



## Trends of Blood and Plasma Donations in Kazakhstan: 12-Years Retrospective Analysis

*\*Nurbek IGISSINOV<sup>1,2</sup>, Dariyana KULMIRZAYEVA<sup>2,3</sup>, Raushan MAGZUMOVA<sup>3</sup>, Cees Th. Smit SIBINGA<sup>4</sup>, Sholpan ALPEISSOVA<sup>5</sup>*

1. *Republican Institute of Postgraduate Medical Education, Astana, Kazakhstan*
2. *PA "Central Asian Cancer Institute", Astana, Kazakhstan*
3. *JSC "Astana Medical University", Astana, Kazakhstan*
4. *Faculty of Medical Sciences, University of Groningen, Netherlands*
5. *National Research Center of Surgery named After Syzganov, Astana, Kazakhstan*

**\*Corresponding Author:** Email: n.igissinov@gmail.com

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### Abstract

**Background:** Each country faces a continuing challenge to collect enough blood to meet the national needs. According to WHO, there should be at least 20 blood donations per 1,000 population for developing countries, in Kazakhstan this indicator was only 16.8 in 2011. Thus, we conducted an epidemiological assessment and drew a map of the regional distribution of blood and plasma donations in Kazakhstan during the years 2000-2011.

**Methods:** The retrospective study was conducted from 2000 to 2011. Data on blood and its components donations were acquired from the Ministry of Health (annual statistical reporting form № 39).

**Results:** During 2000-2011, number of blood donors decreased to 17.4% and blood donations to 6.3%. The proportion of non-remunerated blood donations and donors decreased from 97.6% to 77.9% and 97.9% to 87.7%, respectively. The paid donations had the opposite trend. Number of plasma donors increased in 2.1 times, plasma donations in 2.4 times, nevertheless the proportion of non-remunerated plasma donations decreased from 60.1% to 29.8%. The average number of blood donations per 1,000 population decreased from 19.8 (2000) to 16.8 (2011), plasma donations increased from 1.4 to 3.1. Regionally, annual average rates of blood and plasma donations per 1,000 population over 12 years varied greatly.

**Conclusion:** This is the first study conducted in Kazakhstan to provide detailed information, including the regional characteristics of blood and plasma donations over an extended period of time, which can be used in blood transfusion services work.

**Keywords:** Blood and plasma donations, Non-remunerated donation, Trends, Mapping, Kazakhstan

### Introduction

Blood transfusion services are integral and indispensable parts of the healthcare system facing the dual challenge of ensuring a sufficient supply of blood and blood products, as well as quality and safety for patients (1, 2). Donors are the source of blood from whom globally more than a million units are collected every year. Generally, donors

are classified into three categories: voluntary, family/replacement and remunerated (3). At the present time, internationally the major source of donated blood is a combination of family/replacement donors (mainly relatives, friends and workmates of patients), and a growing number of voluntary non-remunerated donors (4).

However in most developing and transitional countries replacement and paid blood donors are still a significant source of blood (5, 6).

Despite the growing demand for blood due to surgery, cancer treatment, and aging population, the number of blood donors is reducing (6). Thus, each country faces a continued challenge to collect enough blood from safe donors to meet national needs. Indeed, with each unit of blood there is a risk to become infected with transfusion-transmissible infections, mainly hepatitis B virus, hepatitis C virus, human immunodeficiency virus and syphilis (7, 8). According to WHO, repeat voluntary non-remunerated donors are the safest source of blood (9). Thus, a policy aimed at 100% voluntary non-remunerated donor blood procurement by the year 2020 has been adopted (10). Without a system based on voluntary non-remunerated blood donation, especially on a regular voluntary donation, no one country can provide enough safe blood for all patients requiring transfusion (11).

