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Blood Transfusion Practices in a Tertiary Referral Intensive Care Unit: A Clinical Audit and Performance Improvement Project

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ABSTRACT

Anemia is common among critically ill patients, despite guidelines recommendations for restrictive transfusion practices, blood transfusion continues beyond recommended triggers. Frequency of blood transfusion in ICU calls for auditing of practices.

Method: Two audit cycles a month each, separated by interventional period, audit standards were order issuing personnel, documentation of trigger, trigger according to policy, checking of received unit documentation, monitoring during transfusion, and reporting of adverse events.

Results: Standards of trigger documentation, trigger according to policy, and checking documentation were very low in the first cycle, but showed significant improvement in the second cycle, after the performance improvement project. The transfusion rate was significantly lower in the second cycle (18.8/100 patient days vs 14.8 /100 patient days; p = 0.04).

Conclusion: Blood transfusion practices remain unsatisfactory in several aspects, however, they could be improved by quality performance improvement projects.

Keywords: Blood transfusion, intensive care unit, ICU, clinical audit, performance improvement project

INTRODUCTION

Critically ill patients admitted to intensive care units (ICU) are frequently found to be anemic with hemoglobin (Hb) levels below 9 gm/dl [(1)], and almost all of the few patients with normal Hb levels upon ICU admission become anemic during their ICU stay [(2,3)]. Several etiologies have been implicated of such condition, including anemia of chronic illness, blunted erythropoietic activity [(2)], and dysregulation of iron homeostasis [(4)]. However, practices within the ICU itself that are related to the provision of care to patients were also found to be related to the development of anemia within the ICU, practices such as repeated phlebotomy and blood extraction [(5)], which could account for up to 70 ml of blood loss daily during the ICU stay. Other causes could be related to the admission diagnosis itself such as trauma or post-operative conditions, occult or overt gastrointestinal tract blood loss, and anemia due to inflammation which is frequent in cases of sepsis and septic shock [(5,6)].

Perks of blood transfusion in ICU remain controversial. Undoubtedly, blood transfusion may be life-saving in cases hemorrhagic shock, trauma, or post-operative bleeding [(7)], however, out of that scope, blood transfusion in ICU seems to focus around the assumption that higher Hb levels will improve oxygen delivery to tissues [(4)], but in reality blood transfusion is

more focused on correcting Hb levels rather than treating an actual condition [(1)], not forgetting of course other well-known possible draw backs such as Transfusion-Related Acute Lung Injury (TRALI), Transfusion-Related Circulatory Overload (TACO), in addition to possible immunomodulation which may lead to increase in nosocomial infections [(8)], furthermore, while less frequent, catastrophic events due to mismatched blood transfusion can only occur during an episode of blood transfusion [(9)].

Accordingly, auditing of blood transfusion practices is a much needed activity of quality monitoring and improvement, to ensure local institutional policies are being followed and implemented, with regards to triggers of transfusion, documentation, and patients' safety aspects. But perhaps more importantly, to identify gaps in the process, and possible areas for improvement.

METHOD

***Setting*:** This audit and performance improvement project (PIP) was conducted in the ICU of King Saud Medical City (KSMC), Riyadh, Saudi Arabia. KSMC is the largest government hospital in the central region of Saudi Arabia, with a bed capacity of 1400 beds. The ICU harbors 127 beds, divided into six units (namely: Main unit, medical, surgical, respiratory, burn, and maternity units), it is a closed ICU operated by intensivists round the clock, fully equipped with capabilities of invasive as well non-invasive ventilation, in addition to invasive and non-invasive vital signs monitoring for each bed. The ICU operates at a nurse to patient ratio of 1:1, and physician to patient ratio of 1:12.

We generally followed the recommendations of the Healthcare Quality Improvement Partnership (HQIP) [(10)] for a clinical audit to performed in cycles, where in the first cycle data are collected about the current practice, compared to the standards of the organization, gaps are identified and improvement interventions are put in place, then the second cycle commences to measure the success of the improvement intervention. This work was approved by the Total Quality Management (TQM) department at KSMC, with waiver of consent.

***Geographical boundaries and timeframe*:** The audit took place only in the Main ICU (41 beds), and the first cycle was conducted during June 2018, whereas the second cycle took place in December 2018, with five months in between for the interventional performance improvement plan to be conducted.

