommended blood transfusion resources available online

SN	Resource	Author/ Editor	Website
1.	Guideline on the Administration of Blood Components	British Committee for Standards of Haematology	http://www.bcshguidelines.com/documents/Admin_blood_components_bcsh_05012010.pdf
2.	Professional guidelines, best practice and clinical information	UK Blood Transfusion and Tissue Transplantation Services	http://www.transfusionguidelines.org.uk
3.	The Clinical Use of Blood Handbook	World Health Organisation	http://www.who.int/bloodsafety/clinical_use/en/Handbook_EN.pdf
4.	Handbook of Transfusion Medicine	DBL McClelland	http://www.transfusionguidelines.org.uk/index.aspx?Publication=HTM
5.	eLearning for safe, effective and appropriate transfusion practice	Scottish National Blood Transfusion Service	http://www.learnbloodtransfusion.org.uk/

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Appendix 1

Routine Blood Transfusion Knowledge Questionnaire

Nb: Please Circle the Response(S) You Are Selecting. Do Not Use A Tick Mark.

Section A: Demographic Details And Training

1. What type of hospital you are working in?
a. A university hospital b. A Ministry of Health hospital
2. What nursing qualification(s) do you hold?
a. Diploma in general nursing b. Bachelor of Science in Nursing c. Diploma in midwifery
d. Masters degree e. Other (please specify) _____
3. How old are you? _____ years.
4. What is your gender? a. Male b. Female
5. How long have you been working on ward(s) where blood transfusion is performed?
-----years -----months
6. Over the past 6 months, what was the approximate number of times you performed a blood transfusion?
(Choose ONE answer only)
a. None at all
b. 1-4 times
c. 5-8 times
d. 9-12 times
e. More than 12 times
7. Have you ever participated in any in-service training program in relation to blood transfusion within the period you have worked for the ward, in which blood transfusion is performed?
a. Yes. If yes, how many programs have you participated in during the last year?
_____ When? (list month and year) _____ Where? _____
b. Never
8. What specific area(s) relating to transfusion practice do you feel you would like further training/education? (You may choose more than one)
a. Sampling
b. Collection of blood bag
c. Administration
d. Adverse reactions
e. Serious hazards
f. None

Section D: Pre-Transfusion Initiation Nursing Activities

1. On the ward after obtaining the blood pack but before starting the transfusion, what is the most important nursing action that the nurse must do with regards to patient? (Choose ONE answer only).
 - a. Document baseline vital signs
 - b. Check the doctor's order with another nurse
 - c. Identify the right patient
 - d. Provide information to the patient (or family)
 - e. Report high temperature to the doctor

2. When is blood warming prior to administration clinically indicated? (Choose THREE answers only)
 - a. Each time a unit of blood is to be transfused
 - b. In exchange transfusion in infants
 - c. In rapid transfusion
 - d. In patients with cold agglutinins
 - e. In patients with hypothermia

3. A unit of blood was delivered to the ward at 4.00 PM. What is the best time by which the transfusion should start? (Choose ONE answer only).
 - a. 4:10 PM
 - b. 4:20 PM
 - c. 4:30 PM
 - d. 4:40 PM
 - e. 4:50 PM

4. In the ward after obtaining a blood bag, how would you handle the blood? (Choose ONE answer only).
 - a. Wrap the unit with a blanket or bedsheet
 - b. Allow blood to wait in room temperature
 - c. Immerse the unit in hot water
 - d. Start the transfusion immediately
 - e. Warm in a microwave

5. Select THREE most important steps that a nurse has to follow in order to properly identify the right patient prior to initiating the transfusion
 - a. Ask patient to state his/ her name when possible
 - b. Call patient name when possible
 - c. Check room and bed number
 - d. Ensure that patient identification details match on blood bag, ID band and request form
 - e. Ask patient to state his/ her date of birth when possible
 - f. Compare ID band with blood bag

6. What is the suitable filter size of blood transfusion set? (Choose ONE answer only).
 - a. 90-120 micron
 - b. 130-160 micron
 - c. 170-200 micron
 - d. 210-250 micron

Section E: Post Transfusion Initiation Nursing Activities And Issues

1. Select THREE ROUTINE nursing activities a nurse has to perform just after starting the blood transfusion until it ends.
 - a. Setting up the flow rate
 - b. Documentation of relevant information including vital signs
 - c. Flush line using normal saline
 - d. Inform the doctor of any transfusion reaction
 - e. Observation for transfusion reaction
 - f. Carry out emergency treatment in case of transfusion reaction as ordered
 - g. Check patient's identity

2. What may happen to a patient if rapid⁵ administration of cold blood is performed through a central venous route terminating in or near the right atrium? (Choose ONE answer only)
 - a. Post transfusion purpura
 - b. Cardiac arrhythmia
 - c. Acute intravascular haemolytic reaction
 - d. Transfusion associated acute lung injury

If you are not working with adult patients, skip question 3.

3. The doctor has prescribed a unit of blood to an adult patient. At what rate would you start this transfusion? (Choose ONE answer only).
 - a. Not more than 60 mL/ hour
 - b. Not more than 120 mL/ hour
 - c. Not more than 150 mL/ hour
 - d. Not more than 200 mL/ hour
4. In your ward, how do you regulate blood flow rate? (Choose ONE answer)
 - a. Manually
 - b. Via an electronic pump
5. For continuous multiple blood transfusions, what is the maximum duration each blood administration set could be used? (Choose ONE answer only).
 - a. 4 hours
 - b. 6 hours
 - c. 8 hours
 - d. 10 hours
 - e. 12 hours

If you are not working with paediatric patients, skip question 6.

