TRANSFUSION ERRORS and THEIR PREVENTION

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ACKNOWLEDGEMENT

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  Sunnybrook Hospital, Toronto Canada

DISCLAIMER

- No conflict of interest
- Products shown are given as examples
  - No endorsement

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Background

- Incorrect blood component transfused is the most common event reported to SHOT
  - Stainsby D. ABO incompatible transfusions. Transfusion clinique et biologique 2005;12:385-388.
- The risk of ABO-incompatible transfusion is similar in all jurisdictions, and the risk is likely underestimated:
  - France 1:135,000
  - 8-yr SHOT report 1:100,000
  - Ireland 1: 71,000
  - New York State 1: 38,000
  - Germany 1: 36,000
  - Québec 1: 33,000
  - Aberdeen 1: 27,000

Source: Callum, JL Sunnybrook Hospital, Toronto

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Background

- ABO-incompatible transfusions are the result of errors in the transfusion chain
  - Unacceptable blood bank samples - 1 in 165
  - Wrong blood in tube - 1 in 1986
  - Wrong blood requested - 1 in 346
- 50% of events attributed to multiple errors
- 70% of errors originate on the ‘clinical’ side
- Near-misses are 300-fold more common and represent free lessons in error management

Dzik WH et al. An international study of the performance of sample collection from patients. Vox Sang 2003;85:40-7
Callum JL et al. Reporting of near-miss events for transfusion medicine: improving transfusion safety. Transfusion 2001;41:1204-11
Stainsby D. ABO incompatible transfusions. Transfusion clinique et biologique 2005;

Errors and their prevention

- **Error tracking systems**
- Controlled patient registration
- Computerized physician order entry
- Double grouping
- Transfusion registry
- PPI for samples and pick-up slips
- PPI bedside check
- Bedside Compatibility Test
- Barrier systems for bedside check

Error tracking systems

- Pioneer work of Harold Kaplan, MD
  - Medical Event Reporting System in Transfusion Medicine (MERS-TM)
  - In use in many USA hospitals, Ireland and other hospitals in some countries

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Error tracking systems

- Serious Hazards of Transfusion (SHOT) in UK
  - Tracking incorrect blood component transfused (IBCT) since 1996
- Transfusion Error Surveillance System (TESS) in Canada
  - Tracking all transfusion errors at pilot hospital sites since 2005