Kazakhstan is a country in Central Asia with a population of over 16 million people, and a geographical area of 2,724,900 km<sup>2</sup>. The country is divided into 16 administrative and geographical entities (14 oblasts and the cities of Astana and Almaty) (12). The history of blood transfusion in Kazakhstan as well as of other countries of the former USSR is related to the Soviet period (13, 14). In 1934 the Kazakh branch of the Central Institute for Blood Transfusion was organized, later in 1941 reorganized into the Kazakh Republican Blood Transfusion Station of the Ministry of Health of the Kazakh SSR. In parallel, the regional stations and other institutions of blood transfusion were opened. During the period 1935-1945 blood transfusion stations in 13 cities of Kazakhstan and 25 blood transfusion units in major regional centers and towns were organized. After the year 1945 the main task was to massively attract people to donate blood (15). Since the mid 50s of the 20<sup>th</sup> century the intensive work on blood donation, especially voluntary non-remunerated donation development, began (16). From 1963 to 2011 the blood procurement increased from 9,778 to 398,000 units. Throughout

Kazakhstan new stations and branches were opened. At the end of 1981 there were 28 blood transfusion stations and 125 units for blood transfusion (15) over the Republic; in 2000, 28 blood centers and 150 units for blood transfusion (17). In the following years, in line with global trends reorganization of the blood transfusion service, including the closure of some blood transfusion units in regional hospitals took place.

Today 23 blood centers are operational: Scientific Production Center of Blood Transfusion in Astana, Republican Blood Center in Almaty, 14 regional and 7 city centers, as well as 21 blood transfusion units (18), each operating within a defined geographical area and providing services to the population within the relevant region. Blood transfusion units relate to hospitals. The remaining blood centers are independent organizations, but all are under regular control of Scientific and Production Center of Blood Transfusion (19) and the Ministry of Health. During the blood service reform in accordance with international standards the government programs have been designed to focus on solving some critical tasks necessary for the development of blood services (20-22). According to the program, blood donations by 2015 should reach 35 per 1,000 inhabitants.

In order to promote blood donation system the legislation provides the following incentives for donors: 1) During the medical examination and the donation day the donor gets the day off while keeping the average salary, or that day may be linked to the annual labor holiday or a day off from the educational process; 2) If the donation is voluntary and non-remunerated a donor receives a free meal or a cash equivalent to 0.25 of the monthly calculation index (MCI) (23) MCI is the index used in Kazakhstan for the calculation of pensions, benefits and other social payments. One MCI equals 1,731 tenge in 2013 (24). The state policy in Health Care promotes the development of voluntary non-remunerated blood donation (23), meanwhile, an institution of paid donation is preserved in the country with a remuneration from 2 to 8 MCI depending on the type of donation (25). Family/replacement donations are not isolated in a separate category and are referred to

the voluntary non-remunerated donations, as relatives and friends of the recipient, donate the blood for free. Questions devoted to blood donation in Kazakhstan have also been studied already (18, 26-28). However, a detailed epidemiological study over a long period of time has not been carried out previously.

The objective of the present study was to present epidemiological evaluation of blood and plasma donations in Kazakhstan and assesses their changes over time.

## Materials and Methods

The study was retrospective (2000-2011). The annual statistics reporting form №39 on blood and its components donation in the Republic compiled by the Republican Blood Center were extracted from the database of the Ministry of Health of the Republic of Kazakhstan. Data on the population density and geographical spread were obtained from the National Agency of Statistics (29).

Our study describes the rates of blood and plasma donations in Kazakhstan. The most commonly in clinical practice fresh frozen plasma and cryoprecipitate are used. Fresh frozen plasma is produced by method of plasmaphoresis and centrifugation of whole blood. Cryoprecipitate is produced by processing fresh frozen plasma. Collection and production of blood and plasma are carried out by public health organizations operating in the field of blood services, which include: Scientific Production Center of Blood Transfusion, Republican

Blood Center, regional and urban blood centers. Ready plasma is transferred to the clinics (30). According to statistics reporting form №39 the blood and plasma donations are calculated separately (including non-remunerated donation), whereas plasma donors are calculated in the structure of all donors.

Various methods of biomedical statistics, such as extensive and intensive indexes, mean value, 95% confidence interval, average annual growth/decline rates ( $T$ , %) were used (31). For the calculation of the average annual growth/decline rates of the dynamic series, the average geometrical was used. The method of map compiling based on the calculation of the standard deviation ( $\sigma$ ) from the mean ( $\bar{x}$ ) was used (32).

While collection and analyzing the data, the Microsoft Excel computing program and BIOSSTAT for Windows (Version 4.03 by Glantz) were used.

