

-- Inventory Practice Survey 2003 --

Headline Summary

- During the survey period 61,524 red cell units were issued to the 99 respondent hospitals. 3105 (5% of issues during the survey period) were reported as mismatched to 1028 patients.
- 2164/3105 (69%) red cell units were transfused to 954 patients. 348 patients also received matched units in the same transfusion episode.
- The two most common reasons for mismatching were “insufficient stock available” (57%) and “unit time expiring” (26%).
- 992/3105 (31%) of the mismatched units were O Neg, of which 79% were transfused.
- The highest number of mismatched units was for A Pos patients.
- 21% of mismatches were for AB patients, which is disproportionate to the frequency of group AB in the UK population.

1. Background

Mismatching red cell units can have an impact on the management of the blood inventory for a number of reasons including causing a disproportionate demand pressure on a specific group inventory. This demand pressure can be high, particularly in the case of O Neg, which may lead to supply continuity problems. It may also be low, in the case of group AB, which may lead to underuse and waste of the inventory.

Mismatching can also have an impact on the blood transfusion laboratory, the blood group of a patient transfused a high number of mismatched units may not match the historical group, this may cause problems particularly if the transfusion staff are unaware that the patient has received mismatched units.

In 1999, under the auspices of the Blood Stocks Project, a survey was conducted in a few participating hospitals to ascertain the level of mismatching of donor against patient group. The results of the survey showed a high level of O Neg mismatching, which it was felt may have had an impact on NBS O Neg stock levels. The results were never published.

The BSMS steering group decided to carry out another mismatch survey covering more participants to determine:

- the level of O Neg mismatching
- the level of mismatching by patient and donor group
- the reasons for mismatching

The survey took place between 17 February and 14 March 2003. Participation was voluntary and 99 hospitals returned surveys, accounting for 44.6% of total NBS red cell issues during the survey period.

1028 patients were crossmatched with 3105 mismatched units. Of these, 954 patients were transfused with 2164 mismatched units. 348/954 (36%) were also transfused with matched units in the same transfusion episode.

2. Mismatch Reasons

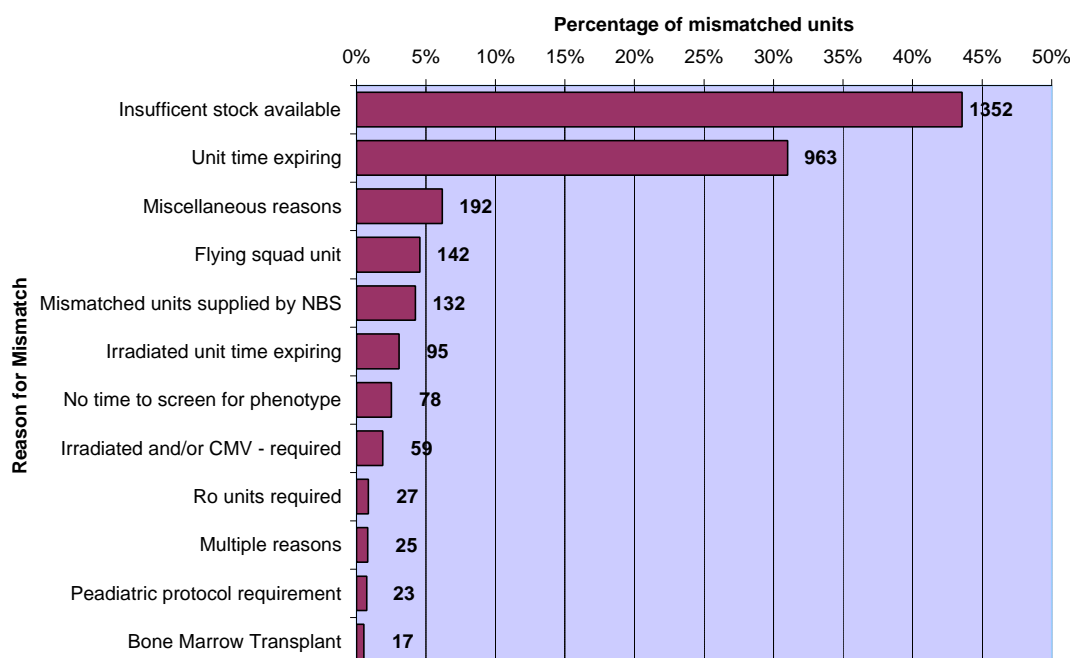
343 units (11%) were mismatched for a reason other than those specified in the survey. Where appropriate these mismatches were grouped together giving five further reasons not originally specified. A comprehensive list of reasons with descriptions is given below (Table 1).

