Improving patient safety for the critically ill

The challenges of implementation

Borgert, M.

Creative Commons License (see https://creativecommons.org/use-remix/cc-licenses):
Other

Citation for published version (APA):

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: https://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
IMPLEMENTATION OF A TRANSFUSION BUNDLE REDUCES INAPPROPRIATE RED BLOOD CELL TRANSFUSIONS IN INTENSIVE CARE - A BEFORE AND AFTER STUDY

Marjon Borgert, Jan Binnekade, Frederique Paulus, Margreeth Vroom, Alexander Vlaar, Astrid Goossens, and Dave Dongelmans

ABSTRACT

Background. Restrictive red blood cell (RBC) transfusion has been widely described in transfusion guidelines. However, compliance with these guidelines is often poor. Therefore, we developed a care bundle for the transfusion of RBCs in intensive care. We investigated the effect of the application of the transfusion bundle on transfusion practice, hypothesizing that the implementation of the transfusion bundle would lead to a reduction of inappropriate RBC transfusions.

Study design and methods. We conducted a before and after study between January to December 2014 in a medical-surgical intensive care unit (ICU) of a university hospital in Amsterdam, the Netherlands. The primary outcome was the percentage of appropriate transfusions, referring to those transfusions that were in accordance to the patients’ individual preset haemoglobin threshold.

Results. The mean pre-transfusion haemoglobin level was 7.3 g/dL\textsuperscript{1} (SD=1.15) during baseline and significantly decreased to 7.1 g/dL\textsuperscript{1} (SD=1.04) after transfusion bundle implementation, 95% confidence interval (CI): 0.009 to 0.308, P-value = 0.04. The number of inappropriate transfusions significantly decreased from 25% (111/439) during baseline to 15% (42/280) during implementation, difference 10%, 95% CI: -0.164 to -0.042, P-value 0.001. This further decreased to 12% (45/370) in the post-implementation phase. A logistic regression analysis showed that the chance to find an appropriate transfusion is approximately twice as high after transfusion bundle implementation.

Conclusions. Introduction of a transfusion bundle results in a significant reduction of the number of inappropriate RBC transfusions in the medical-surgical ICU. Our results show that the introduction of a transfusion care bundle helps to improve compliance with transfusion guidelines in daily practice.
INTRODUCTION

In the past decades randomized trials have shown that a restrictive red blood cell (RBC) transfusion policy is safe for most critically ill patients and even results in improved survival in specific critically ill patients. A restrictive (7 g/dL) RBC transfusion policy has now been widely implemented in transfusion guidelines for critically ill patients. Unfortunately, compliance with these guidelines is poor. It is important to improve compliance as this reduces mortality in critically ill patients and reduces waste of scarce as well as expensive RBC products.

To improve adherence to guidelines, the Institute for Healthcare Improvement (IHI) developed the concept of care bundles. Care bundles consist of a small set of evidence-based key interventions. These interventions should be performed together for every patient. The idea behind bundling evidence-based interventions is that bundles improve the reliability of care so that all patients receive the care they need. The first designed care bundles were the ventilator bundle and central line bundle. They aimed to reduce the incidence of ventilator-associated pneumonia (VAP) and catheter-related bloodstream infections respectively. Both bundles are nowadays widely used in intensive care units (ICUs), showing significant improvements in clinical outcomes and in reducing costs. Care bundles might also be effective in transfusion medicine. Therefore, we have developed a care bundle for the transfusion of RBCs in the ICU. We have selected those interventions that have proven to have a great impact on RBC transfusion safety or on decision making regarding RBC transfusion, which will subsequently lead to a reduction in costs and in improved clinical outcomes. For instance, adequate pre-transfusion ‘bedside’ checks should be carried out and decisions for transfusion should be made on reliable haemoglobin (Hb) results. Moreover RBCs should only be transfused when the preset Hb threshold is reached.

