

Assessment of performance of professionals in immunohematology proficiency tests of the public blood bank network of the State of Minas Gerais

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Background: Despite significant advances, the practice of blood transfusion is still a complex process and subject to risks. Factors that influence the safety of blood transfusion include technical skill and knowledge in hemotherapy mainly obtained by the qualification and training of teams.

Objective: This study aimed to investigate the relationship between professional categories working in transfusion services of the public blood bank network in the State of Minas Gerais and their performance in proficiency tests.

Methods: This was an observational cross-sectional study (2007-2008) performed using a specific instrument, based on evidence and the results of immunohematology proficiency tests as mandated by law.

Results: The error rates in ABO and RhD phenotyping, irregular antibody screening and cross-matching were 12.5%, 9.6%, 43.8% and 20.1%, respectively. When considering the number of tests performed, the error rates were 4.6%, 4.2%, 26.7% and 11.0%, respectively. The error rates varied for different professional categories: biochemists, biologists and biomedical scientists (65.0%), clinical pathology technicians (44.1%) and laboratory assistants, nursing technicians and assistant nurses (74.6%). A statistically significant difference was observed when the accuracy of clinical pathology technicians was compared with those of other professionals with only high school education (p -value < 0.001). This was not seen for professionals with university degrees (p -value = 0.293).

Conclusion: These results reinforce the need to invest in training, improvement of educational programs, new teaching methods and tools for periodic evaluations, contributing to increase transfusion safety and improve hemotherapy in Brazil.

Keywords: Blood Banks/standards; Blood Transfusion; Security measures; Training courses; Evaluation; Quality control

Introduction

The target of all medical specialties is to improve efficiency with blood transfusions being one of their most relevant procedures. Despite significant advances, this is still a complex process that is subject to risks.⁽¹⁻³⁾ In Brazil, professionals of transfusion medicine should comply with the regulations of the Ministry of Health as laid down by the Collegiate Board resolution RDC No. 153 of 14 July 2004. This regulation normalizes and standardizes blood banking procedures, including the collecting, processing, testing, storage, transportation and use of blood and blood products.⁽⁴⁾

Complications related to failures in the transfusion process can result from non-compliance to established standards arising mainly from factors associated with the calibration of equipment, conservation and handling of reagents (inputs) and clerical errors (inadequate qualification of staff). Such complications may cause from slight to severe harm to patients with civil or even criminal consequences.^(3,5-8)

Although prevention of all human errors is impossible, diminishing the probability of errors must be a goal.⁽⁵⁾ There is currently a consensus among institutions and experts in the area of hemotherapy that maintaining a safe blood supply suitable for transfusion is linked, among other things, to the use of effective laboratory practices in pre-transfusion tests.^(2,9)

Studies emphasize that factors, including the technical skill and knowledge in hemotherapy, especially arising from the technical qualifications and continued training of the transfusion team, influence safety. Competence is therefore essential to prevent potential complications including transfusion reactions.^(1,4,5,9,10) The demands exerted by transfusion medicine today with multi-professional teams, have increased exponentially,

especially regarding the qualifications and experience of the team.⁽⁹⁾

Latin America, with its differences between countries, faces major variations in the availability, composition and distribution of healthcare professionals. Thus some areas lack services and human resources and there are persistent difficulties in the distribution of professionals. Working conditions have deteriorated and there is a lack of stimulation associated with deficiencies in strategies aimed at maintaining the quality of professionals.⁽¹¹⁾

Historically in Brazil, the education, including both schooling and vocational training, has suffered the influence of aspects such as the size of the territory and the different socioeconomic and cultural conditions. Despite commitment to establish educational policies, failures in the fixing of objectives, purpose and proposals are aggregated to these aspects.⁽¹²⁾

This study aimed at comparing the results of immunohematological proficiency tests of different professional categories who work in the transfusion services (TSs) of the public blood public network of the State of Minas Gerais. The results obtained from this study will contribute to the elaboration of policies aimed at training in accordance with the needs of public blood bank network of the state and country.

