Twelve Years of the Brazilian External Quality Assessment Program in Immunohematology: Benefits of the Program

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The Brazilian External Quality Assessment Program in Immunohematology (BEQAPI) was introduced with the objective of evaluating the quality of diagnosis in immunohematology. From 1992 to 2003, proficiency tests for ABO grouping, Rh (D, C, c, E, e), K phenotyping, direct antiglobulin testing (DAT), antibody screening (AS), and antibody identification (AI) were performed. A total of 41 evaluations were carried out in 223 institutions. Over the period of 12 years, the program included 8,014 ABO typing, 8,000 RhD typing, 5,193 Rh typing (C, c, E, e), 5,101 K phenotyping, 7,939 AS, 4,533 AI, and 7,912 DATs. Erroneous responses were classified as clerical, technical, or undetermined. A substantial proportion of erroneous responses

due to clerical errors occurred in ABO typing (76/76 errors), RhD typing (34/58 errors), and Rh phenotyping (50/73 errors). Technical errors occurred predominantly for weak D (91/95 errors), AS (252/301 errors), and AI (321/335 errors). Based on these results, since 1996, participants have received "Questions and Case Studies in Immunohematology" as an incentive for training and education. The results of the present study show an improvement in the performance of participants in the course of the program. We found that a well-organized external proficiency program can contribute to the improvement of quality of testing in Immunohematology. *J. Clin. Lab-Anal.* 19:209–218, 2005 © 2005 Wiley-Liss, Inc.

Key words: blood group serology; transfusion laboratory practice; proficiency tests; external evaluations; ABO grouping; Rh and K phenotyping; antibody screening and identification; technical and clerical errors

INTRODUCTION

Blood transfusion in Brazil is legislated by the Federal Constitution, by laws and decrees and by the Brazilian National System of Blood Components and Derivates—SINASAN—implemented by the Ministry of Health, and controlled through the National Agency of Sanitary Vigilance (ANVISA). The pillars are noncommercialization and voluntary donation, practiced by public services and complemented by private services. Related with the complexity of services there are 2,079 services distributed in different levels of complexity: Coordinator's Hemocenters (26), Regional Hemocenters (59), Nucleus of Hemotherapy (287), Collection and Transfusion Units (178), Collection Units (10), and Transfusion Agencies (1477) (1).

Brazil, like many other countries in the world, has seen a dramatic reduction in the transmission of infectious agents by blood transfusion. Both public and private sectors substantially invested in the con-

struction of new facilities and the introduction of new tests for infectious agents. Recently, the Ministry of Health of Brazil has mandated the introduction of NAT for HCV and HIV, and implementation is expected in the foreseeable future (2). However, less attention has been paid to the area of immunohematology. In October

Abbreviations: AI, antibody identification; AS, antibody screening; BEQAPI, Brazilian External Quality Assessment Program In Immunohematology; DAT, direct antiglobulin testing; GEL-LISS, gel low ionic strength solution antiglobulin test; GEL-PAP, gel papain; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IAT, indirect antiglobulin testing; LISS, low ionic strength solution; LISS-AGT, LISS antiglobulin test; NAT, nucleic acid testing; PEG-AGT, polyethylene glycol antiglobulin test.

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1997, the decree of the Brazilian National Program of External Quality Control in Serology and Immunohematology was published (3), determining public and private blood transfusion services to participate in external assessments. Therefore, in spite of the decree, the Ministry of Health started the external evaluation in immunohematology for public Coordinators and some Regional Hemocenters only at year 2003, with obligatory tenet. The Brazilian Society of Hematology and Hemotherapy (SBHH), a Non-Governmental Organization, initiated an External Quality Assessment Program in Immunohematology in 1992, prior to the decree. The intent was to assess the quality of blood group serology and stimulate improvement of immunohematology practices in Brazil. Participants in the program receive, on a quarterly basis, two vials containing serum and two vials containing suspensions of red blood cells for the determination of ABO blood groups, phenotyping of immunogenic and clinically significant antigens, Rh (D, C, c, E, e) and K, antibody screening (AS), antibody identification (AI), and direct antiglobulin testing (DAT). In addition, since 1996, participants have received "Questions and Case Studies in Immunohematology" as an incentive for training and education. Individual responses are confidential and only aggregate data are reported. Participants receive certificates, from "Quality" in basic tests to "Elite" in all tests for successful completion of the program. This work collates the Brazilian data obtained from proficiency test results from 1992 to 2003. It further reviews trends and discusses the role that different techniques may have in terms of successful performance. Essentially, we have observed great improvement in the performance of blood group serology in Brazil over the course of 12 years.