Table 1. Mismatch categories with descriptions

Reason for mismatch	Description
Insufficient stock available	Insufficient time to obtain stock from NBS
No time to screen for phenotype	Urgent request, insufficient time to wait for the NBS to supply
Mismatched units supplied by NBS	Request for unit from NBS received as an ABO Rh mismatch
Unit time expiring	Unit approaching expiry date
Irradiated unit time expiring	Irradiated unit approaching the expiry date
Flying squad unit	Unit for use uncrossmatched in an emergency
Irradiated and/or CMV - required	Hospital protocol necessitates use
Pediatric protocol requirement	Hospital protocol necessitates use
Bone Marrow Transplant	Hospital protocol necessitates use
Multiple reasons	More than one reason given
R ₀ units required	Specific R ₀ units unavailable
Miscellaneous reasons	Not able to assign to a category

43% of all mismatches were because of “insufficient stock available” and 31% because of “unit time expiring” (Fig 1).

Fig. 1. Number and percentage of mismatched units by reason
The number shown to the right of each bar is the total number of mismatches reported for the associated reason.



3. Mismatched Crossmatches

3.1 Mismatch pathway

Table 2 shows the donor blood group and the number of mismatched units for each patient blood group.

Table 2. Mismatching by patient against donor group.
The highest number of mismatches are highlighted in red. Incompatible crossmatches are shaded in grey.

		Patient Group								Totals
		O Pos	O Neg	A Pos	A Neg	B Pos	B Neg	AB Pos	AB Neg	
Donor Group	O Pos		167	113	6	310	0	2	0	598
	O Neg	549		111	97	44	184	5	2	992
	A Pos				42			300	1	343
	A Neg			459				5	131	595
	B Pos						19	60	0	79
	B Neg					320		19	4	343
	AB Pos								0	0
	AB Neg							155		155
	Totals	549	167	683	145	674	203	546	138	3105

3.1.1 A Pos patients

67% of mismatched units for A Pos patients were A Neg, of these 70% were mismatched because the unit was time expiring. 16% of the mismatched units were O Pos, of these 18% were mismatched because they were supplied as mismatched by the NBS.

3.1.2 B Pos patients

46% of mismatched units for B Pos patients were O Pos, of these 74 % were mismatched because of insufficient stock available. 47% of mismatched units were B Neg, of these 43% were mismatched because insufficient stock was available and 48% because the B Neg unit was time expiring.

3.1.3 AB Pos patients

55% of mismatched units for AB Pos patients were A Pos and 28% AB Neg. 69% of the mismatched units were because insufficient AB Pos stock was available.

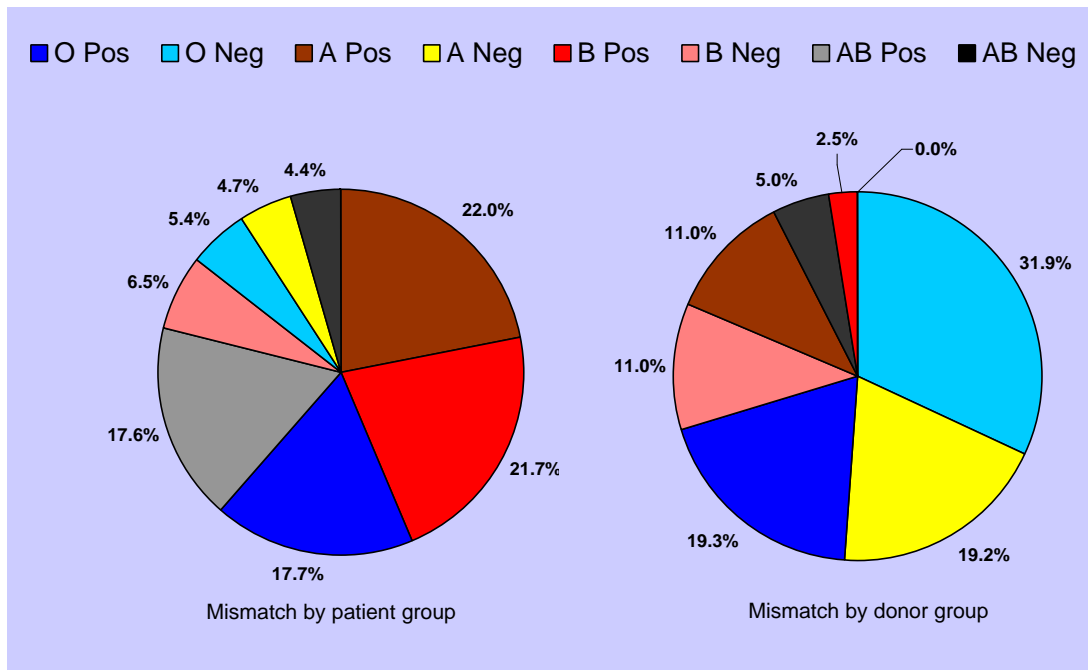
3.1.4 AB Neg patients

92% of the mismatched units for AB Neg patients were because insufficient AB Neg stock was available.