Methods

A cross-sectional observational study, part of the research project "Transfusion safety: Evaluation of the physical and operational infrastructure of public transfusion service network in the State of Minas Gerais, 2007-2008" was developed in the Fundação Hemominas (Hemominas) in the period from January 2007 to April 2009.⁽³⁾ The participants were all public, private or philanthropic TSs (including sectors of Hemominas) that transfuse blood and blood components collected by Hemominas.

Questionnaires, based on legislation and the technical standards in force, were designed specifically for this study.^(4,13) This study is based on evidence (audits, documents, manuals, standard operating procedures, etc.) that had previously been tested and validated in a pilot study with reproducibility as shown by a measure of inter-rater agreement (KAPPA coefficient), with a mean value of 0.65.

All TSs were contacted to schedule inspections. Information was obtained through in loco checks and interviews were conducted by professionals prepared for practical and theoretical training. Data collection was carried out between July 2007 and August 2008 and then transmitted to the project coordinator to input in the database.

In addition to data collection and in order to evaluate the performance of the staff of TSs, technicians were required to do proficiency tests, which consisted in immunohematology tests using one of 13 different sample panels

specifically produced by Hemominas for this study. These panels were composed of four samples of 5% red blood cells (RBC suspensions and serum, simulating two donors and two recipients).

TSs were required to perform ABO and RhD phenotyping, irregular RBC antibody screening and compatibility tests (CT), as is mandatory before transfusions according to current regulations (RDC 153/2004).⁽⁴⁾ The tests, characterizing everyday situations, had variations in the results of ABO and RhD phenotyping and irregular RBC antibody screening but with all the TSs being similar.

The methodology used for the production of the panels was that adopted by the External Quality Evaluation Program in Immunohematology (AEQIH Program) of the Agência Nacional de Vigilância Sanitária/Ministry of Health. A descriptive study was conducted using a questionnaire related to human resources (e.g., professional categories and training and the results of proficiency tests).

The Chi-square test or Fisher's exact test was employed to compare data with the significance level being 5%. The EpiData 3.1 computer program was used for data entry, MapInfo Professional 9.5 for spatial distribution and SPSS 17.0 and Epiinfo 6.4 for statistical analysis.

Results

Two hundred and twenty-six TSs of the blood public network of the State of Minas Gerais were studied; 19 were part of Hemominas and the others were public, private, or philanthropic institutions. The TSs were located in 177 municipalities in the State of Minas Gerais and one in the State of Espírito Santo; the latter was included as it was close to a Hemominas unit and contracted their services (Figure 1).

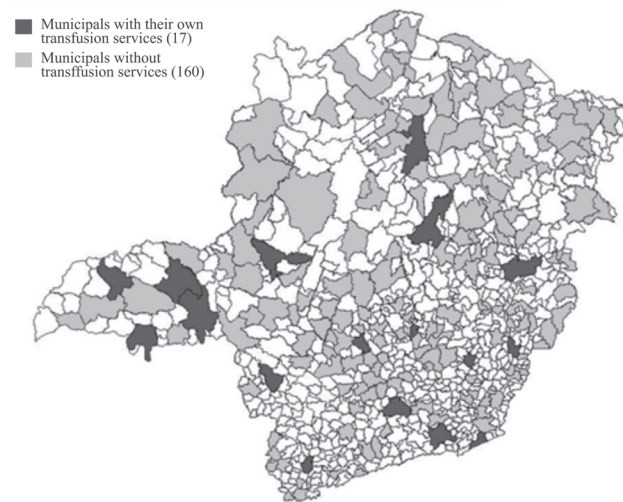


Figure 1 – Spatial distribution of the 177 municipalities with transfusion services belonging to the public blood bank network in the State of Minas Gerais, 2007-08

Table 1 - Distribution of 219 transfusional services of the public blood bank network of Minas Gerais in respect to professional categories and according to population covered, 2007-08