MATERIALS AND METHODS

Brazilian External Quality Assessment Program in Immunohematology

The Brazilian External Quality Assessment Program in Immunohematology (BEQAPI) was initiated in June 1992. The basic tenets were voluntary participation,

confidentiality, and an impartial evaluation of laboratory procedures and test results. Participants were asked to treat the proficiency specimens as routine samples. There were 41 proficiency cycles between June 1992 and December 2003.

Samples

For each cycle, participants received ready-to-use kits, prepared by DiaMed AG (Switzerland), commercially available, containing two vials with 5 mL sera samples and two vials with 5 mL of 5% red blood cells suspended in modified low ionic strength solution (LISS). As informed by the manufacturer, sera containing red cell alloantibodies were diluted with ABO-compatible sera to achieve the desired antibody titer. The manufacturer assumed responsibility for all quality control including determination of stability and expiration dates. A coordinating laboratory confirmed the manufacturer's results.

Forms and Tests

Two report forms, one for each sample, were included with each shipment. Participating laboratories were asked to follow their standard operating procedures and to carry out only the tests that were part of their normal routine using the same staff, techniques, and reagents. The different methods used for each test by the participants are listed in Tables 1–7.

Practical Evaluations

Tests included ABO typing, Rh (D, C, c, E, e) and K phenotyping, AS, AI, and DAT. The proficiency testing samples never included A subgroups (A₂ or A₂B), although there is not a reason for that. We did not include antigens other than K because the majority of the laboratories do not have protocols for the extending phenotyping in their routine.

Theory Evaluations

Since 1996, 56 "Questionnaires and/or Case Studies in Immunohematology" were sent to all participants in

TABLE 1. ABO grouping methods by the participants

ABO grouping methods (%)	Year												
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Average
Tube	61.5	65.6	68.7	61.7	67.1	61.6	59.8	60.6	61.3	61.6	60.0	60.2	62.5
Gel	20.2	16.3	17.3	20.9	20.9	25.3	28.5	30.1	31.3	32.4	33.1	33.9	25.9
Microplate	9.4	7.1	6.7	6.1	6.2	5.9	4.7	4.2	3.9	4.1	4.0	3.8	5.5
Slide	6.1	8.9	6.3	9.7	4.2	5.0	4.4	3.7	2.5	1.1	1.6	0.6	4.5
Tile	2.8	2.1	1.0	1.7	1.6	2.2	2.6	1.4	1.1	0.7	1.3	1.5	1.7

TABLE 2. RhD grouping methods by the participants

RhD grouping methods (%)	Year												Average
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Tube	61.1	65.7	67.7	61.7	66.9	60.0	59.7	60.6	61.2	61.2	60.0	60.2	62.2
Gel	20.4	16.1	17.1	20.9	21.0	28.6	28.5	30.1	31.3	32.1	33.2	33.9	26.1
Microplate	6.2	8.9	7.6	9.7	4.1	4.5	4.4	3.7	2.5	1.1	1.6	3.8	4.8
Slide	9.5	7.1	6.7	6.1	6.2	4.8	4.7	4.2	3.9	4.1	4.0	0.6	5.2
Tile	2.8	2.1	1.0	1.7	1.8	2.2	2.6	1.4	1.1	1.4	1.3	1.5	1.8

TABLE 3. Rh phenotyping methods used by the participants

Rh phenotyping methods (%)	Year												Average
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Tube	52.7	64.2	60.8	73.0	60.4	52.1	45.6	47.0	43.9	36.1	39.3	38.9	51.2
Gel	33.3	26.5	33.2	17.8	35.5	42.5	49.0	48.8	52.4	60.9	57.8	58.6	43.0
Microplate	9.3	9.3	6.0	6.5	4.0	3.0	1.8	2.7	2.7	2.1	2.3	2.0	4.3
Slide	1.6	0.0	0.0	1.6	0.2	2.5	3.6	1.6	1.0	0.9	0.6	0.5	1.2
Tile	3.1	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3