3.2 Mismatches by patient and donor group

Percentage mismatches by patient and donor groups are shown in Fig 2.

Fig. 2. Percentage mismatch by patient group and donor group



3.2.1 Mismatches by patient group

Units were most frequently mismatched for A Pos (22.0%) and B Pos (21.7%) patients.

3.2.2 Mismatches by donor group

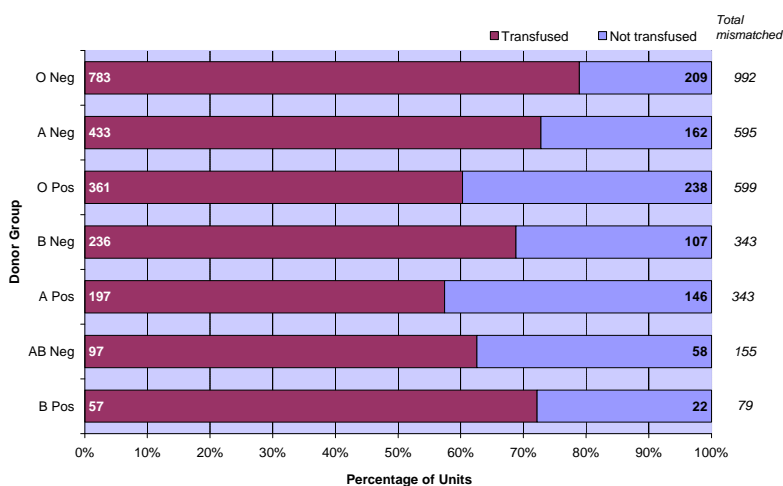
O Neg (31.9%), O Pos (19.3%) and A Neg (19.2%) were the most frequently mismatched donor group.

4. Mismatched Units Transfused

4.1 Analysis by Donor Group

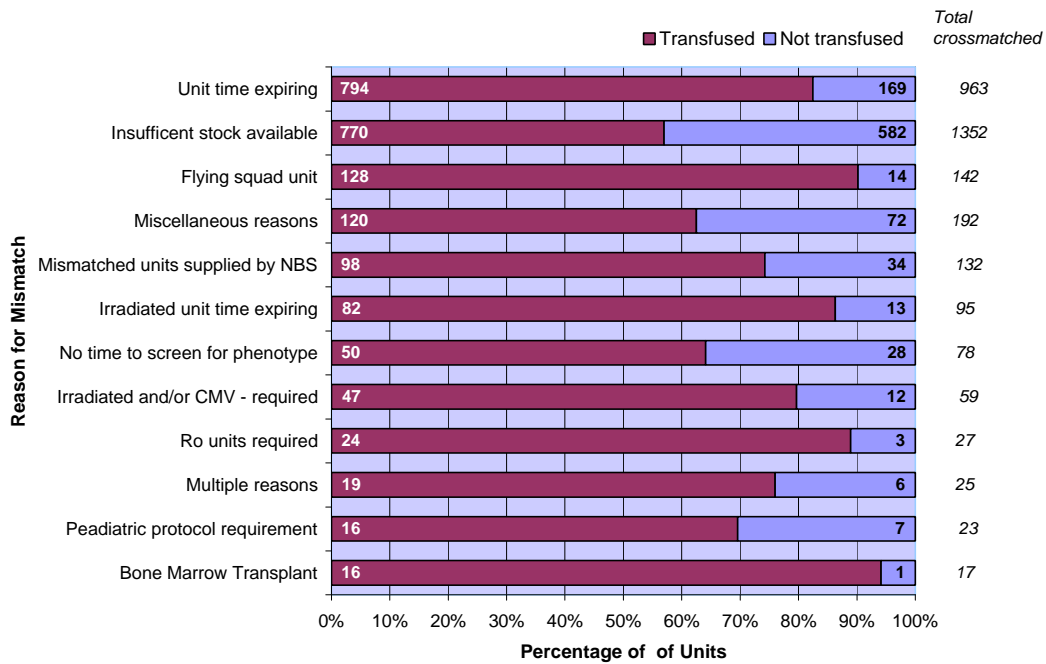
79% of the mismatched O Neg units, 73% of the mismatched A Neg units and, 60% of the mismatched O Pos units were transfused (Fig 3).