Professional category n (%)	Population covered						Total
	5001 to 10,000 n = 7	10,001 to 20,000 n = 39	20,001 to 50,000 n = 76	50,001 to 100,000 n = 38	100,001 to 500,000 n = 27	> 500.000 n = 32	
University degree							
Physicians	7 (100.0)	38 (97.4)	73 (96.1)	37 (97.4)	27 (100.0)	32 (100.0)	214 (97.7)
Biologists	0 (0.0)	0 (0.0)	2 (2.7)	4 (10.5)	3 (11.1)	2 (6.3)	11 (5.0)
Biomedical scientists	0 (0.0)	2 (5.1)	7 (9.2)	4 (10.5)	2 (7.4)	1 (3.1)	16 (7.3)
Biochemists	7 (100.0)	34 (87.2)	56 (73.7)	22 (57.9)	15 (55.5)	5 (15.6)	139 (63.5)
High school							
Clinical pathology technicians	1 (14.3)	9 (23.1)	22 (28.9)	15 (39.5)	17 (63.0)	28 (87.5)	92 (42.0)
Laboratory assistants	3 (42.9)	2 (5.1)	14 (18.4)	8 (21.1)	5 (18.5)	8 (25.0)	40 (18.3)
Nursing technicians	1 (14.3)	13 (33.3)	25 (32.9)	17 (44.7)	8 (29.6)	8 (25.0)	72 (32.9)
Assistant nurses	1 (14.3)	6 (15.4)	16 (21.1)	10 (26.3)	7 (25.9)	8 (25.0)	48 (21.9)

Thirteen of 19 municipalities with Hemominas TSs also had non-Hemominas TSs. Of the total, 219 TSs in 171 municipalities performed proficiency testing; the others did not send back the test results. Most (55.7%) of the TSs were located in towns with populations of between 5000 to 50,000 inhabitants (Table 1).

Regarding to the technical staff, in five TSs (2.3%) there was no doctor responsible for the blood bank. Among the 219 TSs evaluated, 97.7% had physicians and, in 75.8% of the services, at least one of the other professionals had a university degree. Of the professionals with high school education, clinical pathology technicians were present in 42.0% of TSs and their presence was proportional to the population (Figure 2). Some TSs employed laboratory technicians, nursing technicians and assistant nurses to do the tests (Table 1).

The 219 TSs performed a total of 2628 proficiency tests with 9.2% of errors; 85 (38.8%) TSs had no errors in respect to tests that are mandatory by law. Regarding to the type of tests, the percentages of errors were 4.6%, 4.2%, 26.7% and

11.0% for the ABO and RhD phenotype, IAS and CT, respectively (Table 2). The distribution of these errors in TSs was 12.5% (27), 9.6%, (21) 43.8% (96) and 20.1%, (44) since many services erred in more than one test. According to the results of this study, the greater the size of the municipality, the greater the percentage of correct results were seen (Figure 2).

Table 2 - Percentage distribution of correct and incorrect results in the immunohematological tests carried out by the 219 transfusion services of the public blood bank network of Minas Gerais, 2007-08

Immunohematological tests	Total tests	Correct		Incorrect	
		n°	%	n°	%
ABO	876	836	95.4	40	4.6
RhD	876	839	95.8	37	4.2
Irregular antibody screening	438	321	73.3	117	26.7
Compatibility test	438	390	89.0	48	11.0
Total	2628	2386	91.8	242	9.2

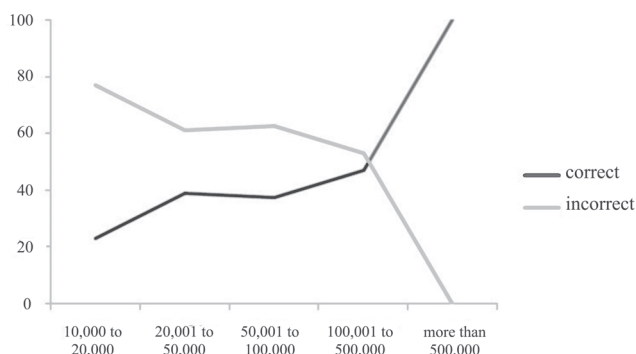


Figure 2 – Distribution of correct and incorrect results to immunohematological tests according to the population size of the 171 municipalities of the public blood bank network of the State of Minas Gerais