Nurses play a significant role in transfusion decision making. Vlaar et al. showed that the need for transfusion is often pointed out by nurses. Greater involvement of nurses in reviewing the appropriateness of a transfusion order before blood is given might be effective in reducing inappropriate transfusions. In this study, we quantified the true effect of the transfusion bundle by assessing, per transfusion, whether the decision to transfuse was based on a lower pre-transfusion Hb-level than the patients’ individual preset Hb threshold. The objective of this study was to investigate whether application of the transfusion bundle would reduce the number of inappropriate red blood cell transfusions in an ICU setting.
METHODS

Design
A before and after study was conducted from January to December 2014. We primarily assessed the effect of the transfusion bundle on the percentage of appropriate transfusions. To objectively assess this effect, we focused on the number of appropriate transfusions. Appropriate transfusions were defined as transfusions for which the last recorded pre-transfusion Hb level was lower than the patients’ individual preset Hb threshold as registered in the electronic patient file by the ICU physicians. A secondary outcome was the likelihood of appropriate transfusions, controlling for other variables. We implemented the transfusion bundle from May to August 2014. This implementation period denotes the transition period. The post-implementation, from September to December 2014, refers to the period in which the intervention is considered fully implemented as intended.

Setting
The study was conducted in a 28-bed mixed medical-surgical ICU of a university hospital in Amsterdam, the Netherlands. The ICU is a ‘closed format’ department for adult patients (≥ 18 years) with four units in which patients are under the direct care of the ICU team. The patient-nurse ratio is 1:1 or 1:2, depending on the patients’ severity of illness.

Study population
The transfusion bundle was applied by nurses to every eligible ICU patient who received at least one unit of RBCs. Transfusion in patients for whom therapeutic haemapheresis was indicated or patients who were massively bleeding were excluded due the urgency of the situation. The massive blood transfusion protocol was activated in case of the presentation of the following signs or symptoms: (i) rapid decrease in blood pressure (systolic < 90mmHg; and (ii) not responding to fluid therapy; and (iii) existence of a high suspicion for bleeding. Furthermore, blood products other than RBCs were excluded.

Transfusion bundle
We have developed the transfusion bundle by using a prospective risk analysis, i.e. the Bow-Tie analysis model. A multidisciplinary expert team of two ICU nurses, three intensivists, one haemovigilance officer and one laboratory analyst from the blood bank joined the Bow-Tie analysis session. The results of the Bow-Tie analysis were used to identify the potential interventions to include in the transfusion care bundle. The expert team selected the final set of five key interventions through discussion until consensus was achieved. In Table 1, the interventions are shown. The interventions were
Implementation of a transfusion bundle

underpinned with evidence and/or were reported in the (inter)national transfusion guidelines. All interventions aimed to reduce unnecessary, inappropriate or unsafe transfusions.\textsuperscript{1,2,12-14,16} The transfusion bundle was actively implemented from May to August 2014 by using educational activities and audit & feedback (A&F). A&F was given monthly to the nursing teams. Half of the nurses received additionally individual A&F after every transfusion. However, the implementation of the bundle itself was not the subject of this study. In this study, we focused on the effect of the bundle on inappropriate transfusions.

\textbf{Table 1. Transfusion bundle interventions}

\begin{tabular}{|l|}
\hline
1. Verification of the Hb measurement reliability \\
2. Transfusions given according to patients’ individual Hb-threshold, i.e. transfusion trigger \\
3. Verification of obtained Informed Consent \\
4. Verification of the right patient by two persons independently \\
5. Verification of the right blood product by two persons independently \\
\hline
\end{tabular}

\textbf{Data collection}

Data about transfusions were collected at baseline (4 months), during the implementation period (4 months) and during the post-implementation period (4 months). Transfusions during the baseline period were collected retrospectively from the electronic Patients Data Management System (PDMS) (Metavision, Ite medical Tiel). All patient and transfusion data during the baseline period were reviewed one by one and entered into the study database. Data during the implementation and post-implementation periods were prospectively collected from the PDMS. During week days the occurrence of a RBC transfusion was audited in the PDMS three times per day by the researcher. Transfusions that had occurred during the weekends were audited on Mondays. Bundle checklists were used to track the levels of bundle compliance. Compliance with the completion of each element of the bundle was assessed by reviewing the bundle checklist. Compliance levels were calculated using the all-or-none approach.\textsuperscript{18} This means that all five bundle-interventions had to be completed in order to be labelled as compliant to the transfusion bundle.
Analysis