## Results

Between 2000 and 2011 the population of Kazakhstan increased by 1,540,318 (10.3%) million people. Despite the positive trend of population growth the total number of donors decreased by 43,864 (17.4%) (Table 1). Average annual trend of decline was  $T = -1.7\%$ . The number of non-remunerated donors decreased from 246,770 (97.9%) to 182,497 (87.7%), whereas the number of paid donors increased from 5,278 (2.1%) in 2000 to 25,687 (12.3%) in 2011. The average number of non-remunerated donors in 12 years was 226,848 (95% CI=205,854-247,841) ( $T = -12.7\%$ ).

**Table 1:** Blood and plasma donations trends in Kazakhstan for the period 2000-2011

	2000		2011		Average	95% CI
	n	%	n	%		
Total Population	14,901,641	100	16,441,959	110.3	15,343,488	
Total donors,	252,048	100	208,184	82.6	237,654	218,409-256,898
among them:						
Plasma donors	8,252	100	17,150	207.8	13,847	11,909-15,786
Total blood donations	295,095	100	276,475	93.7	274,228	218,409-256,898
Total plasma donations	21,031	100	50,939	242.2	42,078	35,113-49,043
Blood donations/Donors	1.21	100	1.45	119.6	1.23	1.16-1.30
Plasma donations/Donors	2.55	100	2.97	116.5	3.02	2.79-3.25

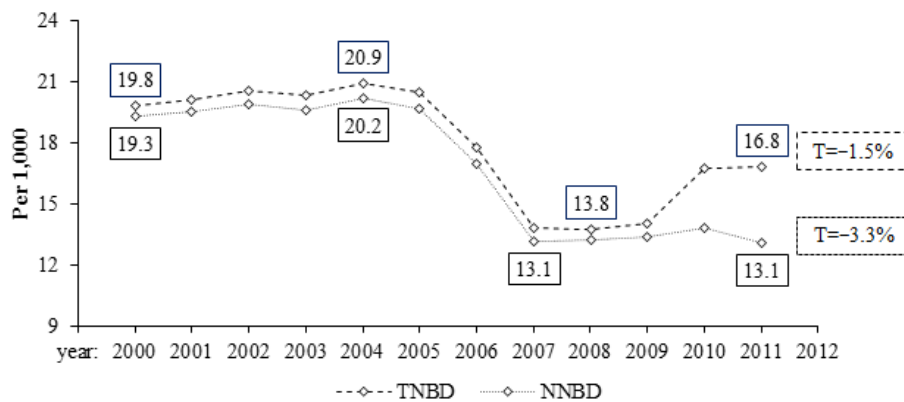
The average number of paid donors was 10,556 (95% CI=7,501-13,611) ( $T=+15.5\%$ ).

Over the study period the total number of blood donations decreased by 18,620 (6.3%) (Table 1). The average annual rate of decline was  $T=-0.6\%$ . The number of non-remunerated blood donations in the dynamics increase of plasma donors in 2.1 times and plasma donations in 2.4 times was observed (Table 1). The average annual growth rates were  $T=+6.9\%$  and  $T=+8.4\%$ , respectively. Here with the proportion of non-remunerated plasma donations decreased from 60.1% (12,848) to 29.8% (15,193). The average number of non-remunerated plasma donations in 12 years was 18,982 (95% CI=16,540-21,425) ( $T=+1.5\%$ ). There was a slight increase in the frequency of

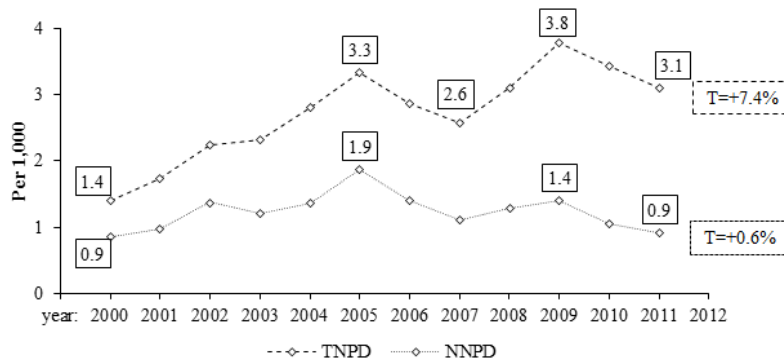
decreased from 287,989 (97.6%) to 215,266 (77.9%). The average number of this indicator was 256,935 (95% CI=232,457-281,413) ( $T=-2.6\%$ ). The average number of paid donations was 17,293 (95% CI=6,878-27,709) ( $T=+21.6\%$ ).

blood and plasma donations by individual donor (Table 1).

During 2000-2011 both the total number and non-remunerated number of blood donations per 1,000 population decreased considerably (Fig. 1). An increase in the total number of blood donations beginning 2009 year was observed, reaching 16.8 in 2011, but the rate of non-remunerated donations in 2011 compared to previous years was the lowest (13.1).



**Fig. 1:** Dynamics of total and non-remunerated number of blood donations per 1,000 population in Kazakhstan for 2000-2011/ TNBD, total number of blood donations, NNBD, number of non-remunerated blood donations



**Fig. 2:** Dynamics of total and non-remunerated number of plasma donations per 1,000 population in Kazakhstan for 2000-2011/ TNP, total number of plasma donations, NNPD, number of non-remunerated plasma donations.

In the dynamics the total number of plasma donations per 1,000 population increased in 2.2 times, the number of non-remunerated plasma donations in 2000 and 2011 had the same rate (0.9) (Fig. 2). Regionally the blood and plasma donation rates (Fig. 3, 4) were grouped into three clusters. The

annual average index of total number of donations in Kazakhstan was 18.3 (95% CI=16.8-19.8) ( $T=-1.5\%$ ). The annual average index of total number of plasma donations in Kazakhstan was 2.7 (95% CI=2.3-3.2) ( $T=+8.2\%$ ).

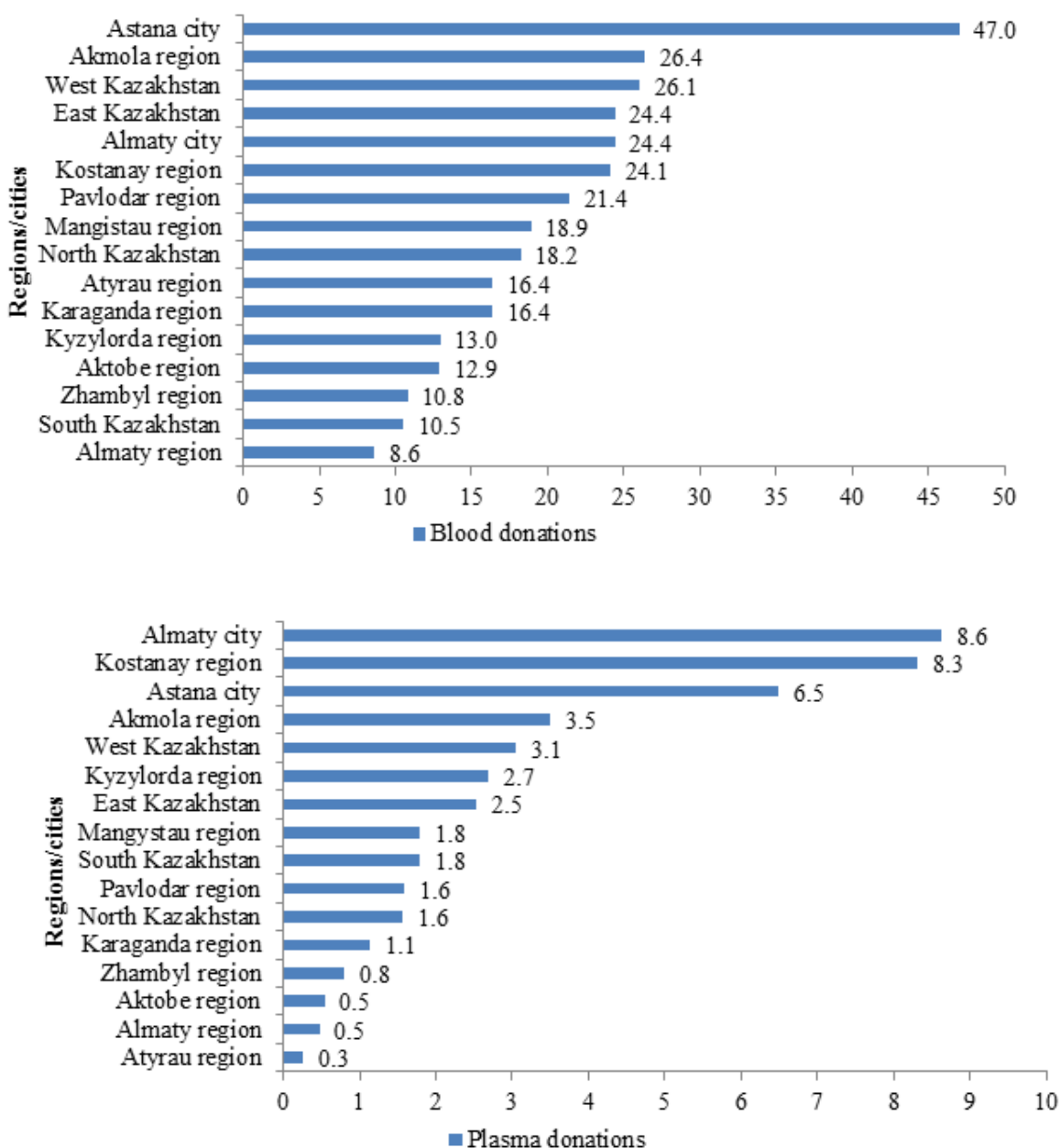
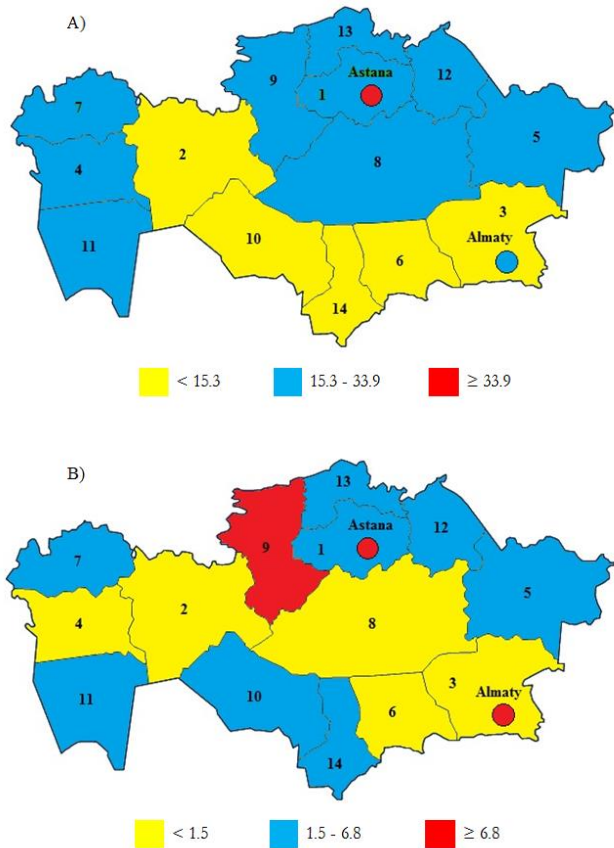


Fig 3: Regional distribution of blood and plasma donations per 1,000 population in Kazakhstan for 2000-2011



**Fig 4:** The map of blood (A) and plasma (B) donations per 1,000 population in Kazakhstan for 2000-2011

Regions: 1. Akmola, 2. Aktobe, 3. Almaty, 4. Atyrau, 5. East-Kazakhstan, 6. Zhambyl, 7. West-Kazakhstan, 8. Karaganda, 9. Kostanay, 10. Kyzylorda, 11. Mangistau, 12. Pavlodar, 13. North-Kazakhstan, 14. South-Kazakhstan

## Discussion

The data collected showed the negative dynamics of non-remunerated blood and plasma donations in Kazakhstan over the period 2000-2011. Consequently paid blood donation showed the opposite trend. Despite the decrease of total number of blood donations, plasma donations rates increased in the dynamics. To the causative factors of such changes in blood donation system of Kazakhstan may relate the differences in amount of remuneration for donation: whole blood donation equals 2 MCI, plasma donation 4 MCI (25); differences in