Fig. 3. Number and percentage of units mismatched, crossmatched & transfused by donor group



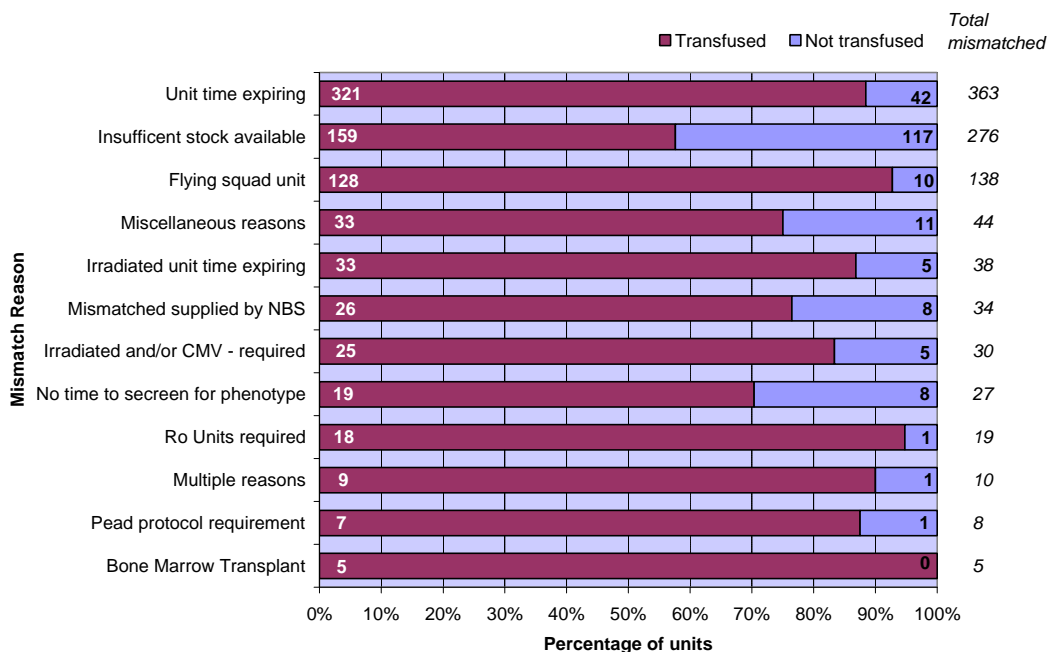
69% of all mismatches were transfused. 82% of units mismatched because of "unit time expiring" and 57% of units mismatched because of "insufficient stock available" were transfused (Fig 4).

Fig. 4. Number and percentage of mismatched units crossmatched, transfused, and not transfused by reason



93% of O Neg mismatched flying squad units and 88% of O Neg mismatched "time expiring" units were transfused. Only 57% of O Neg units mismatched because of "insufficient stock available" were transfused (Fig 5).

Fig. 5. Number and percentage of mismatched O Neg units crossmatched, transfused, and not transfused by reason



52% of O Pos mismatched units were transfused because there was “insufficient stock available.” 56% of A Neg mismatched units were transfused because the unit was time expiring.

4.2 Analysis by Patient Group.

The highest number of mismatched units transfused were to A Pos (527), O Pos (477), and B Pos (441) patients (Fig 6). 90% of mismatches for A Pos patients, 96% of mismatches for O Pos patients and 92% of mismatches for B Pos patients were transfused.

Fig. 6. Number and percentage of mismatched units crossmatched, transfused, and not transfused by patient blood group