Continuous variables that were normally distributed were expressed as means with standard deviations (SD) and not normally distributed variables as medians and interquartile ranges (IQR). To test independent groups of not normally distributed continuous variables, the Kruskal Wallis test was used or Mann-Whitney U test when appropriate. Categorical variables were expressed as percentages, numerators and denominators and were compared with the Chi-square test or Fisher’s exact test. Analysis of variance (ANOVA or unpaired t-test) was used to test for differences in means across the study periods. In some cases the denominator does not correspond fully with the overall number of patients. This difference is due to missing values on some variables.

The goal of the logistic regression analysis was to quantify the net effect of the implementation of the transfusion bundle on the likelihood of appropriate transfusions, controlling for other variables. Exploration of interaction (effect modification) and confounding was considered methodologically relevant. We first focused on the crude (uncorrected) effect of the implementation of the bundle (independent variable) on appropriate transfusions (dependent variable). Then, statistical and clinically relevant covariates were added as an interaction term. If the interaction term appeared to be significant \( (P < 0.05) \), this would indicate that the relation between the implementation and appropriate transfusions could be different for various levels of the covariate. This indicates the need for separate models for the levels of the covariate. As a significant interaction was not found, the model was examined for confounding. Confounding was defined as \( \geq 10\% \) change in the coefficient of the central determinant implementation as a consequence of adding a covariate. Statistical significance was considered to be at \( P < 0.05 \). When appropriate statistical uncertainty was expressed by the 95% confidence levels. Analyses were performed using R (version: 3.1.3; R Foundation for Statistical Computing, Vienna, Austria).

Ethics

The study was approved by the Medical Ethics Committee of the Academic Medical Center of Amsterdam, the Netherlands and the need for informed consent was waived.
RESULTS

Patient demographics

A total of 386 patients were included in this study, 146 patients during baseline, 112 during implementation and 128 during the post-implementation period. Each patient received a median of 2 units of RBCs during their ICU admission (IQR=1-4). In total, 1128 units of RBCs were transfused. Table 2 shows that the cohorts were similar during the baseline, implementation and post-implementation period with respect to age, gender, type of admission and ICU mortality. Most admissions were medical admissions, followed by cardio-surgical admissions. During the phase of active implementation, less units of RBCs were administered compared to the baseline and to the post-implementation period (difference baseline 16%, 95% CI: 0.122 to 0.200, P-value < 0.001; difference post-implementation: -9%, 95% CI: -0.122 to -0.045, P-value < 0.001).

Table 2. Patients demographics

<table>
<thead>
<tr>
<th></th>
<th>Baseline period</th>
<th>Implementation period</th>
<th>Post-implementation</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients receiving ≥1 RBC transfusions during ICU admission*</td>
<td>146</td>
<td>112</td>
<td>128</td>
<td>0.03</td>
</tr>
<tr>
<td>Total number of transfused RBCs</td>
<td>466/1128 (41)</td>
<td>284/1128 (25)</td>
<td>378/1128 (34)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>RBCs per patient, median IQR</td>
<td>2 (1-4)</td>
<td>2 (1-4)</td>
<td>2 (1-3)</td>
<td>0.49</td>
</tr>
<tr>
<td>Age in years, median (IQR)</td>
<td>67 (54-75)</td>
<td>62 (52.8-72.0)</td>
<td>62 (52.5-74.0)</td>
<td>0.54</td>
</tr>
<tr>
<td>Gender (male), n/N (%)*</td>
<td>78/135 (58)</td>
<td>64/112 (57)</td>
<td>71/128 (56)</td>
<td>0.93</td>
</tr>
<tr>
<td>Type of admission*</td>
<td>88/135 (65)</td>
<td>63/102 (62)</td>
<td>76/106 (72)</td>
<td>0.30</td>
</tr>
<tr>
<td>Medical case</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical case</td>
<td>9/135 (7)</td>
<td>11/102 (11)</td>
<td>9/106 (5)</td>
<td>0.53</td>
</tr>
<tr>
<td>Cardio-surgical case</td>
<td>38/135 (28)</td>
<td>28/102 (28)</td>
<td>21/106 (20)</td>
<td>0.29</td>
</tr>
<tr>
<td>APACHE IV, median (IQR)*</td>
<td>69 (52.5-96.0)</td>
<td>61 (48.3-82.8)</td>
<td>74.5 (54.5-99.8)</td>
<td>0.005</td>
</tr>
<tr>
<td>ICU LOS (days), median (IQR)*</td>
<td>5.02 (2.6-10.1)</td>
<td>6 (3.0-12.0)</td>
<td>5.5 (2.0-14.0)</td>
<td>0.26</td>
</tr>
<tr>
<td>ICU mortality, n/N (%)*</td>
<td>36/135 (27)</td>
<td>26/112 (23)</td>
<td>28/128 (22)</td>
<td>0.64</td>
</tr>
<tr>
<td>Hospital mortality</td>
<td>40/130 (31)</td>
<td>28/101 (28)</td>
<td>33/116 (29)</td>
<td>0.86</td>
</tr>
</tbody>
</table>