6. In order to initiate a blood transfusion **SLOWLY** on a 4 month-old infant, at what rate would you start this transfusion during the **FIRST** 15 minutes? (Choose ONE answer only)
 - a. Not more than 0.5 mL/kg/hour
 - b. Not more than 1.00 mL/kg/hour
 - c. Not more than 2.00 mL/kg/hour
 - d. Not more than 3.00 mL/kg/hour
7. A unit of blood intended for an adult patient was removed from blood bank at 4.00 PM. What is the maximum duration when the unit should be totally consumed by the patient? (Choose ONE answer only)
 - a. 2 hours
 - b. 3 hours
 - c. 4 hours
 - d. 5 hours
8. Slow blood transfusion should be considered for which of the following patients? (Choose TWO answers only)
 - a. Patients with heart disease
 - b. Patients with renal stones
 - c. Patients with bronchial asthma
 - d. Patients with severe anemia
 - e. Patients with CVA
9. Specify which of the following solutions/agents could be safely mixed with transfusion of blood (Choose TWO answers only)
 - a. 5% Dextrose water
 - b. Normal saline 0.9%
 - c. Lactated ringer
 - d. Morphine 1.0 mg/mL in NS
 - e. Frusemide (Lasix) 20 mg/ 2mL

⁵ >50ml/kg/hour.

10. A unit of blood was initiated at 2.00 PM and is expected to be completed at 5.00 PM. When should the patient's vital signs be recorded after initiation until completion? (Choose FOUR answers only)
- First hour at: a. 2:05 and 2:15 PM b. 2:20 and 2:40 PM c. 2:45 and 3.00 PM
 - Second hour at: a. 3:15 PM b. 3:30 PM c. 3:45 PM d. 4:00 PM
 - Third hour at: a. 4:15 PM b. 4:30 PM c. 4:45 PM d. 5:00 PM
11. When and for how long it is essential to physically observe the patient for possible transfusion reaction? (Choose ONE answer only)
- a. For the first hour
 - b. For the first 10-15 minutes
 - c. Throughout the transfusion
 - d. Throughout the shift

Section F: Complications Related to Blood Transfusion

1. What interventions could minimise the risk of the patient experiencing acute transfusion reaction? (Choose FOUR answers only)
- a. Administration of blood that is compatible with that of the recipient
 - b. Starting the transfusion within 20 minutes after collection from blood bank
 - c. Starting the transfusion within 40 minutes after collection from blood bank
 - d. Administering a unit of blood to the patient within 4 hours after collection
 - e. Taking history from the patient
 - f. Not transfusing together drugs or solutions that are incompatible with blood
 - g. Stopping blood if there are signs and symptoms of transfusion reaction
2. What signs and symptoms indicate that the patient is developing an acute haemolytic transfusion reaction? (Choose FOUR answers only).
- a. Tachycardia
 - b. Productive cough
 - c. Chest pain
 - d. Bradycardia
 - e. Hypotension
 - f. Shallow slow respiration
 - g. Nausea/ vomiting
 - h. Neck pain
3. What should be done **IMMEDIATELY** when signs and symptoms of acute haemolytic transfusion reaction are seen? (Choose FOUR answers only)
- a. Stop blood transfusion
 - b. Notify the blood bank
 - c. Keep vein open with 0.9% normal saline
 - d. Inform nursing supervisor
 - e. Check patient's vital signs
 - f. Write an incident report
 - g. Notify the doctor and begin emergency treatment according to medical order
4. Due to an emergency situation, a unit of blood collected at 8.00 PM was kept in the nurses' station until 9:30 PM. What should the nurse do with the blood? (Choose ONE answer only)
- a. Start the transfusion immediately and complete within 2 1/2 hours
 - b. Start the transfusion immediately and complete within 4 hours
 - c. Don't start the transfusion, notify the blood bank and return the blood
 - d. Start the transfusion and observe the patient closely for any reaction

5. A patient has sustained a mild allergic transfusion reaction. What is the usual presenting complaint?
(Choose ONE answer only)
 - a. Pain in the arm
 - b. Loin pain
 - c. Urticarial rash
 - d. Drop in BP
 - e. Mild dyspnea
6. What is the FIRST action that the nurse should take to handle the patient's condition in question 5?
(Choose ONE answer only)
 - a. Stop the transfusion and notify the doctor
 - b. Notify the doctor and slow the transfusion rate
 - c. Slow the transfusion rate and notify the doctor
 - d. Check the patient's vital signs and notify the doctor
 - e. Notify a senior nurse
7. What is the commonest cause of the most fatal transfusion reactions? (Choose ONE answer only)
 - a. Warming blood to more than 37°C
 - b. Error in blood bank testing
 - c. Antibodies in Rh system
 - d. Identification error of patient
8. Before administering blood, when is it acceptable NOT to check patients' details at the bedside? (Choose ONE answer only)
 - a. Nurse clearly knows patient
 - b. Patient is unconscious
 - c. Never
 - d. Patient is barrier nursed
 - e.

Section G: Issues Related to Blood Transfusion Policies and Procedures

1. Is there a written policy for the administration of blood in your ward?
 - a. Yes
 - b. No
 - c. I do not know
2. If yes, have you read the policy?
 - a. Yes
 - b. No