TABLE 4. K phenotyping methods used by the participants

K phenotyping methods (%)	Year												Average
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Tube	54.8	64.2	60.6	63.3	59.8	51.1	45.0	45.2	43.5	34.8	38.6	38.4	49.9
Gel	33.9	26.5	31.5	30.4	35.6	42.7	49.7	50.5	52.8	62.1	58.5	58.2	44.4
Slide	1.6	0.0	0.0	1.1	0.6	3.1	3.4	1.6	1.0	0.9	0.6	1.9	1.3
Microplate	9.7	9.3	5.9	4.4	4.0	3.1	1.8	2.7	2.7	2.2	2.3	1.5	4.1
Tile	0.0	0.0	2.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2

TABLE 5. DAT methods used by the participants

DAT methods (%)	Year												Average
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Tube	73.0	80.3	76.0	73.0	72.8	69.1	62.2	57.4	54.4	53.0	51.9	52.5	64.6
Gel	25.8	18.8	23.8	26.7	27.2	30.5	37.1	41.7	44.8	46.3	47.4	46.8	34.7
Microplate	1.2	0.9	0.3	0.4	0.0	0.4	0.7	0.9	0.8	0.7	0.8	0.7	0.6

order to encourage the continued training of working team. A few days after each theoretical evaluation, from the program coordinator, all participants receive the correct answers and comments on their incorrect answers.

Errors Definition

Erroneous responses were classified as clerical, technical, or undetermined errors. Clerical errors corre-

sponded to an incorrect recording of a result when the assay was properly performed, including mistakes of: 1) Transposition (mix-ups): participant recording correct result on the wrong report sheet (e.g., recording results of sample 1 on the wrong reporting form 2 and vice versa) and 2) Transcription errors in which the participant accomplished the test correctly, but recorded results incorrectly on the correct reporting sheet (e.g., the laboratory result was A RhD+ for

TABLE 6. Antibody screening methods used by the participants

Antibody Screening methods (%)	Year												Average
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Gel	11.4	15.6	19.2	21.9	23.1	26.2	27.3	28.0	29.4	30.4	32.3	33.2	24.8
PEG	5.5	7.8	8.3	8.1	10.9	13.3	11.6	11.4	11.6	13.7	14.4	16.8	11.1
Gel Enz.	8.7	10.4	12.0	13.5	12.8	13.2	14.8	15.4	16.0	16.8	16.1	14.9	13.7
LISS	15.5	15.0	14.3	12.2	12.5	14.2	12.4	12.0	11.0	11.1	10.9	10.3	12.6
Albumin	44.3	40.1	35.1	33.7	33.6	27.0	20.7	17.6	16.5	12.4	11.2	9.1	25.1
Saline	0.0	0.0	0.0	0.0	0.0	0.0	6.9	6.6	6.9	7.3	7.5	8.0	3.6
Tube Enz.	11.9	8.5	7.7	5.4	4.9	3.1	4.1	6.4	6.5	6.4	5.3	4.8	6.3
MP	0.9	1.3	1.7	3.1	1.6	2.1	1.2	1.4	1.4	1.1	1.5	2.0	1.6
MP Enz.	1.8	1.3	1.7	2.1	0.6	0.9	1.0	1.2	0.7	0.8	0.8	0.9	1.2

sample 1, but on the reporting form 1 it was recorded as A RhD—).

Technical Errors

Participant accomplished the test but did not achieve the correct result (e.g., in the AS test, the serum sample had two antibodies, but only one was identified).

Undetermined Errors

Errors that could not be assigned to either category above were classified as due to “undetermined cause.”

Statistical Analysis

A confidence interval (CI) of 95% was applied to assess whether differences in sensitivity were statistically significant. When the intervals were rejected, the sensitivities were statistically different. Since the interval of confidence has been calculated as $\alpha = 5\%$, when there was a difference, the P value was 0.05.

Certificates

In order to motivate participation and to recognize the institutions which have achieved the standards

determined, three kinds of certificates were issued according to strict criteria: 1) Certificate of Quality in basic tests: 100% of correct results in five consecutive Proficiency Tests for ABO, RhD, AS, and DAT; 2) Certificate of Excellence in all tests: the same criteria used to the Certificate of Quality plus 100% of correct results for Rh (C, c, E, e) and K phenotyping and 80% of correct results in AI, in five consecutive Proficiency Tests; 3) Certificate of Elite: the same criteria used to the Certificate of Excellence plus 80% of correct results in theoretical evaluations as “Questions and Case Studies in Immunohematology.”