RBC= Red Blood Cells, ICU= Intensive Care Unit, APACHE= Acute Physiology and Chronic Health Evaluation; LOS=Length Of Stay; *including ICU readmissions; In some cases the denominator does not correspond fully with the overall number of patients receiving ≥ 1 RBC transfusions during ICU admission. This difference is due to missing values on some variables.
## Transfusion bundle

During the baseline period 466 units of RBCs were transfused, 284 during the implementation period and 378 units post-implementation. After introducing the transfusion bundle, compliance was 50% (141/284) during implementation, and 37% (141/378) during the post-implementation period (difference -13%, 95% CI: 0.045 to 0.202, \(P\)-value = 0.002).

### Red Blood Cell transfusions

In Figure 1, the preset Hb thresholds and the last recorded pre-transfusion Hb levels are shown. The mean pre-transfusion Hb level was 7.3 g/dL\(^{-1}\) (SD=1.15) during the baseline period. After introducing the bundle the mean pre-transfusion Hb level decreased to 7.1 g/dL\(^{-1}\) (SD=1.04), difference 0.2 g/dL\(^{-1}\), 95% CI: 0.009 to 0.308, \(P\)-value = 0.037.

In Figure 2, the percentage deviation between the preset Hb thresholds and the last recorded pre-transfusion Hb levels is shown. In the vast majority of transfusions the pre-transfusion Hb was below the Hb thresholds, i.e. appropriately transfused. Compared to the baseline period, the number of inappropriate transfusions significantly decreased during implementation from 25% (111/439) to 15% (42/280) during implementation, difference 10%, 95% CI: -0.164 to -0.042, \(P\)-value 0.001. During the post-implementation period, the number of inappropriate transfusion further decreased to 12% (45/370). Table 3 shows the results from the univariate analysis. The covariates ‘intervention’, i.e. transfusion bundle, and ‘pre-transfusion Hb’ showed a statistical significant effect on the appropriateness of transfusions. The logistic regression analysis shows that the chance (Odds) to find an appropriate transfusion is approximately twice as high after the implementation of the transfusion bundle (Table 4). The pre-transfusion Hb level influences this effect. The direction of this odds ratio shows that a lower pre-transfusion Hb level is associated with better protocol compliance, resulting in more appropriate transfusions when lower pre-transfusion Hb levels were measured.
Figure 1. Patients’ individual pre-set Hb threshold as green dots and pre-transfusion Hb level as blue dots.

Implementation of a transfusion bundle.
Figure 2. Percentage deviation from patients’ individual pre-set Hb threshold by pre-transfusion Hb level. Light blue dots reflect the transfusions associated with a higher pre-transfusion Hb level than the patients’ individual pre-set Hb threshold.
Table 3. Logic regression model for appropriate transfusions