***Inclusion and exclusion criteria*:** The audit included all patients newly admitted to the Main ICU during the project period, as long as they were: Adults (age > 18 years), stayed for more than 24 hours, without a Do Not Resuscitate (DNR) order. Patients were excluded if they were admitted to ICU post-operatively (conservative surgical patients could be included), trauma patients, admitted with the diagnosis of hemorrhagic shock and/or required activation of massive blood transfusion protocol. We also excluded any episodes of transfusion of blood products other than packed red blood cells (PRBCs), as well as sessions of therapeutic apheresis.

***Data collection and Audit standards*:** Data collection included demographic and clinical parameters of admitted patients (Age, gender, diagnostic category, severity score, and mechanical ventilation status), we also noted Hb level upon ICU admission and on the day of transfusion order, ICU length of stay (LOS), requirement of intubation for spontaneously breathing patients, and binary ICU outcome (dead or alive).

The audit standards were adopted from our institutional policy of blood transfusion, and included:

1. Order of blood transfusion by a privileged physician.

2. Trigger of transfusion documented in patient's file, and is in concordance with institutional policy (Hb < 7 gm/dl for general population, and Hb < 9 gm/dl for ischemic stroke and acute coronary syndrome patients).
3. Correct checking of received blood unit(s) from blood bank on the designated form.
4. Proper monitoring of vital signs during transfusion as per policy.
5. Reporting of side effects or adverse events.

***Statistical plan*:** The unit of comparison for demographic and clinical data was the patient, whereas, the unit of comparison for audit standards was the episode of blood transfusion. The rate of transfusion episodes was per 100 patient days. We summarized continuous data as mean ± standard deviation (SD), while discrete data were summarized as frequency and percentage. Comparison of data between the two cycles was performed using student t test or Mann Whitney U test for continuous data, and Chi square or Fisher's exact test for discrete data, as appropriate for each data type. All statistical tests were considered significant with p value < 0.05, without correction for multiple testing. Commercially available software STATA ® was used for statistical analysis [StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP.]

RESULTS

During the first cycle (June, 2018) 98 patients were admitted to the main ICU, of which 16 patients were excluded, leaving 82 patients to be enrolled for analysis. While during the second cycle (December, 2018) 106 patients were admitted, 19 were excluded and 87 were enrolled for analysis (Figure 1 depicts patients' enrollment flow, and reasons of exclusion).

Table 1: Demographic, clinical characteristics, and outcomes of patients:

	Cycle 1 (n = 82)	Cycle 2 (n = 87)	P value
Males: n (%)	45 (54.9%)	50 (57.5%)	0.7
Age (mean ± SD)	52.3 ± 14.8	52.5 ± 14.4	0.9
Diagnostic Category: n (%)			
Medical	61 (74.4%)	69 (79.3%)	0.4
Surgical	21 (25.6%)	18 (20.7%)	
Cardiac	12 (14.6%)	13 (14.9%)	0.9
APACHE 4 (mean ± SD)	29.3 ± 13.6	28.6 ± 14	0.7
Mechanical Ventilation: n(%)	53 (64.6%)	61 (70.1%)	0.4
Hemoglobin (mean ± SD)	8.1 ± 1.4	7.9 ± 1.5	0.5
****Required Intubation: n(%)**	9/29 (31%)	5/26 (19.2%)	0.3
Number of transfusions (mean ± SD)	2 ± 0.3	1.6 ± 0.5	< 0.001*
ICU LOS (mean ± SD)	11.1 ± 7.1	10.4 ± 5.1	0.9*
ICU Mortality: n (%)	14 (17.1%)	11 (12.6%)	0.4
Transfusion Rate (transfusion/100 patient days)			
Transfusion episodes	171	134	
Patient days	908	903	
Rate	18.8 / 100 patient days	14.8 / 100 patient days	0.04

SD = standard deviation, n = count, APACHE =Acute Physiology and Chronic Health Evaluation, ICU = intensive care unit, LOS = length of stay.
**Mann Whitney U test, due to violation of normality assumption.*
***Percentage calculated out of patients admitted to ICU spontaneously breathing.*

Table 2: Comparison of audit standards:

	Cycle 1 (n = 171)	Cycle 2 (n = 134)	P value
Order issued by privileged intensivist: n (%)	**171 (100%)**	**134 (100%)**	**……...**
Trigger of transfusion documented: n (%)	**48 (28%)**	**71 (53%)**	**< 0.001**
Trigger of transfusion in concordance with policy: n(%)	**75 (44%)**	**98 (73%)**	**< 0.001**
Proper checking of blood unit: n(%)	**26 (15%)**	**112 (84%)**	**< 0.001**
Proper Monitoring during transfusion: n(%)	**169 (99%)**	**134 (100%)**	**0.99**
Reporting of adverse events: n(%)	**152 (89%)**	**126 (94%)**	**0.2**

Table 1 shows that enrolled patients in both cycles were similar, except for the mean number of transfusion events, the mean number of transfusion events in the first and second cycles were 2±0.3 and 1.6±0.5 respectively, mean number of

transfusion events was significantly higher in the first cycle (95% CI of difference: 0.3 – 0.5; $p < 0.001$). As for the transfusion rate, in the first cycle there were 171 episodes, while the enrolled 82 patients accounted for 908 patient days, giving a transfusion rate of 18.8 episodes / 100 patient days. The second cycle had 134 transfusion episodes, and the enrolled 87 patients accounted for 903 patient days, yielding a transfusion rate of 14.8 episodes/100 patient days. The transfusion rate was significantly lower during the second cycle (95% CI of difference: 0.002 – 0.1; $p = 0.04$)

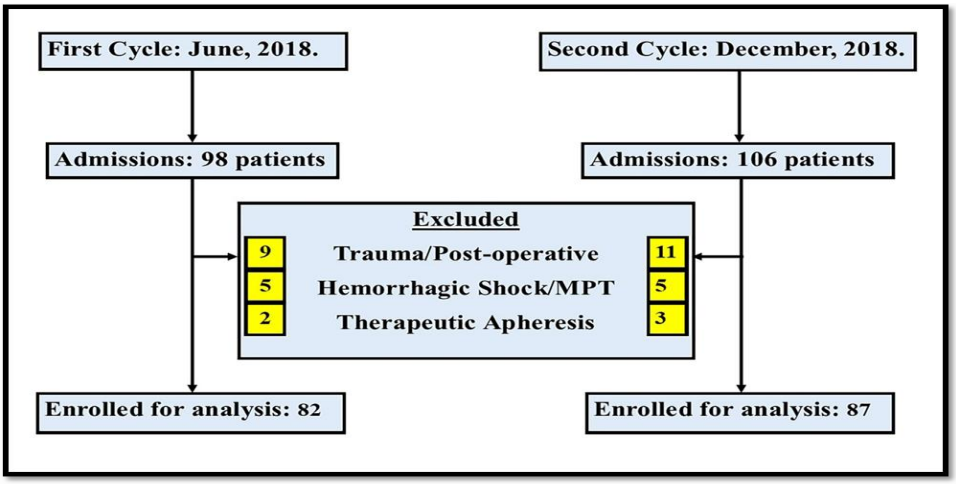

Figure 1: Patients' enrollment flow chart:

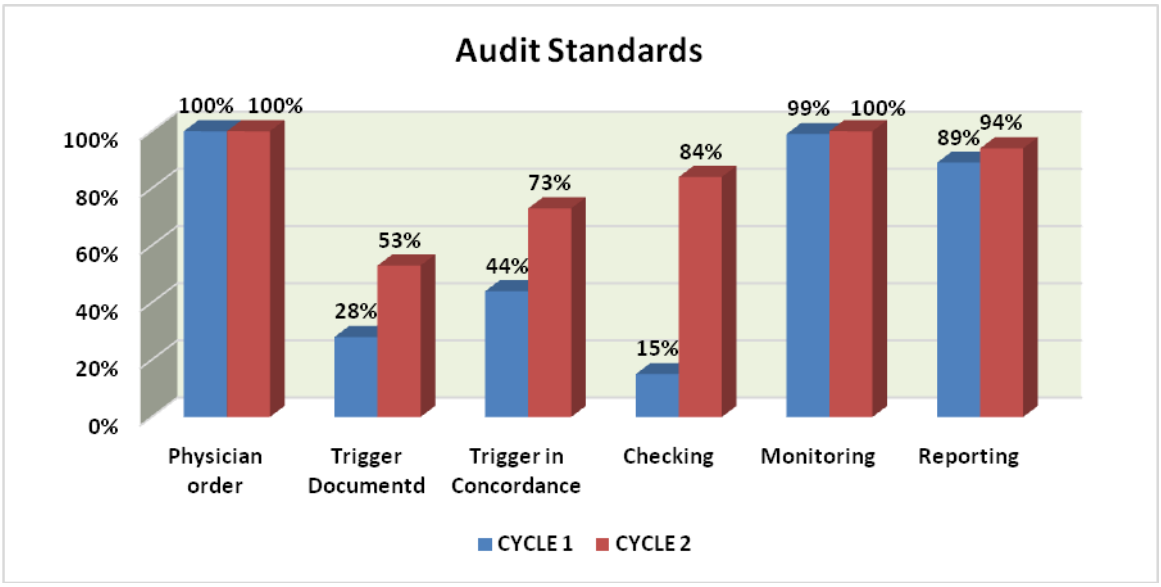

Figure 2: Audit standards percentage compliance:

Table 2 and Figure 2 show the comparison between both cycles with regards to pre-defined audit standards. All orders of blood transfusion during both cycles were issued by a privileged intensivist, whereas, documentation of the trigger of blood transfusion, blood transfusion triggered according to policy, and proper checking of the blood unit were all significantly higher in the second cycle. Both cycles were similar with regards to monitoring of vital signs during transfusion, and reporting of adverse events.

Performance improvement project: Based on the results of the first audit cycle, the Quality and Patient Safety Division (QPSD) of the critical care department initiated a PIP with the aim of improving compliance with the standards and regulations of blood transfusion in the period between cycles. We conducted four major (1 day long) awareness sessions,

where we presented the blood transfusion policy, reviewed published studies and guidelines on blood transfusion, and discussed with attendees the harms of liberal blood transfusion strategies, according to evidence based medicine. Furthermore, during those sessions we were able to obtain feedback and suggestions from the stakeholders (physicians and nurses), the most significant of which, was the discovery that the form used to check blood received was not user-friendly, and was time and effort consuming. So, we acted upon this finding, and redesigned the form to be more efficient and obtained approval for its use from TQM. It was that form that was used to check received blood during the second cycle of the audit, and lead to a significant increase in the percentage of properly checked units of received blood. In addition to the four major awareness session, daily rounds were conducted by the team, to encourage compliance to the regulations of blood transfusion according to our institutional policy.

DISCUSSION

This audit and performance improvement project provided some useful insights about the epidemiology of blood transfusion in our ICU, as well as its practice. About one fifth of admitted patients throughout the whole audit were anemic (Hb < 7 gm/dl), which is lower than the usually reported percentages of anemic patients admitted to ICU [1, 2]. In our ICU the triggers of blood transfusion follow international guidelines and recommendation of 7 gm/dl for the general population, and 9 gm/dl for ischemic heart patients [11, 12], however, we observed poor compliance with this recommendation, particularly in the first cycle of the audit, clearly indicating that blood transfusion may be given just to improve Hb level, or under the assumption of improving tissue oxygen delivery [1, 13]. Indeed there was no difference in ICU mortality between both cycles, despite a significantly lower transfusion rate in the second cycle, this supports the conclusion of lack of benefit demonstrated by randomized clinical trials that compared liberal versus restrictive blood transfusion strategies [11, 12], moreover, our findings indicate that healthcare providers are less inclined to comply with documentation requirements, both when it comes to documenting triggers of transfusion, or checking the received unit. This by no means, is a reflection of their clinical practice, as we didn't observe any incident of mis-matched blood transfusion throughout the audit. This is simply a reflection of the burden of paperwork on healthcare providers.

During this PIP we learnt that non-compliance to rules and regulations doesn't necessarily reflect negligence or resistance, on the contrary, it may be a result of poorly designed systems and arduous forms. When the blood checking form in our hospital was redesigned to a more user-friendly format, this was coupled in the second audit cycle with a significant improvement in documentation of blood checking, simply because the form itself was easier to use. We also confirmed our finding from a previous audit [14] that changes can be brought about by simple interventions such as awareness and education. However, efforts towards improvement should be continuous, and should never be terminated with the conclusion of a single PIP, as our results show, we still have non-satisfactory compliance rates, for example for following policies on the triggers of blood transfusion, and its documentation, despite improvement compared to the first cycle. Accordingly, quality improvement efforts should be maintained, and practices of a PIP should become routine after the conclusion of the project itself.

CONCLUSION

In our ICU practices of blood transfusion didn't follow institutional polices, particularly with regards to triggers of transfusion, documentation of the trigger, and checking of blood received. Improvement can be achieved by usual

quality methods, and despite improvement, the compliance within those three domains remains unsatisfactory, mandating continuation of improvement efforts.

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