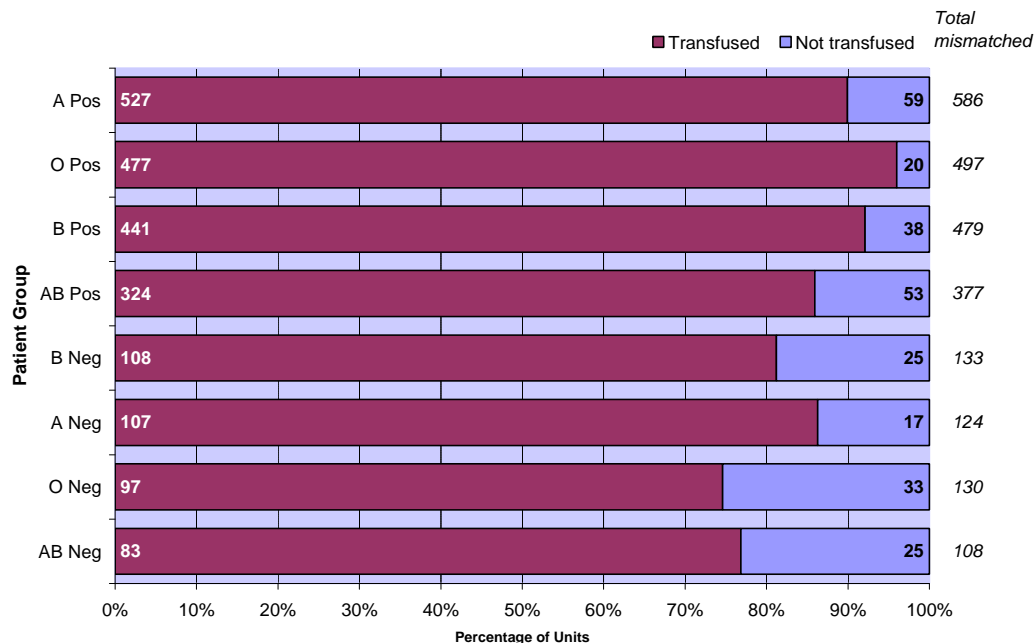


Table 3 shows mismatches by reason and patient group. Over 50% of A Pos and O Pos patients were mismatched and transfused because the donor unit was time expiring. 63% of AB Pos units were mismatched and transfused because there was “insufficient stock available”.

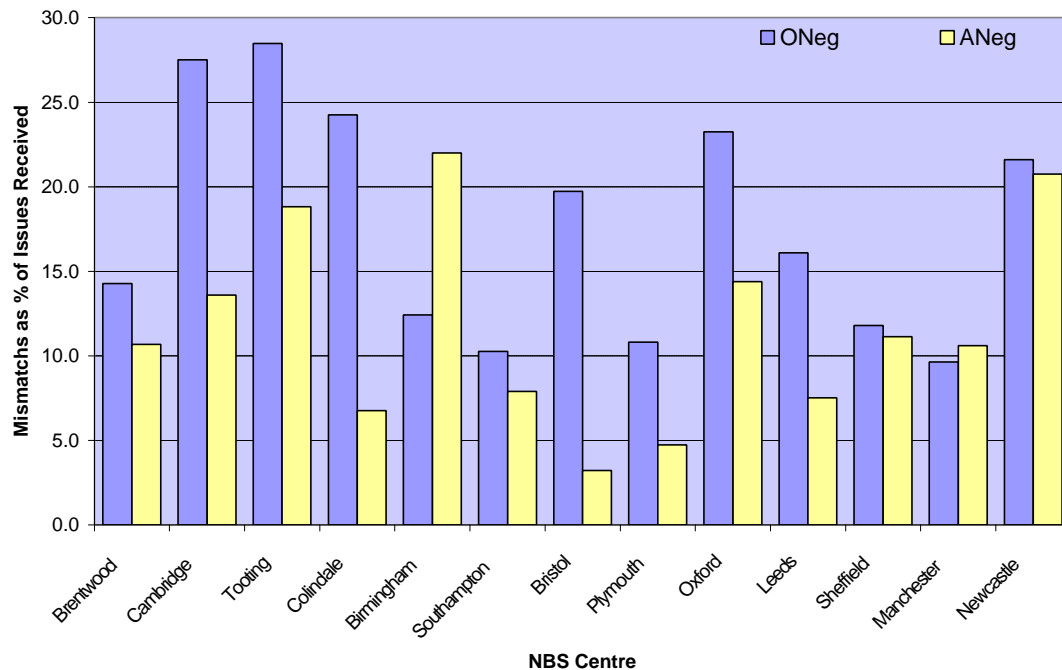
Table 3. Total number of mismatched units transfused by patient group and reason
The highest number of mismatches are highlighted in red.

Mismatch Reason	Patient group							
	O Pos	O Neg	A Pos	A Neg	B Pos	B Neg	AB Pos	AB Neg
Insufficient stock available	29	51	34	68	223	85	205	75
No time to screen for phenotype	14	0	13	0	15	0	8	0
Mismatched units supplied by NBS	11	0	41	1	26	4	7	8
Unit time expiring	273	22	273	19	119	11	77	0
Irradiated unit time expiring	33	0	45	0	1	0	3	0
Flying squad unit	39	0	51	19	19	0	0	0
Irradiated and/or CMV - required	21	0	7	0	12	4	3	0
Pead protocol requirement	5	0	8	0	1	0	2	0
Bone Marrow Transplant (BMT)	3	0	13	0	0	0	0	0
Multiple reasons	0	0	6	0	5	0	8	0
R ₀ units required	18	0	2	0	2	0	2	0
Miscellaneous reasons	31	24	34	0	18	4	9	0
Total	477	97	527	107	441	108	324	83

5. Regional Variability

Rh Neg mismatching was analysed by supplying NBS centre and mismatching as a percentage of issues received by the survey hospitals (Fig 7).

Fig. 7. O Neg and A Neg mismatched units as a percentage of issues during the survey period.
(B Neg and AB Neg units were excluded from the chart as their numbers were significantly smaller)



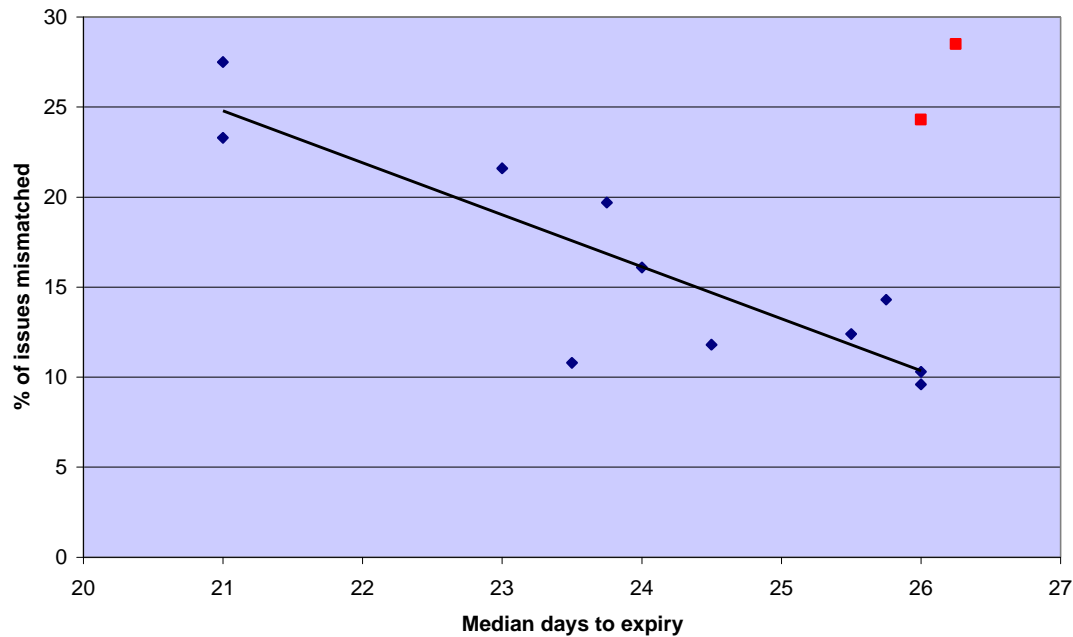
5.1 A Neg donor units

Hospitals with the highest mismatch as a percentage of issues for A Neg (over 20%) were supplied by Birmingham and Newcastle centres. Hospitals supplied by Bristol and Plymouth had the lowest rate (<5%).

5.2 O Neg donor units

Hospitals served by five centres had O Neg mismatch rates of over 20%, compared to hospitals served by a further five centres with O Neg mismatch rates of less than 12.5%. Analysis of the age profile of the O Neg issues showed that there was some evidence to suggest that there was a correlation between age of O Neg at issue and mismatching rates (Fig 8).

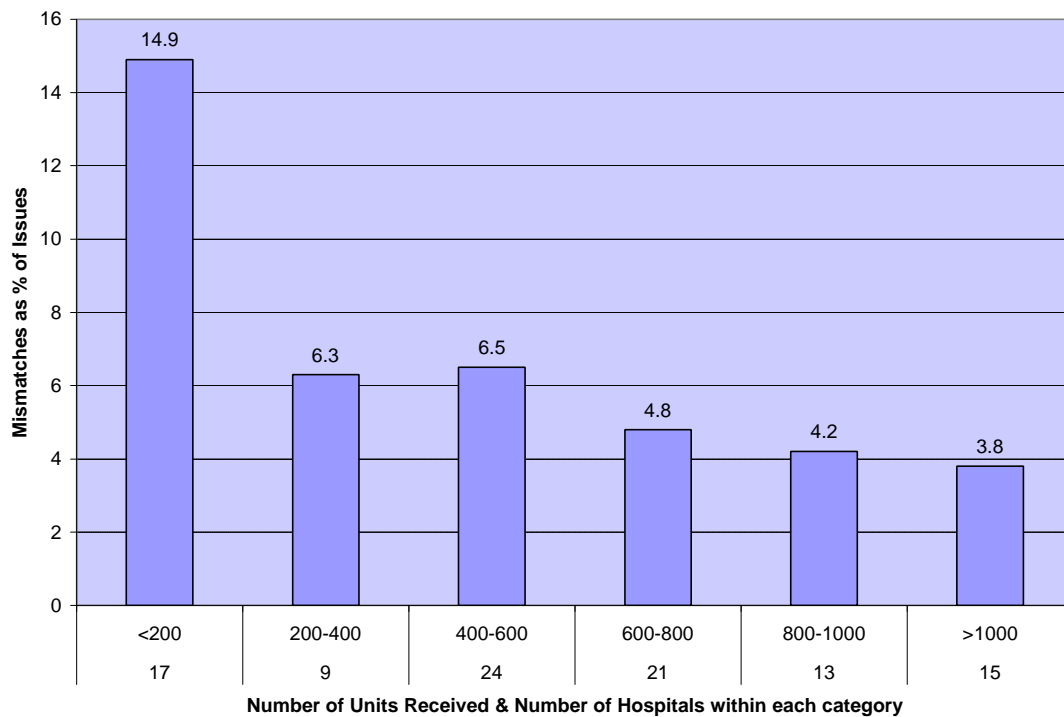
Fig. 8. Relationship between days to expiry at issue and percentage of issues mismatched at respondent hospitals by NBS centre. The linear trend line is shown to highlight the relationship. The two red data have been excluded because they are outliers.



6. User Hospital Profiles

Mismatching as a percentage of issue decreased as the red cell usage rate increased (Fig 9). Low usage hospitals had the highest mismatch rate (14.9%) and hospitals that received over 1000 units during the report period had the lowest mismatch rate (3.8%).

Fig. 9. Mismatches as a percentage of issues during the survey period by usage



6.1 Low usage hospitals

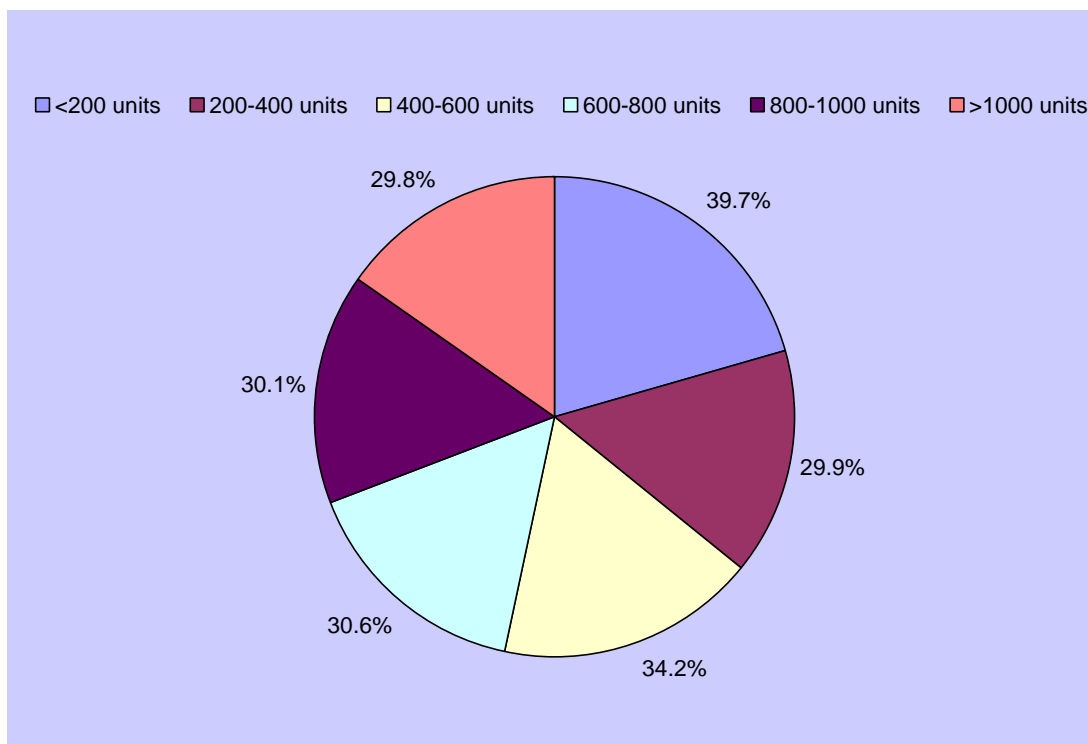
Low usage hospitals (<200 units during survey period) accounted for 7.3% of respondents and had the highest mismatches as a percentage of issues (Fig 9).