<table>
<thead>
<tr>
<th></th>
<th>OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline (reference)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Baseline – intervention*</td>
<td>2.26 (1.65 to 3.10)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Age</td>
<td>1 (0.99 to 1.02)</td>
<td>0.26</td>
</tr>
<tr>
<td>Gender</td>
<td>1.35 (0.85 to 2.13)</td>
<td>0.20</td>
</tr>
<tr>
<td>Apache IV score</td>
<td>0.99 (0.99 to 1)</td>
<td>0.11</td>
</tr>
<tr>
<td>Pre transfusion Hb</td>
<td>0.25 (0.19 to 0.32)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Transfusion delay (hours)</td>
<td>0.99 (0.91 to 1.07)</td>
<td>0.79</td>
</tr>
<tr>
<td>Medical/surgical admission</td>
<td>0.82 (0.59 to 1.15)</td>
<td>0.26</td>
</tr>
</tbody>
</table>

Dependent variable: transfusion according to protocol = 1 (Hb reference value), protocol deviation = 0; *Intervention: use of the transfusion bundle during (post) implementation periods

Table 4. Multivariable analysis

<table>
<thead>
<tr>
<th></th>
<th>OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline – interventions*</td>
<td>2.05 (1.47 to 2.86)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pre transfusion Hb</td>
<td>0.26 (0.20 to 0.34)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Intervention: use of the transfusion bundle during (post) implementation periods

DISCUSSION

The main finding of the current study is that the introduction of a transfusion bundle has resulted in a significant reduction of the percentage of inappropriate transfusions. Effectively, using the transfusion bundle helps to improve compliance to transfusion guidelines in daily practice. Since the landmark of Hébert et al. attempts have been made to reduce the number of transfusions given the concerns about the safety of transfusion as well as the rising costs and shortage of blood products.1,19,20 Reducing the number of inappropriate transfusions is expected to result in improved clinical outcomes and reduced health care costs.21 The transfusion care bundle may therefore diminish costs by reducing waste of scarce and expensive RBC products.
We implemented the transfusion bundle in the ICU nursing teams. Vlaar et al. showed that most often, it is the nurse who points out the need for transfusion. Therefore, the use of the transfusion bundle by nurses might have had an important effect on reducing inappropriate transfusions.

In the literature, care bundles are often evaluated by measuring the effect of the bundle by using compliance levels. These compliance levels are often calculated by using bundle checklists. In this study, we were primarily interested in the reduction of the number of inappropriate RBC transfusions. For this we assessed per transfusion if this was based on lower pre-transfusion Hb levels than the patients individual preset Hb thresholds.

Our results showed a significant reduction in the number of inappropriate transfusions. Remarkably, compliance-levels of the whole bundle remained low during the study period. It is known that the reported levels of bundle compliance are widely variable between studies. This might, for example, be due to the way compliance was calculated or the number of bundle interventions included. In our study, we have calculated bundle compliance by using the all-or-none approach. This means that if one of the bundle interventions was not performed, the whole bundle was considered as non-compliant. It may also be possible that the bundle interventions were actually performed without using the bundle checklist. The use of paper-based bundle checklists could have influenced this effect and may have led to a documentation burden. However, the intention of care bundles is not to use them as checklists but to improve habits and processes and to internalize the bundle interventions. The latter might be true in our study. This might be due to an increased awareness of the risks of RBC transfusion due to the implementation of the transfusion bundle.

In our study, we have examined whether transfusions were based on lower pre-transfusion Hb levels than the preset Hb threshold per individual patient. We have not assessed whether the pre-set threshold was considered adequate for each individual patient according to the transfusion guideline. Interestingly, our results show that in most cases, restrictive Hb thresholds were used as stated in the transfusion guideline. Hébert et al. showed that in most critically ill patients the Hb threshold can be safely lowered without influencing clinical outcomes negatively. To further improve the effect of the transfusion bundle, the preset thresholds could be reviewed and discussed by peers. This might have an effect in lowering the preset Hb thresholds for more patients. Using the transfusion bundle on these preset Hb levels may lead to a larger reduction of inappropriate transfusions. However, to sustain the implementation effect for appropriate transfusions, real-time clinical decision support systems for ordering blood
Implementation of a transfusion bundle

products appear to be effective.\textsuperscript{26,27} Such systems are integrated in a blood ordering system in electronic patient files. Several studies showed significant reductions in blood products when a clinical decision support system was implemented.\textsuperscript{26,28} Decision support systems complements might be used in conjunction with the transfusion bundle.

