Comparing the demand for blood in hospitals of Jahrom and standard blood transfusion indices

Dashab M¹, Solhjou K², Erfanian S³

Introduction:
Due to the high costs of preparation and preservation of blood on the one hand, and the lack of a suitable model for blood preservation and utilization in Iranian hospitals, on the other hand, the current study was conducted to investigate the demand and the amount of blood utilization rate in different parts of hospitals in Jahrom and compare them with standard blood transfusion indices.

Material and methods:
In this descriptive cross-sectional study, 1066 patients were studied within 3 months for whom blood supply was requested in different wards of two hospitals in Jahrom. Patients’ demographic data, hospitalization ward, blood group, hemoglobin, hematocrit, the number of requested and cross-matched blood units, the number of transfused blood units before and after surgery were collected. Statistical central tendency indices were determined by SPSS software and standard indices of blood transfusion including cross match/transfusion ratio (C/T), transfusion index (TI) and transfusion probability (TP) were calculated.

Results:
In the current study, of 1414 blood units requested, 10.18% of units were transfused to patients and only 19.38% of the cross-matched units were used. Blood transfusion indices C/T, TP and TI, were 5.15, 14.52 and 0.26, respectively, and the highest and lowest rates of C/T related to urology ward (18.18) and neonatal intensive care unit (0.1), respectively.

Conclusion:
Given the obtained blood transfusion indices, a significant number of cross-matched bloods are not used in the hospitals of Jahrom and for those surgeries in which cross-matched blood supply is needed; blood request should be based on the maximum surgical blood ordering schedule.

Keywords: Blood Transfusion, Hospitals, Crossmatching, Blood

Introduction
Blood transfusion is an essential part of medical care, and if performed properly, it can save lives (1). Blood is so important that the World Health Organization named 2000, year of safe blood (2). Today, the need for blood transfusion has increased because of increasing numbers and extent of surgeries (3). Excessive demand for blood is a common problem in hospitals, which causes such problems as inappropriate distribution of blood
Comparing the demand for blood in different centers, rising cost of preparing, and also increasing workload of blood banks. The rising demand is for the fear of running out during surgery (irrespective of use or otherwise), or due to lack of a clear blood ordering pattern that ultimately leads to blood shortages and worsening of overall storage. It can be argued that blood ordering is done at will in most hospitals (4, 5). Gharabaghian et al. point out that appropriate use of blood products requires national regulation, hospital committee, and alternative method, standard blood ordering form, ordering guide tables, and establishment of blood maintenance system (6).

Although most blood units are used in surgery departments, blood and its products are also required in other departments. Today, blood transfusion indices such as C/T Ratio (ratio of number of cross-matched blood units to transfused units) and TI index (blood transfusion) can be used for proper assessment of blood demand and use in various hospital wards. Accordingly, C/T Ratio greater than 2.5 indicates improper blood transfusion conditions, which means less than 40% of cross-matched blood has been transfused. Blood transfusion index is indicative of number of transfused units for the number of cross-matched units, and ratios above 0.5 indicate the need for blood storage prior to surgery (6, 7, and 8).

Assessment of C/T Ratio in studies on demand and consumption shows that this index is different in different hospital wards. This ratio was higher than standard in midwifery and maternity ward and male and elective surgery wards in Yahyanejad Hospital in Babul (7), and in surgery and orthopedic wards in Besat Teaching Hospital in Hamedan, which means a large percentage of blood sacks are not used in these wards, but in other wards of these hospitals, this ratio is within standard range (less than 2.5) (8).

Considering that most blood units are used in surgery wards, plans have been proposed as Maximum Surgical Blood Ordering Schedule (MSBOS), in which a specific guideline is prepared according to reports of amount of blood use for various surgical operations in hospitals and blood ordering for surgeries is performed according to a clear pattern (9, 10). In this schedule, the need for blood in every surgery is calculated using certain indices. Thus, in elective surgeries that normally require no blood, only blood group and antibody screening (Type and Screen= T&S) will be performed, and request for blood cross-match test will be limited to surgeries, in which according to indices, probability of blood transfusion is high (11). Given the high costs of blood preparation and storage, this study was conducted with the aim to investigate blood ordering and use in different wards of Jahrom hospitals, and to compare these with standard blood transfusion indices so as to prevent imposing costs on hospitals and to correct blood ordering and use process.

Materials and methods
In this descriptive cross-sectional study, 1066 patients in different wards of hospitals A and B in Jahrom for which blood supply had been ordered were studied over 3 months in 2012. Based on previous studies, blood use order was 49.9%, study power 70%, with confidence of 95%, and sample size was calculated at 1066 patients.

Patients for whom blood supply was ordered included: 1-patients with surgery, 2-patients with reduced hemoglobin (bleeding, blood transfusion in high bilirubin cases, chronic anemia or liver diseases, late post-op complications and …). Patients with thalassemia and dialysis patients that require constant supply of blood were excluded from the study. Before surgery, the following information was collected from patients: age, gender, admission ward, blood group, hemoglobin and hematocrit, blood units ordered, cross-matched units, and post-surgery units.
transfused units. Departments studied included: gynecology and maternity, urology, orthopedic, general surgery, neurology, internal, accidents and emergency, ear nose and throat, neonatal intensive care unit, intensive care unit, and coronary care unit.

After entering data to SPSS software, central tendency indicators and blood transfusion indices were determined for each ward including: ratio of cross-matched to transfused blood, C/T Ratio, blood Transfusion Index (TI), blood Transfusion Probability (TP), and MSBOS (12, 13).

Ratio of cross-matched to transfused blood (C/T Ratio) is equal to the ratio of cross-matched blood units to transfused units. Values more than 2.5 show cross-matched units in excess of required blood for surgery.

Blood Transfusion Probability (TP=\%T) equals ratio of the number of patients receiving blood to the number of patients with prepared cross-matched blood in percentage. Values more than 30% show significant probability of blood use.

Blood Transfusion Index (TI) equals ratio of transfused blood units to patients with prepared cross-matched blood. Values in excess of 0.5 show the need for blood supply before surgery.

Maximum blood order for surgery (MSBOS) equals TI×1.5, which is number of units needed to supply before surgery multiplied by 1.5 times number of units used in that surgery.

**Results**

Of the 1066 patients studied in two hospitals, 277 were male (26%), and the rest were female. Patients’ mean age was 35.35±18.19 years. Blood group O+ was the most frequent (37.8%) among patients, and blood group AB- with 6% was the least frequent. 1414 blood units had been ordered for 1057 patients, 743 cross-matched units for 537 patients, and 144 units had been transfused in 78 patients. In other words, in Jahrom hospitals, only 10.18% of ordered blood units, and 19.38% of cross-matched units had been transfused to patients. Results indicate that in hospital A, 11.56% of ordered units and 36.87% of cross-matched units had been used, and in hospital B, these values were 9.25% and 17.81% respectively (figure 1).

![Figure 1](image-url)  
*Figure 1: Comparison of ordered, cross-matched, and transfused blood units in hospitals A and B in Jahrom*
In Jahrom hospitals, overall C/T index equaled 5.15, overall T/P equalled 14.52%, and overall transfusion index was 0.26. The highest C/T Ratio related to urology ward (TI=0.06, T%=3.32, and C/T=18.18). In other words, in this ward, the number of ordered blood units was nearly 18 times the transfused units. This meant that the majority of patients did not require blood. The lowest C/T related to neonatal intensive care unit (TI=1, T%=100, and C/T=1) (table 1).

Table 1: Blood transfusion indices in various wards of Jahrom hospitals

<table>
<thead>
<tr>
<th>Order</th>
<th>Ward</th>
<th>Cross-matched</th>
<th>Transfused</th>
<th>Ratio</th>
<th>%T</th>
<th>TI</th>
<th>MSBOS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>number of patients</td>
<td>Number of units</td>
<td>Number of patients (%)</td>
<td>Number of units (%)</td>
<td>C/T</td>
<td>10.30</td>
</tr>
<tr>
<td>1</td>
<td>Obstetrics and gynecology</td>
<td>165</td>
<td>215</td>
<td>17 (10.30%)</td>
<td>28 (13.02%)</td>
<td>7.67</td>
<td>10.30</td>
</tr>
<tr>
<td>2</td>
<td>Urology</td>
<td>180</td>
<td>200</td>
<td>6 (3.33%)</td>
<td>11 (5.5%)</td>
<td>18.18</td>
<td>3.33</td>
</tr>
<tr>
<td>3</td>
<td>Orthopedics</td>
<td>46</td>
<td>87</td>
<td>10</td>
<td>15 (17.24%)</td>
<td>5.8</td>
<td>21.73</td>
</tr>
<tr>
<td>4</td>
<td>General surgery</td>
<td>19</td>
<td>31</td>
<td>6 (31.58%)</td>
<td>2 (38.21%)</td>
<td>2.58</td>
<td>31.57</td>
</tr>
<tr>
<td>5</td>
<td>Neurology</td>
<td>64</td>
<td>92</td>
<td>6</td>
<td>12 (13.04%)</td>
<td>7.66</td>
<td>9.37</td>
</tr>
<tr>
<td>6</td>
<td>ENT*</td>
<td>4</td>
<td>4</td>
<td>1 (25.00%)</td>
<td>2 (50.00%)</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>7</td>
<td>Neonatal intensive care unit</td>
<td>7</td>
<td>7</td>
<td>7 (100%)</td>
<td>7 (100%)</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>8</td>
<td>Intensive care unit</td>
<td>16</td>
<td>36</td>
<td>6 (37.50%)</td>
<td>14 (38.89%)</td>
<td>2.85</td>
<td>37.5</td>
</tr>
<tr>
<td>9</td>
<td>Cardiac care unit</td>
<td>2</td>
<td>3</td>
<td>1 (50.00%)</td>
<td>1 (33.33%)</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>Men’s</td>
<td>10</td>
<td>24</td>
<td>7 (70.00%)</td>
<td>17 (70.83%)</td>
<td>1.41</td>
<td>70</td>
</tr>
<tr>
<td>11</td>
<td>Accidents and emergency</td>
<td>24</td>
<td>44</td>
<td>11 (45.83%)</td>
<td>25 (56.82%)</td>
<td>1.76</td>
<td>45.8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>537</td>
<td>743</td>
<td>78 (14.53%)</td>
<td>144 (19.38%)</td>
<td>5.15</td>
<td>14.52</td>
</tr>
</tbody>
</table>