RESULTS

Program Participation

A total of 223 institutions from all regions of Brazil participated in the program during the period of this study (109 public and 114 private institutions), some enrolling and others dropping out at different times. The number increased steadily from 49 in 1992 to 158 in 2003, as shown in Fig. 1. The number of institutions that participated for different intervals in the survey is shown in Table 8. Average participation was 17.9 evaluations per participant. Over the period of 12 years, the

TABLE 7. Antibody identification methods used by the participants

Antibody Identification methods (%)	Year												Average
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Gel	16.1	19.9	23.2	28.2	25.7	27.4	32.1	30.4	34.6	35.6	36.1	36.5	28.8
Gel Enz.	18.8	14.3	16.1	20.4	23.2	22.2	23.6	23.6	22.3	24.1	23.8	25.2	21.5
PEG	5.4	8.3	9.4	9.8	10.9	13.9	11.6	11.6	12.4	13.2	15.3	17.5	11.6
Albumin	32.1	31.6	32.9	27.8	28.7	23.2	17.9	16.2	14.2	10.2	9.7	6.9	21.0
Saline	0	0	0	0	0	0	4.6	5.4	5.1	5.8	6.0	6.4	2.8
LISS	10.7	11.6	7.8	6.7	7.1	8.8	7.6	7.3	7.6	6.5	6.7	4.9	7.8
Tube Enz.	12.9	11.3	8.7	4.9	3.9	4.1	2.6	5.1	3.4	4.5	2.1	2.2	5.5
MP	1.3	1.5	0.6	1.1	0.3	0.3	0	0.4	0.4	0.1	0.3	0.4	0.6
MP Enz.	2.7	1.5	1.3	1.1	0.2	0.1	0	0	0	0	0	0	0.6

Fig. 1. Yearly number of participating institutions in the BEQAPI.

TABLE 8. Number of institutions that participated in different intervals of surveys

No. of surveys	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40	≥ 41
No. of participants	50	30	33	22	13	27	16	27	1

program included 8,014 ABO typing tests (it should be noted that the kit supplier never sent subtypes of Group A, and consequently the participants were never asked to determine A subgroups A₂ or A₂B), 8,000 RhD typing tests, 5,193 Rh (C, c, E, e), 5,101 K phenotyping tests, 7,939 AS tests, 4,533 AI tests, and 7,912 DATs.

ABO Typing

Results are described in Fig. 2. Of 8,014 tests performed, 7,938 (99%) were correct results. There were 76 (0.9%) erroneous results for ABO typing; all of them were classified as clerical errors. Of these 76 clerical erroneous results 51 (67.1%) erroneous reports were

classified as transposition errors and 25 (32.9%) were classified as transcription errors. No technical errors were recorded.

A total of 37 institutions provided all the 76 errors found in ABO tests: 31 presented errors in only one evaluation (52 errors) and six participants were responsible for repeated errors.

RhD Typing

Of 7,376 tests performed, 7,318 (99.2%) were correct results (Fig. 2). Of the 58 (0.8%) RhD typing errors, 34 (58.6%) were classified as clerical errors, 17 (29.3%) were of undetermined cause, and 7 (12.1%) were due to

Fig. 2. Yearly percentage of correct results for ABO, RhD, and weak D typing tests.

technical errors. Of these 34 clerical errors, 24 (70.6%) were transposition and 10 (29.4%) were due to transcription of results.

Weak D Typing

Of 624 tests performed, 529 (84.8%) were correct results (Fig. 2). Of the 95 (15.2%) incorrect results 91 (95.8%) were classified as technical errors, three (3.2%) as undetermined cause, and one (1%) was autoclassified as clerical (transposition).

Rh Phenotyping

Of 5,193 tests performed, 5,020 (96.7%) were correct results (Fig. 3). Of the 173 (3.3%) incorrect results, 50 (28.9%) Rh phenotyping errors resulted from clerical errors, 114 (65.9%) were classified as undetermined cause and nine (5.2%) were autoclassified as technical errors. Of these 50 classified as clerical errors 37 (74%) were transcription and 13 (26%) were transposition.

In order for results to be considered as correct, participants were obliged to identify correctly each of the four Rh antigens: C, c, E and e. Partial results (for example three antigens phenotyped) were not considered.

K Phenotyping

Of 5,101 tests performed, 5,032 (98.6%) provided correct results (Fig. 3). Of the 69 (1.4%) K phenotyping errors, five (7.3%) were classified as clerical, 62 (89.8%) as undetermined cause, and two (2.9%) were autoclassified as technical errors. Of the five classified as clerical errors, two (40%) were transposition and three (60%) were transcription.

Direct Antiglobulin Test (DAT)

Of 7,912 tests performed, 7,858 (99.3%) were correct results (Fig. 4). Of the 54 DAT errors (0.7%), 28 (51.9%)

were classified as technical, 25 (46.3%) as undetermined, and one (1.9%) as clerical (transcription).

Antibody Screening

Of 7,939 tests performed, 7,638 (96.2%) provided correct results (Fig. 4). Of the 301 (3.8%) antibody screening errors, 252 (83.7%) were due to technical errors, 28 (9.3%) were classified as undetermined cause, and 21 (7%) were clerical errors. Of these 21 classified as clerical errors, 14 (67%) were transposition and seven (33%) were transcription; and the majority of technical errors were related to the assay sensitivity or to the incorrect handling of the technique.

As shown in Fig. 5 the use of a single technique was predominant (54.9%) when compared with the use of a combination of techniques. We observed a decrease in the percentage of errors in the AS and also a trend toward abandoning the use of the albumin test in favor of the gel test, PEG-AGT, and LISS-AGT. We also observed an improvement in the LISS-AGT tube technique during the 12-year period (Figs. 6 and 7).

Antibody Identification

Of 4,533 tests performed, 4,198 (92.6%) provided correct results. Of the 335 (7.4%) AI errors, 321 (95.8%) were due to technical reasons and 14 (4.2%) were classified as clerical; 12 (85.7%) were transposition and two (14.3%), were transcription.

As shown in Figure 7, the use of a single technique (43.5%) and double technique (39.9%) were predominant.

Figure 8 suggests that the enzyme-gel (GEL-PAP) was more sensitive for identifying the majority of antibodies and that single Rh antibodies or other single antibodies (non-Rh) are more readily identified than the simultaneous presence of Rh with other antibodies, regardless of the technique used. These differences were

Fig. 3. Yearly percentage of correct results for Rh (C, c, E, e) and K phenotyping tests.

Fig. 4. Yearly percentage of correct results for AS and DAT among BEQAPI participants.

statistically significant ($P > 0.05$ for enzyme tube; $P = 0.05$ for LISS-AGT tube and $P = 0.01$ for the other techniques). However, there was no significant difference between the rate of identification of single Rh antibodies and that for other single antibodies ($P > 0.05$).

Albumin was the worst technique used for the identification of single Rh antibodies ($P = 0.05$ for enzyme tube and $P = 0.01$ for other techniques). It was also the worst technique for the identification of Rh antibodies in combination with other antibodies ($P = 0.05$ for enzyme tube and PEG-AGT and $P = 0.01$ for the other techniques). When used for the identification of other single antibodies, albumin was comparable with enzyme and LISS-AGT tube techniques ($P > 0.05$) but worse than the other techniques ($P = 0.01$). Mixtures of two antibodies were more difficult to identify than single antibodies ($P = 0.01$), and the data suggest that a mixture of two antibodies was more difficult to identify than a mixture of three

antibodies in the sample ($P = 0.01$). There was no statistical significance between the rate of identification of single antibodies when compared with a mixture of three antibodies ($P > 0.05$).

Theoretical Evaluations as Questions and Case Studies in Immunohematology

The average number of participants that answered the Questions and Case Studies in Immunohematology was 68.0% from 1996 to 2003. Among the participants who answered the Questions and Cases, 46.7% sent correct answers for at least 80% of the questionnaires.

DISCUSSION

External quality assessment programs provide the means for laboratories to compare their proficiency with those of their peers, to monitor trends in overall performance, and the opportunity to examine the

Fig. 5. Yearly distribution of single and combinations of techniques used in antibody screening.

Fig. 6. Yearly distribution of more used techniques in antibody screening.

relationship between different techniques and successful outcomes, aiding laboratories to set acceptable standards. The results of the present study show a steady improvement in the performance of participants over the course of 12 years of the BEQAPI, sponsored by the Brazilian Society of Hematology and Hemotherapy. We attribute part of these improvements to the stimulus provided by the program. Some of the improvements are probably due to the introduction of new and more rigorous Brazilian guidelines and new assays such as the gel test (4).

A substantial proportion of erroneous responses occurred due to clerical errors in ABO typing (76/76 errors), RhD typing (34/58 errors), and in Rh phenotyping (50/73 errors), and were observed during the entire 12-year period. These repeatedly observed errors provide evidence of the nonobservance of rules and that the

participants did not analyze their own results and did not read remarks written by the coordinators of the program. Clerical errors constitute the major cause of fatalities in blood transfusion (5,6). In the United States, such errors account for between 1;100,000–600,000 (5,7) and 1;2,000,000 fatal hemolytic transfusion reactions. Currently, these rates exceed the rates of transmission of all viral infections by transfusion (8).

Technical errors occurred predominantly for weak D (91/95 errors), antibody screening (252/301 errors), and antibody identification (321/335 errors). The sensitivity of detecting weak D depends on the anti-D reagent and on the exact conditions of the methods. As the national guidelines require detection of weak D in all donors that are apparently RhD–, this emphasizes the necessity to control the quality of reagents and differences in sensitivity of techniques in use, to observe standard

Fig. 7. Yearly distribution of single and combinations of techniques used in antibody identification among participants of BEQAPI.

Fig. 8. Percentage of correct results for antibody identification by technique among participants of BEQAPI.

procedures and the variability in proficiency. In Brazil, the AGT is still required for RhD typing of RhD-donors, in order to preserve RhD-resources. Weak D phenotypes have to be recognized, especially in blood donors because their red blood cells may immunize a RhD- patient. A typing method with a high sensitivity, such as the AGT in combination with blend or polyclonal anti-D, is being recommended as part of the benefits of the program.

The deficiency in detecting irregular antibodies was related to the sensitivity of the technique used. The use of a single technique and less sensitive technique, such as albumin, contributed to the high percentage of error rate found in the AS test. Improvements were observed when there was an increased use of new techniques such as GEL-LISS, GEL-PAP, and PEG-AGT and a decrease in the use of LISS-AGT tube and albumin tube tests. In Brazil, the frequency of clinically significant red cell alloantibodies, capable of binding to red cells in vivo with the possibility of causing accelerated destruction of red cells are 4.97% in patients; 2.43% in pregnant women and 0.13% in blood donors (9). Considering these data and the mistakes in AS that occurred in this report, it is possible that 1/6,670 patients with antibodies could experience an avoidable hemolytic transfusion reaction. This ratio is remarkably similar to the 1/6,715 reported between 1993 through 1998 at the Mayo Clinic in Rochester, MN (10).

It is important to emphasize that no single technique will detect all clinically significant antibodies (9,11,12). Interestingly, regardless of technique, survey participants had difficulties in identifying combined Rh antibodies, for instance anti-c with anti-E, because anti-c often masks the presence of anti-E. Anti-c with anti-K also proved problematic, with anti-c masking antibodies anti-K. Although a patient with anti-c will

receive a R₁R₁ blood unit and the clinical significance of detecting the anti-E could be questioned, we observed that participants had problems identifying an antibody directed against a low frequency antigen in the presence of antibodies against higher frequency antigens. As a benefit of the program, we alerted by phone call or letter the participants that made mistakes in the practical test. Moreover through the theoretical evaluations the program can be benefic commenting errors, stimulating corrective actions and also training the participants to better identify antibody associations, sending case studies with mixtures of such antibodies.

The data obtained in the current study may not be representative of routine clinical practice for several reasons. First of all, the proficiency specimens for antibody identification were dilutions of sera containing high titers of antibodies, which are different from nondiluted specimens with low antibody titers. Secondly, while laboratories are instructed to handle exercise materials in the same manner as routine clinical samples, this may not occur because the samples and forms are different from those in routine use (13). On several occasions, we had difficulty determining whether the errors were due to technical reasons or to errors involving transposition or inaccurate transcription of results. Despite these limitations, this study provides an approach for monitoring trends and identification of participants that use less than optimal procedures (14).

Pretransfusion test protocols have evolved to prevent hemolytic transfusion reactions and new techniques can help to guarantee the safety of transfusion in the large majority of patients. However, despite technologist training, Immunohematology tests are often conducted in a repetitive but intermittent fashion. We found that a well-organized external proficiency program can contribute to the improvement of quality of testing in

immunohematology. This consequently reduces the potential risk of hemolytic reactions and enhances the quality of patient care.

An external assessment in laboratory performance can help participants to detect potential problems and, when associated with educational activities, can help participants learn to address and resolve problems in immunohematology, thus reducing the risks to patients.

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