Seven of the eight professional categories committed mistakes in immunohematological tests. Only one physician performed the proficiency tests and he had no errors. It was noted, however, that the error rate was lower in the 90 (41.1%) TSs where the blood bank medical doctor was present at the time of the previously scheduled audit (65.3% versus 53.8%). On comparing the results of the tests, the performance of clinical pathology technicians was significantly better than the other professionals that had only studied as far as high school (p-value < 0.001). Of the university graduates (biomedical scientists and biologists), there were no significant statistical differences in the numbers of errors (p-value = 0.293). There was a statistically significant difference in the results of clinical pathology technicians and all the other university graduates (p-value = 0.01 - Table 3).

A total of 72.1% (158) of the TSs had participated in training within the previous 12 months however not all the

professionals in any one category were trained. The percentages of training for physicians, biochemists, biologists, biomedical scientists, clinical pathology technicians, laboratory assistants, nursing technicians and assistant nurses were 41.6% (92), 59.3% (86), 27.3% (3), 64.7% (11), 46.2% (43), 27.5% (11), 46.6% (34) and 39.6% (19), respectively (Figure 3).

Table 3 - Percentage distribution of correct and incorrect results in the immunohematological tests according to level of schooling and professional category in the 219 transfusion services of the public blood bank network of Minas Gerais, 2007-08

Level of schooling	Correct		Incorrect		p-value
	n°	%	n°	%	
University graduate					
Biochemists	21	32.3	44	67.7	0.293
Others	7	46.7	8	53.3	
High school					
Clinical pathology technicians	33	55.9	26	44.1	< 0.001
Others	17	25.4	50	74.6	

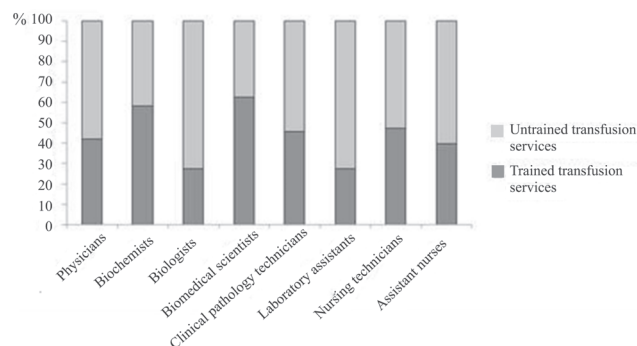


Figure 3 – Distribution of training carried out within the previous year in the 219 transfusion services of the public blood bank network in Minas Gerais by professional category, 2007-08

Table 4 - Percentage of correct results in proficiency tests of the transfusion services of the public blood bank network of the State of Minas Gerais in respect to training within the previous twelve months, 2007-08

Professional category	Trained transfusion services*		Untrained transfusion services		p-value
	Total n° of professionals	Correct results	Total n° of professional	Correct results	
	n°	%	n°	%	
Physicians	1	1 100.0	-	-	
Biochemists	21	19 90.5	44	27 61.4	0.015
Biologists	1	1 100.0	1	0 0.0	-
Biomedical scientists	3	2 66.7	5	3 60.0	0.571
Clinical pathology technicians	30	13 43.3	25	13 52.0	0.373
Laboratory assistants	5	1 20.0	8	3 37.5	0.962
Nursing technicians	9	9 100.0	18	10 55.6	0.052
Assistant nurses	2	1 50.0	18	8 44.4	0.688
Total	72	47 65.3	119	64 53.8	0.425

* At least one professional trained in the transfusion service

A higher overall accuracy in the tests was achieved by professionals who received training (65.3%) compared to those who did not (53.8%). However, this difference was not statistically significant. When the professional category was considered, a statistically significant difference was observed only for biochemists (Table 4).