Comparing cross-matched blood units to transfused units in different wards of Jahrom hospitals shows that the highest and lowest percentages of cross-matched blood used were in neonatal intensive care unit (100%) and urology ward (5.5%), respectively.

Discussion
Blood transfusion undoubtedly has a major role in reviving patients undergoing surgery. However, growing demand for storing blood and blood products has led to reduced shelf life of blood sacks stored, increased workload, and ultimately, increased financial burden for patients and blood banks.

Overall indices found in this study (C/T=5.15, TI=0.26, and T%=14.52) indicate that blood ordering in Jahrom hospitals do not enjoy a favorable status compared to standard amounts (C/T Ratio<2.5, TI>0.5).

Comparing C/T ratio found in present study with that in similar studies in Iran shows this index was 21.5 in Firoozgar Hospital in Tehran (11), 7.8 in hospitals in Urmia (14), and 10.35 in 22nd Bahman Hospital in Mashhad (15), which exceed the standards like Jahrom. This index was 2.01 in Yahyanejad Hospital in Babul (7), 2.44 in Besat Hospital in Hamedan (8), 1.9 in Rasht hospitals (6), 1.19 in Qum teaching hospitals (16), and 1.1 in Shohada Ashayer Hospital in Khoramabad (1), which were less than that in the present study and within standard range. This index was 2.3% in a North-Western Ethiopian University Hospital (17), 2.9% in a teaching hospital in Nigeria (18), 3.9%
Comparing the demand for blood in... 

Establishment of blood transfusion committee, revision of blood ordering, a monitoring system, changes in blood supply standards and the wrong programs also affects this problem. Thus, it can be argued that in hospitals across the country, blood supply without observing standards and cross-match tests without any use can lead to squandering of funds and reduced blood supply.

Percentage of cross-matched blood units used was 43.6% in North-Western Ethiopian university hospital (17), 34.5% in Nigerian teaching hospital (18), and 25.2% in Egypt's Alexandria university hospital (19). Comparison shows that hospitals in other countries higher percentage of cross-matched blood is used, yet this index still has an unfavorable status in other countries.

Although any patient’s particular condition affects level of blood ordered, ordering at will among surgeons in different parts of the country is clear. Absence of countrywide regulations and educational programs also affects this problem. Thus, the issue can be pursued through establishment of blood transfusion committee, revision of blood ordering, a monitoring system, changes in blood

In this study, blood transfusion index less than 0.5 in gynecology and maternity, urology, orthopedics, and neurology departments shows the distance from blood supply standards and the wrong blood ordering routine in these wards whereas in general surgery, internal, accidents and emergency, ENT and neonatal intensive care, intensive care, and coronary care wards exceeded the desirable level in the present study. This index was 5 in obstetrics and gynecology ward, 4.03 in men’s surgery, and 14.7 in elective surgery in Yahyanegad Hospital in Babul (7), and in Besat Hospital in Hamedan’s surgery wards (4), and orthopedics (3.2), which were higher than the standard, indicating inappropriate performance of Jahrom hospital wards, Babul’s Yahyanegad hospital, and Besat teaching hospital in Hamedan. In other words, not many of the blood sacks were used in these hospitals.