Of the 247 units mismatched in low usage hospitals, 140 units (57%) were mismatched because of “unit time expiring” and 92 units (37%) because “insufficient stock was available”.

6.2 O Neg

Analysis of O Neg mismatching showed similar levels throughout all usage categories (Fig 10). However, there was variation in the number of O Neg units received; 40/99 (40%) respondents received over 10% of their red cell stock as O Neg and one respondent received 43.9% of its stock as O Neg.

Fig. 10. Number of O Neg units mismatched as a percentage of issues received.



7. Discussion

3105 mismatched units were crossmatched by 99 hospitals, of these 2164 (69.6%) were transfused. The two most common reasons for mismatching were “insufficient stock available” and “unit time expiring.” The donor group most mismatched was O Neg and 36.6% of O Neg units were mismatched because the unit was “time expiring”. This suggests that hospitals mismatched O Neg units that were time expiring to try to ensure that the unit was not wasted. A Pos patients received the most mismatched red cell transfusions.

7.1 Use of O Neg units for non-O Neg patients

992 O Neg units were mismatched and 783 units (78.9%) were transfused. There was regional variation in the level of O Neg mismatching, which may have been associated with the age at issue of O Neg units. O Neg mismatching was relatively constant throughout all six usage categories. Disregarding mismatching there were differences in O Neg usage between hospitals with only 19/99 (19%) hospitals meeting the NBS guideline target for hospitals to routinely stock no more than 8% of red cells as O Neg (*Stainsby and Murphy*

2003). This suggest that hospitals were overstocking O Neg and then mismatching units approaching time expiry to ensure they were not wasted.

7.2 Group B and AB patients

956 units were mismatched for group B and AB patients. The most common reason for mismatching B and AB patients was "insufficient stock available". This accounted for 69% of all mismatched units received by AB Pos patients, 97% received by AB Neg patients, 56% received by B Pos patients, and 84% received by B Neg patients. In comparison, an average of 34% of group O and A patients were mismatched because of "insufficient stock available". This suggests that mismatching was used as an alternative to maintaining stocks of rarer groups.

BCSH guidelines advise that group AB should be used for AB patients but if unavailable, group A or B rather than group O red cells should be used for blood conservation reasons (BCSH 1996b).

8. Conclusion.

There was extensive use of O Neg mismatching during the survey period. The use of O Neg in emergency situations is understandable, however, during the survey period only 138/992 (14%) O Neg units were mismatched as flying squad units. NBS guidelines on the use of group O Neg red cells identify that even though the NBS has increased its collection of O Neg to 9.95% (UK population varies between 6.7 % and 8.3%), O Neg stock levels remain vulnerable to demand (Stainsby and Murphy 2003). BCSH guidelines state that "red cell components of the same ABO and D group as the patient must be selected whenever possible" (BCSH 1996b). Hospitals should carefully consider:

- the use of O Neg red cells for patients other than O Neg to ensure minimum pressure on the O Neg inventory
- holding an appropriate O Neg inventory level to minimise time expiry mismatching.

The survey suggests that AB patients received mismatched transfusions because hospitals did not hold adequate numbers of group AB units in their inventory. AB units are available from the NBS on a sale or return basis and there are sufficient numbers in the inventory to ensure a continuous supply. Therefore, hospitals should either consider increasing their AB inventory or stocking AB units if they do not already do so.

9. Recommendations.

- O Neg inventory levels should be reviewed and where possible the number of O Neg units held should be reduced. This should minimise the number of mismatches taking place because of "time expiry" and conserve the NBS inventory.
- AB inventory levels should be reviewed and hospitals that do not already stock AB should consider doing so. Where AB units are held in the inventory hospitals should consider increasing their inventory. This should reduce the level of mismatching for AB patients.
- The BSMS should ascertain the total number of crossmatches and transfusions that took place in each hospital in the survey period for further analysis to be carried out.

10. References

Stainsby D and Murphy MF Guidelines for the use of Group O D Negative red cells including contingency planning for large scale emergencies. *NBS 2003*

BCSH (1996b) Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories (1996) *Transfusion Medicine* **6** 273 - 283