According to (local) transfusion guidelines and the Joint Commission International (JCI) standards, informed consent should be obtained before transfusion.\textsuperscript{16,29} Obtaining informed consent is one of the five bundle interventions. Not obtaining informed consent was considered as one of the problems that can occur according to the Bow-Tie analysis. Additionally, obtaining informed consent is one of the JCI standards. Because of these reasons, the expert team have chosen to include this element in the transfusion bundle. Moreover, informed consent could have an indirect impact on reducing transfusions since patients are making well-informed decisions whether or not to receive blood products. Obtaining informed consent does not fully comply with the bundle requirements as set by the IHI, i.e. level one evidence.\textsuperscript{6} However, according to the IHI, bundle interventions that are already recommended in (inter)national guidelines and by consensus of clinicians as being applicable to most patients might be considered for inclusion.\textsuperscript{6}

The strength of a care bundle is that a maximum of five interventions can be included.\textsuperscript{6} Not all recommendations can be put into care bundles. Other important problems or risk factors in the blood transfusion procedure could have been selected by the expert team as well, for instance, the mislabelling of blood samples, transfusion of two units of RBCs per transfusion without a re-check of the Hb after each transfused unit or wrong storage of RBCs.\textsuperscript{15,16,20} We have chosen to include those intervention in the transfusion bundle that were marked as serious problems or risks in the Bow-Tie analysis and were based on evidence or international guidelines.

The transfusion care bundle could result in diminishing costs by reducing the waste of scarce and expensive RBC products. These savings are apart from the indirect savings of transfusion-related adverse events when the restrictive policy is applied to the majority of the patients.\textsuperscript{21}

\textbf{Limitations}

Our study has some limitations. The study was a single-center study, which limits the external validity of our results. Furthermore, a before and after design was used. Therefore secular trends may have influenced our results. Baseline transfusions were retrospectively collected; however, each transfusion was thoroughly reviewed in the
PDMS. We quantified the net effect of the bundle by using one of the bundle interventions, i.e. transfusions given according to the patients’ individual Hb-threshold, as we could objectively measure this intervention. We have not actively observed the effect of the other bundle interventions. However, during the study period no transfusion-related incidents were reported in our ICU incident-reporting system. A mixed method study design, using both qualitative and quantitative research methods, would have given insight in the effect of the bundle on all interventions, e.g. on the performance of the final bedside checks. Furthermore, we have not assessed whether the preset threshold was considered adequate for each individual patient as we have chosen to follow clinical practice. Implementation of the transfusion bundle showed moderate levels of bundle compliance. However, high levels of bundle compliance of more than 95% are associated with improved clinical outcomes. In this study, we focused on the number of inappropriate transfusions without taking the cost effectiveness into account.

**Future research**

Future research should focus on implementing a transfusion bundle for other type of blood products, such as fresh frozen plasma or platelets. The transfusion bundle might be an effective tool to reduce the overall number of inappropriate transfusions. Furthermore, future research should focus on the cost effectiveness of implementing the transfusion bundle.

**CONCLUSIONS**

Introduction of a transfusion bundle results in a significant reduction of the number of inappropriate RBCs transfusions in the medical-surgical ICU. Our results show that introduction of transfusion care bundles helps to improve compliance with transfusion guidelines in daily practice.
Competing interest
The authors declare that they have no competing interests.

Funding
This study was funded by ZonMw.
REFERENCES


Supplementary File
Transfusion bundle

<table>
<thead>
<tr>
<th>Transfusion bundle</th>
<th>Yes</th>
<th>No</th>
<th>If no, give reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is the haemoglobin (Hb) result considered reliable?</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>2. Have you verified if the Hb transfusion threshold was reached?</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>3. Have you verified if informed consent was obtained?</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>4. Is the identity of the patient checked by two persons independently before transfusion?</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>5. Is the blood product checked by two persons independently before transfusion?</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
</tbody>
</table>

Patient data
Patient Identification Number:
Name:
Date of birth:

Transfusion of Red Blood Cells
Date of transfusion: ___-___-20___
Time of transfusion: ___:___ hours
Name of the nurse: