Blood collection, components preparation and distribution in Iran, 2008–2012

Azadeh Omidkhoda a,b, Sedigheh Amini Kafi-Abad b,*, Ali Akbar Pourfatollah b,c, Mahtab Maghsudlu b

a Department of Hematology and Blood Banking, School of Allied Medical Science, Tehran University of Medical Science, Tehran, Iran
b Blood Transfusion Research Center, High Institute for Research and Education in Transfusion Medicine, Tehran, Iran
c Department of Immunology, Faculty of Medical Science, Tarbiat Modares University, Tehran, Iran

ABSTRACT

Background: The information about the dynamics of blood collection, components preparation and distribution in Iran was measured and compared during 2008–2012.

Study designs and methods: The survey instruments were based on collecting data from all 220 blood collections and blood processing centers over the country, registering them in the validated data base and reporting them to headquarter of Iranian Blood Transfusion Organization.

Results: Total blood collection increased during this period, and in 2012 represented a 12.6 percent increase compared to that in 2008. On average, red blood cells, fresh frozen plasma and platelet concentrate were prepared from 95.5 ± 2.4, 81 ± 3.8 and 47 ± 8.8 percent of all whole blood collection. From 2008 to 2011, the distribution of whole blood and fresh frozen plasma revealed different patterns. For whole blood, declines were noted, while for fresh frozen plasma increases were reported. In addition the distribution of red blood cells and platelet concentrate did not change considerably. Also between 2008 and 2012, the mean percentage of outdated and discarded units was 3.6 ± 1 and 5.2 ± 4.6.

Conclusion: This study as a first national survey provides comprehensive information about the blood supply, components preparation and distribution, and helps to define strategy for the future.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

Iranian Blood Transfusion Organization (IBTO) has been established in 1974. It is currently an integral part of national health system, and all blood transfusion activities such as collection processing, storage and distribution of blood components to hospitals have been performed as a centralized system, so all transfusion activities are concentrated under authority of one public and centralized transfusion organization. Since 2007 Iran has reached a 100% voluntary blood donation [1–3], and in 2012, up to 2,042,315 units of whole blood for a population of about 76 million was collected by IBTO, which indicates 27 donations per 1000 population.

A well-organized donor selection program, including donors interview, physical examination and confidential unit exclusion along with performing laboratory screening of all blood donations for HIV-1/-2, hepatitis B, hepatitis C, and syphilis, has led to reduce the prevalence of transfusion transmitted disease (TTD) markers in blood donors compared to general population in Iran [4]. Therefore, the safety of blood and blood components has been improved.

In Iran, more than 97% of whole blood (WB) units were separated into blood components [5]. In addition, in recent decade, IBTO has established a toll manufacturer of Fresh-Frozen Plasma (FFP) that improves the availability of plasma-derived medicines in national market [6].

* Corresponding author. Iranian Blood Transfusion Organization, Hemmat Highway, Next Milad Tower, Tehran, Iran. Tel.: +98 2188601586; fax: +98 2188601585.
E-mail address: dr.amini@gmail.com (S. Amini Kafi-Abad).

http://dx.doi.org/10.1016/j.transci.2016.01.026
1473-0502/© 2016 Elsevier Ltd. All rights reserved.
Despite of self-sufficiency in our country for blood and blood components, there is no attempt at assembling overall information about the collection, processing and distribution of blood components in Iran. Such information helps to define strategy and determine policy making decision of blood transfusion services about blood collection, processing and distribution for the future. So in this study we tried to gather information about the dynamics of blood collection, components preparation and distribution during 2008–2012.

2. Materials and methods

In Iran, blood and blood components are collected, processed, tested, stored, and distributed to hospitals for patients by blood transfusion centers. There are 83 blood transfusion and processing centers across the country, in which 31 of them are in the main cities of provinces (Fig. 1). All of these centers have several fixed and mobile blood collection centers so that 220 blood collection, blood processing and blood transfusion centers exist in the country. The survey instruments were based on gathering data of blood collection, processing and distribution from all blood centers, registering them in the valid homemade data base and reporting them to the headquarter of IBTO.

Discarded units consisted of damaged, hemolyzed, testing losses units and other reasons that made these units unsuitable to distribute to the hospitals; outdated and returned blood components units from hospitals were also reported. The number of hospitals that participate in this survey was 1169 over the country. These hospitals that transfuse blood or blood components to patients report the information about their non-transfused and outdated units to the blood centers. Total estimates were calculated by estimating the means and standard deviations (SDs) for each measurement.

3. Results

3.1. 2008–2012 changes in blood collection and blood components preparation

The total blood collection in 2008 was 1,784,246 which reached 2,042,315 in 2012 (Fig. 2), so from 2008 to 2012, total blood collection increased and represented a 12.6 percent increase in comparison with that in 2008. The mean percentage of this change was $+3.2 \pm 1.5$.

During this period, $2.1 \pm 0.1$ percent of supply of blood collection remained as a WB, and RBC was prepared from $95.5 \pm 2.4$ percent of blood supply. The RBC production increased gradually between these years and the mean percentage of this change was $+4.25 \pm 1.9$.

In addition, from 2008 to 2012, on average, FFP and PC were prepared from $81 \pm 3.8$ and $47 \pm 8.8$ percent of all WB collections. The preparation of both of these components enhanced between these years in which the mean
percentage of these changes was $+4.9 \pm 0.6$ and $+9.5 \pm 4.2$ respectively.

The survey also assessed the differential percentage of released units according to blood group based on the number of WB and RBC productions. The highest released units were O$^+$ (34.3 $\pm$ 1.3\%) and then A$^+$ (27.7 $\pm$ 1.2\%) and B$^+$ (22.3 $\pm$ 0.4\%). AB$^-$ units were 6.8 $\pm$ 0.3\% whereas Groups O$^-$, A$^-$, B$^-$ and AB$^-$ were 4.1 $\pm$ 0.1\%, 3 $\pm$ 0.07\%, 2.4 $\pm$ 0.03\% and 0.7 $\pm$ 0.01\%.

### 3.2. 2008–2012 changes in blood components distribution

This survey, which was the first to assess the blood components distribution to hospitals in Iran, was based on the number of productions of each component. According to Table 1, although the distributions of WB declined from 2008 to 2012, there was a remarkable fall in WB distributions in 2011. The mean percentage change of WB distribution was $-15.1$.

### 3.3. 2008–2012 changes in returned blood components from hospitals

The estimated returned blood components from hospitals shown in Table 2 were based on the number of distributions of each component. From 2008 to 2012, the mean percentage of returned WB from hospitals was $13 \pm 0.4$, which increased in 2011 and fell again in the following year.

For RBC, the number of returned units from hospitals decreased between 2008 and 2012. The mean percentage of returned RBC was $5.4 \pm 1.4$. For FFP and PC, the mean percentages of returned units were 1.4 and $2.7 \pm 0.07$. Returned blood components were not released again, and because of low quality, they were destroyed.

### 3.4. 2008–2012 changes in discarded and outdated blood components

Table 3 provided the number and percentage of outdated and discarded units based on WB and RBC productions. According to this table, from 2008 to 2012, the mean percentage of outdated units was 3.6 $\pm$ 0.9 of WB and RBC productions. In addition, between 2008 and 2011, although the mean percentage of units discarded by blood components expressed in thousands of blood donation from 2008 to 2012.
centers was 1.8 ± 0.2, in 2012 the percent of these units increased notably, and as a result the mean percentage of outdated units reached 5.2 ± 4.6.

3.5. Prevalence and trends of HBV, HCV, HTLV and HIV

This survey also analyzed the prevalence and trends of HBV, HCV, HTLV and HIV among blood donations. According to Fig. 3, the prevalence of confirmed positive test was 0.25 ± 0.1 for HBV, 0.011 ± 0.07 for HCV, 0.017 ± 0.007 for HTLV and 0.003 for HIV. Also as shown in Table 4, from 2008 to 2012, the prevalence of blood borne pathogens decreased as a total positive rate of 1-in-205 of blood donation in 2008 reached 1-in-444 in 2012.

4. Discussion

In this survey, the status of blood collection, components preparation and distribution was analyzed from 2008 to 2012. Between these years, the populations of our country increased by 5 percent while the blood donations increased by more than 10 percent. It seems that continuous donor recruitment efforts have resulted in an enhancement of number of blood donations. By increasing the number of blood donations, the number of blood components including RBC, FFP and PC also increased.

It is important to note that according to the race and population, the distributions of the blood groups A, B, O, and AB and the rate of Rh positivity vary across the world [7]. Our data displayed that in Iranian blood donors, blood group O is the commonest blood group followed by A, B, and AB. Also more than 89% of donor population is Rh positive, which is close to the mean of the neighboring Arabs and most Europeans [8]. It appears that the frequency of ABO and Rh blood groups in Iranian blood donors is between the data of eastern and western populations.

During this period, there was a variable pattern for blood components distribution. While the distribution of WB decreased, distribution of RBC and FFP increased between 2008 and 2011, and then decreased in 2012. The decline or growth in distributions of blood components closely associated with requests of hospital physicians from IBTO. Moreover, the decrease in FFP distributions might relate to availability of anti-hemophilic factor and expander blood volume which decrease the demand of FFP for patients.

In Iran, the most important components in terms of volume of transfusion are RBC and PC. According to Table 2, for RBC and PC, the number of returned units from hospitals decreased between 2008 and 2012. Also the number of outdated units decreased during survey period and reached 2.9 percent in 2012. However, it was higher than the percent of outdated units in the United States in 2001 [9]. The decrease in returned RBC and PC units and also in outdated units means that the hospital demand was higher than their true need, and during the survey period, the use of blood components in hospitals has improved compared to that in the past because of improvement in their monitoring by transfusion committees and implantation of hemovigilance system [10]. Furthermore, in Iran, Patient Blood Management (PBM) is a new initiative to minimize and improve utilization of blood components. The goal of this strategy is to maintain hemoglobin concentration and minimize blood loss in an effort to optimize the care of patients who might need blood transfusion [11]. In addition

---

### Table 3
Estimate of the discarded and outdated blood components expressed in thousands of WB and RBC production units from 2008 to 2012.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of WB and RBC productions ×103</th>
<th>Outdated ×103 (%)</th>
<th>Discarded ×103 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>1712</td>
<td>74 (4.3)</td>
<td>35 (2.0)</td>
</tr>
<tr>
<td>2009</td>
<td>1725</td>
<td>73 (4.2)</td>
<td>8 (0.4)</td>
</tr>
<tr>
<td>2010</td>
<td>1829</td>
<td>78 (4.2)</td>
<td>14 (0.7)</td>
</tr>
<tr>
<td>2011</td>
<td>1967</td>
<td>51 (2.6)</td>
<td>33 (1.6)</td>
</tr>
<tr>
<td>2012</td>
<td>2040</td>
<td>59 (2.9)</td>
<td>174 (8.5)</td>
</tr>
</tbody>
</table>

---

### Table 4
Prevalence of HBV, HCV, HTLV and HIV of IBTO donor populations from 2008 to 2012.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of donation ×10³</th>
<th>HBV Rate a</th>
<th>HCV Rate</th>
<th>HTLV Rate</th>
<th>HIV Rate</th>
<th>Total rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>1,784</td>
<td>6.35 (0.36)</td>
<td>281</td>
<td>1.88 (0.11)</td>
<td>949</td>
<td>0.41 (0.022)</td>
</tr>
<tr>
<td>2009</td>
<td>1,791</td>
<td>5.38 (0.30)</td>
<td>333</td>
<td>1.68 (0.09)</td>
<td>1,066</td>
<td>0.31 (0.017)</td>
</tr>
<tr>
<td>2010</td>
<td>1,891</td>
<td>4.64 (0.25)</td>
<td>407</td>
<td>1.35 (0.07)</td>
<td>1,400</td>
<td>0.33 (0.017)</td>
</tr>
<tr>
<td>2011</td>
<td>1,986</td>
<td>3.92 (0.20)</td>
<td>506</td>
<td>1.21 (0.06)</td>
<td>1,641</td>
<td>0.36 (0.018)</td>
</tr>
<tr>
<td>2012</td>
<td>2,042</td>
<td>3.22 (0.16)</td>
<td>634</td>
<td>1.05 (0.05)</td>
<td>1,944</td>
<td>0.27 (0.013)</td>
</tr>
</tbody>
</table>

a Expressed as number of HBV, HCV, HTLV and HIV positive divided by the number of donations.
various studies showed that PBM monitoring program was efficacious in reducing a number of blood product units transfused and their transfusion-related costs [12–14].

Our results also showed that the mean percentage of units discarded by blood centers was 1.8 ± 0.2, but in 2012, the percent of these units increased notably. It seems that the enhancement of percentage of discarded units related to changing of blood collecting bags. Although the quality control department of IBTO and Food and Drug Organization performed quality control on disposable and anticoagulant of new bags, after sealing the cord of new blood bags, some of them had leakage at the site of sealing, therefore these bags were discarded.

This study also showed the decrease in the total positive rate of transfusion transmitted disease markers as a total positive rate of 1-in-205 of blood donation in 2008 reached 1-in-444 in 2012. This point displayed the improvement in the safety of blood and blood components during this period.

This is the first national survey of Iranian blood collection and distribution which provides comprehensive information about the blood supply, components preparation and distribution, and improves the accuracy and reliability of the information produced.

Acknowledgments

This study was supported by the Iranian Blood Transfusion Organization. We thank Miss Mojgan Shariati and all Iranians in blood transfusion centers for their technical assistance and data preparation.

References