Discussion

The performance of professional categories who carry out pre-transfusion testing in TSs is little documented in the literature. Thus, this study hopes to contribute to direct policies related to staff training in respect to the needs of the public blood bank network of the State in Minas Gerais and also to serve as a support/model for the national blood banking services in order to increase transfusion safety.

Although the vast majority of TSs had a doctor responsible for the blood bank legal requirements for the functioning of these services were disobeyed both in respect to federal law (resolution 153/04) and to the contract with Hemominas.^(4,13) The presence of a physician at the time of the audit, determined a lower number of errors in the proficiency tests suggesting that their greater commitment to the service influences the efficiency of the TS.

There were too few professionals with legal competence to perform the pre-transfusion testing including graduated biochemists, biomedical scientists and biologists with specific training in the area. This study showed a need for better criteria in the allocation of these professionals in TSs, because they are responsible for the supervision and implementation of activities in laboratories.⁽¹⁴⁻¹⁸⁾

Although clinical pathology technicians had the best performance among the professional groups that had only studied up to high school, they were present in less than half of the TSs. There was also a relative imbalance in the geographic distribution of these professionals with fewer technicians in smaller municipalities. The consequence of this lack of clinical pathology technicians is that other professions, such as nursing technicians and assistant nurses, who are not qualified to perform immunohematological tests, are employed. This suggests insufficient investment in vocational training courses in the area of blood transfusion and/or little interest in them.⁽¹⁹⁾ A study carried out in 2007 by the Plano Nacional por Amostra de Municípios showed that among the individuals that had previously attended training courses, only 20.2% were in the area of healthcare.⁽²⁰⁾

The number of TSs with errors in proficiency tests is of great concern. There was a direct relationship between the test results and the population attended by the laboratory, suggesting less training of professionals in smaller towns. The lack of opportunities in vocational training, inadequate modernization or improvements and supervisory deficiencies might justify the considerable variations in terms of training and, consequently, the quality of staff.^(3,21)

Immunohematological test errors in practice may entail complications including transfusion reactions. The high percentages of errors in irregular RBC antibody screening and the number of institutions that did not perform the tests are of great concern. The requirement of trained professionals with technical knowledge and skills in hematology is fundamental. The World Health Organization showed that lack of training of professionals is one of the major factors that threatens blood transfusion safety.^(21,22) Studies highlight that professionals who do not meet these requirements may decrease blood transfusion safety and cause considerable harm to the patient.^(1,4,5,9,10) The significant number of errors in proficiency tests, even in TSs in which at least one professional was trained or retrained within the previous year, suggests that the training model employed is inefficient.

It turns out that there is need for investment in training professionals in the area of blood transfusion with reviews of the processes and the methodology used in order to minimize human error.

Simply by performing the task does not qualify the professional, but knowledge of the reasons for and consequences of procedures is essential.^(4,8) The variations in professional performance is influenced by basic training and access to further training, as transfusion practices are constantly changing as a result of progress.⁽⁸⁾

The motivation of healthcare managers in the development of educational programs, new teaching methodologies and instruments for periodic assessment would also contribute to advances in hematology.^(19,21) In particular, periodic retraining and continuing education are preventive procedures against failures and non-conformity that may accrue over time.⁽⁴⁾ Distance learning, widely used in professional education around the world as a decentralizing methodology that supports other approaches in the development of professionals, may be used as a strategy to train in transfusion safety.^(9,21) Thus, the participation of the Federal Government, especially by coordinating the National Policy on Blood and Blood Products, is essential and the updated Tele Lab, an at distance training program edited in 1998 by the Ministry of Health, could be one tool to be implemented.⁽²³⁾

Additionally, the External Quality Control Programs, as an activity monitoring method, as it is used to measure the degree of overall excellence, would complement the proposal by ensuring improvements in the quality of hemotherapy in the State of Minas Gerais and in the country as a whole.

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