minimum intervals between donations: for whole blood is 2 months, for plasma donation 2 weeks (33); prevalence of blood component therapy in recent years. In Kazakhstan the main indicators for plasma use are massive bleeding, clinical signs of disseminated intravascular syndrome with laboratory confirmation and hemophilia. According to WHO for full self-sufficiency of the country it is necessary to have at least 20 donations per 1,000 inhabitants for developing countries and at least 40 donations for developed countries. However, 82 countries reported collecting less than 10 donations per 1,000 population. All countries are among the low or middle-income groups (34). The rate of blood donations in more developed countries also varies considerably. For example, in Denmark it equaled 70.0 per 1,000 population, in Germany 63.7, in France 41.5, in England 39.7, in Spain 37.6, Portugal 33.0 and in Poland 25.4 (35-37). The 12-years retrospective analysis of blood donation in Kazakhstan showed that in spite of the steady population growth over the entire study period (by 10.3%), the decline of donor activity was found, reaching a minimum in 2007-08. The blood donations rate in 2011 was 16.8 per 1,000 population (Fig. 1), and was lower the indicator of 2000 year (19.8). There was a slight increase in the frequency of blood donations by individual donor from 1.21 to 1.23 (Table 1). Despite the ongoing activities of the blood transfusion service in Kazakhstan the blood donations rate in 2011 was below the average annual rate of countries with high income (36.4‰ donations), though is above the average blood donation rate in countries with middle (11.6‰ donation) and low (2.8‰ donation) income (34). Among the reasons that have led to decrease of blood donation rates in Kazakhstan may be the economic collapse that emerged after the declaration of independence in 1991, long economic recovery, which lasted from 1996 to 2007 (12), the global economic crisis, negative information associated with transfusion-transmissible infections (38, 39), insufficient promotion of blood donation in the mass media etc. In 62 countries, national blood supplies are based on 100% or almost 100% (more than 99.9%) voluntary non-remunerated blood donations. The

latest to join this list were Belarus, Iran, Kenya, Malaysia and Zambia. The most significant increase in the percentage of voluntary non-remunerated blood donations during the period was reported by Bulgaria (from 21% in 2007 to 94% in 2008), followed by Afghanistan (from 15% to 88%), Belarus (from 56% to 99.9), Algeria (from 23% to 63%) and Costa Rica (from 29% to 63%). Nowadays despite the priority of voluntary non-remunerated donations (9-11), the system of family/replacement and paid blood donations still continues in many countries (5, 6), because they are not able to fulfill their demand for blood without it. Forty countries have reported collecting less than 25% of the blood supply from voluntary non-remunerated blood donors (34). In Kazakhstan, from 2000 to 2007, the percentage of non-remunerated blood donations was on the level of 96-97%, beginning 2008 this indicator decreased to 77.9% in 2011 (Fig. 1). The percentage of non-remunerated blood donors also decreased from 97.9% (2000) to 87.7% (2011). The proportion of paid donation increased from 2.4% (2000) to 22.1% (2011) and came close to indicators of the middle income countries (27%), while in high-income countries it equals 0.3% (34).

Considering the total number of blood donations regionally, the lowest annual rates per 1,000 population over the study period were found in South Kazakhstan (10.5) and Almaty (8.6) regions, the highest in the capital Astana (47.0). Despite an overall negative growth rate of blood donations over the country in Aktobe, Zhambyl and West Kazakhstan regions the growth rate had a positive trend. The highest annual rates of plasma donations were found in the major cities Almaty (8.6) and Astana (6.5), and Kostanay region (8.3), the lowest in Almaty (0.5) and Atyrau (0.3) regions (Fig. 3, 4). There is no obvious explanation for the variation in donation rate. One of the factors might be geographical location. In Kazakhstan, the population is spread out over a huge area, so in the remote regions the donor activity is lower in contrast to the big cities, where a large number of people live and demand for health care and concentration of medical institutions is relatively high.

The assessment of blood donations profile during 2000-2011 has shown the decreasing tendency of blood donation, increase of plasma donations, shift of voluntary donation to paid, regional differences in blood and plasma donations, which need further detailed study taking into account the socio-economic development, geographical location, demographical situation and health infrastructure of each region. Is it necessary to find a compromise that will allow implementing reasonable and successful policy of blood service and achieving the indicators of advanced countries, especially in non-remunerated donation?

## Conclusion

This epidemiological study provides a detailed information, including the regional characteristics on blood and plasma donations in Kazakhstan over 12 years period and can be used for further development of blood transfusion system paying attention to the socio-economic development, geographical location, demographical situation and health infrastructure of each region.

## Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

## Competing interests

The authors declare that there is no conflict of interests.

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