In Egypt’s Alexandria University Hospital (19), and 5% in a medical center in Malaysia (20). Although overall C/T ratio values in these studies are less than that in the present study, except for the Ethiopian University Hospital, this index exceeded standard value in other studies. Although C/T ratio was less than 2.5 and within favorable range in ear nose and throat, neonatal intensive care, men’s, accidents and emergency wards, in other wards, including obstetrics and gynecology, urology, orthopedics, general surgery, neurology, internal, intensive care, and coronary care exceeded the desirable level in the present study. This index was 5 in obstetrics and gynecology ward, 4.03 in men’s surgery, and 14.7 in elective surgery in Yahyanegad Hospital in Babul (7), and in Besat Hospital in Hamedan’s surgery wards (4), and orthopedics (3.2), which were higher than the standard, indicating inappropriate performance of Jahrom hospital wards, Babul’s Yahyanegad hospital, and Besat teaching hospital in Hamedan. In other words, not many of the blood sacks were used in these hospitals.

In this study, blood transfusion index less than 0.5 in gynecology and maternity, urology, orthopedics, and neurology departments shows the distance from blood supply standards and the wrong blood ordering routine in these wards whereas in general surgery, internal, accidents and emergency, ENT and neonatal intensive care, intensive care, and coronary care wards, this index was within the standard range. Blood transfusion index exceeded 0.5 and was within standard range in Yahyanegad Hospital in Babul (7) in emergency, internal, gynecology, men’s, infections, coronary, brain, and neurology, and in Besat teaching hospitals in Hamedan (8) in special care, orthopedics, neurology, neonatal, and surgery. The high ratio of 0.5 indicates the need for blood supply before surgery. The results of these studies show that various factors can affect values of C/T ratio, and TI indices such as type of disease, type of blood product required, type of surgery, and hospital ward.

Comparing cross-matched and transfused blood units in various wards of Jahrom hospitals showed that the highest percentage of cross-matched blood used related to neonatal special care unit (100%), and men’s ward (70.83%). However, percentage of cross-matched blood used was less than 20% in urology (5.5%), gynecology (13.02%), neurology (13.04%), and orthopedics (17.24%) wards. Meanwhile, comparison of unused cross-matched blood showed that only 19.38% of these units had been used, and the rest remained unutilized. In a study by Khalili-Alam, 4.7% of bloods ordered were transfused in patients (11). This level reached 50% in Alaaaladwleheee study, (7), 13% in Abassivash study (14), 8.1% in Baizae study (15), 40.9% in Nadri study (1), 66% in Akhavan-Sepahi (16), and 25.4% in Mehrvarz study (3). In all these studies, a great proportion of bloods ordered or cross-matched were not used. Thus, it can be argued that in hospitals across the country, blood supply without observing standards and cross-match tests without any use can lead to squandering of funds and reduced blood supply.

Percentage of cross-matched blood units used was 43.6% in North-Western Ethiopian university hospital (17), 34.5% in Nigerian teaching hospital (18), and 25.2% in Egypt's Alexandria university hospital (19). Comparison shows that hospitals in other countries higher percentage of cross-matched blood is used, yet this index still has an unfavorable status in other countries.

Although any patient’s particular condition affects level of blood ordered, ordering at will among surgeons in different parts of the country is clear. Absence of countrywide regulations and educational programs also affects this problem. Thus, the issue can be pursued through establishment of blood transfusion committee, revision of blood ordering, a monitoring system, changes in blood

Journal of Jahrom University of Medical Sciences, Vol. 12, No. 1, Spring 2014
ordering and transfusion patterns, and practical and permanent educational programs in relation to blood ordering and transfusion in every hospital. It is recommended that decisions to order blood be taken according to accurate clinical and laboratory indicators. Success in these decisions requires all-out cooperation of specialists and surgeons, anesthetists, blood bank and others involved in ordering to transfusion process.

**Conclusion**
The present study showed that given C/T ratio, TI, and T% indicators, a significant amount of cross-matched supplied blood in Jahrom hospitals are left unused, and many surgeries and wards have no need for storing cross-matched blood, and blood group test and screening are adequate. If blood ordering is carried out according to proper patterns, inappropriate distribution of blood among various wards and rising costs of blood preparation, and also increased blood bank workload can be prevented.

**Acknowledgements**
We thank colleagues in Jahrom hospitals for their help in various stages of the study, and we also wish to thank Research Deputy of Jahrom University of Medical Sciences for financial support of this research project.

**References:**

Comparing the demand for blood in