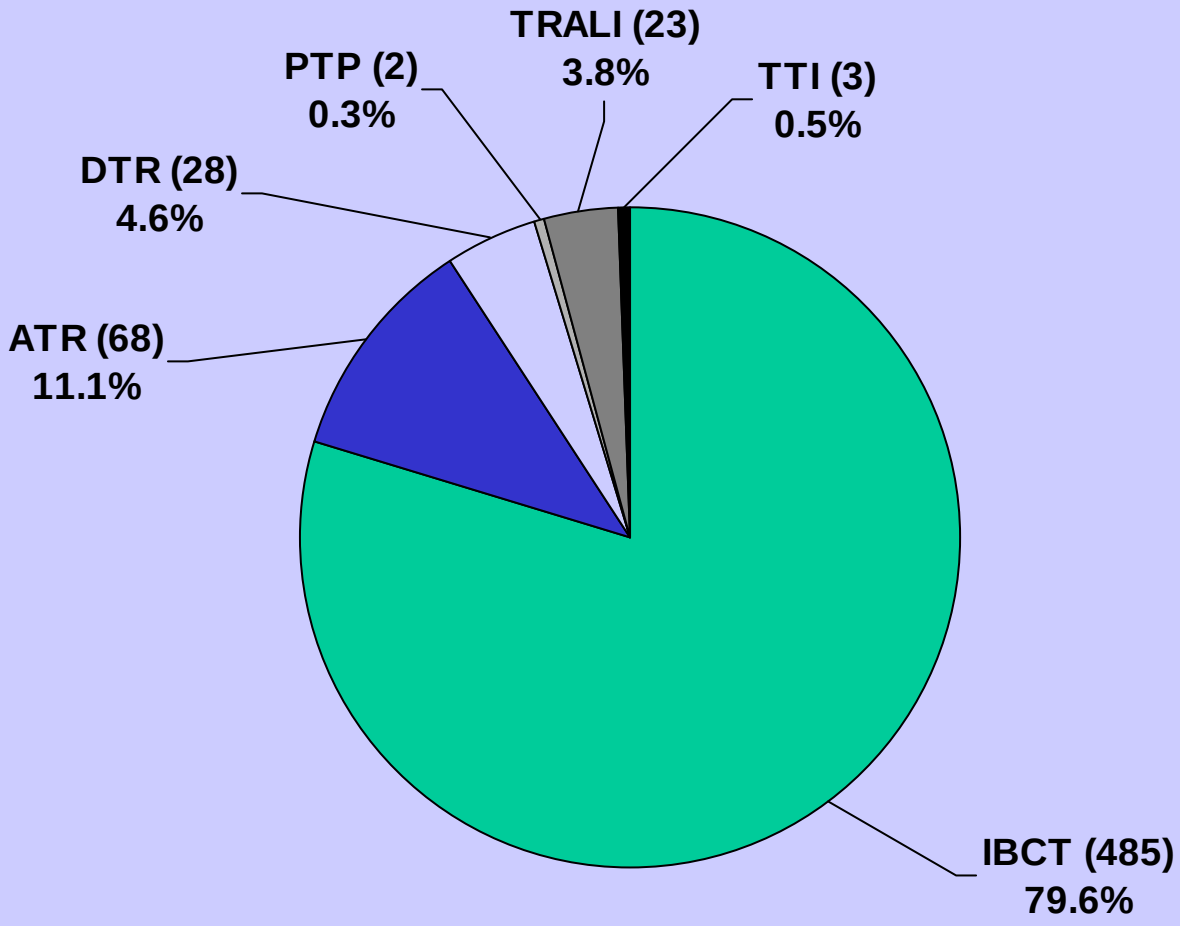
SERIOUS HAZARDS OF TRANSFUSION SHOT

RESULTS FROM THE

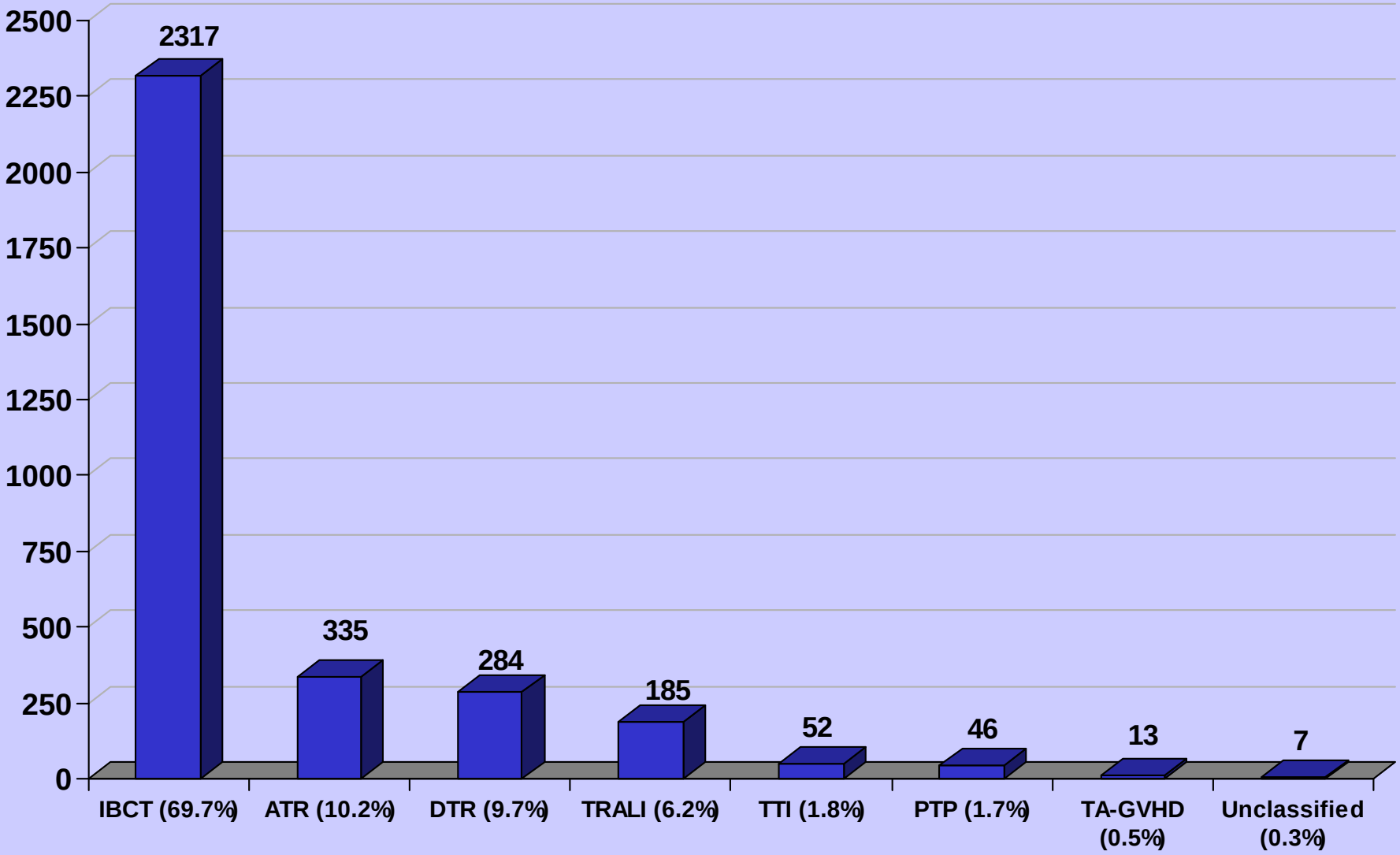
2005

ANNUAL REPORT

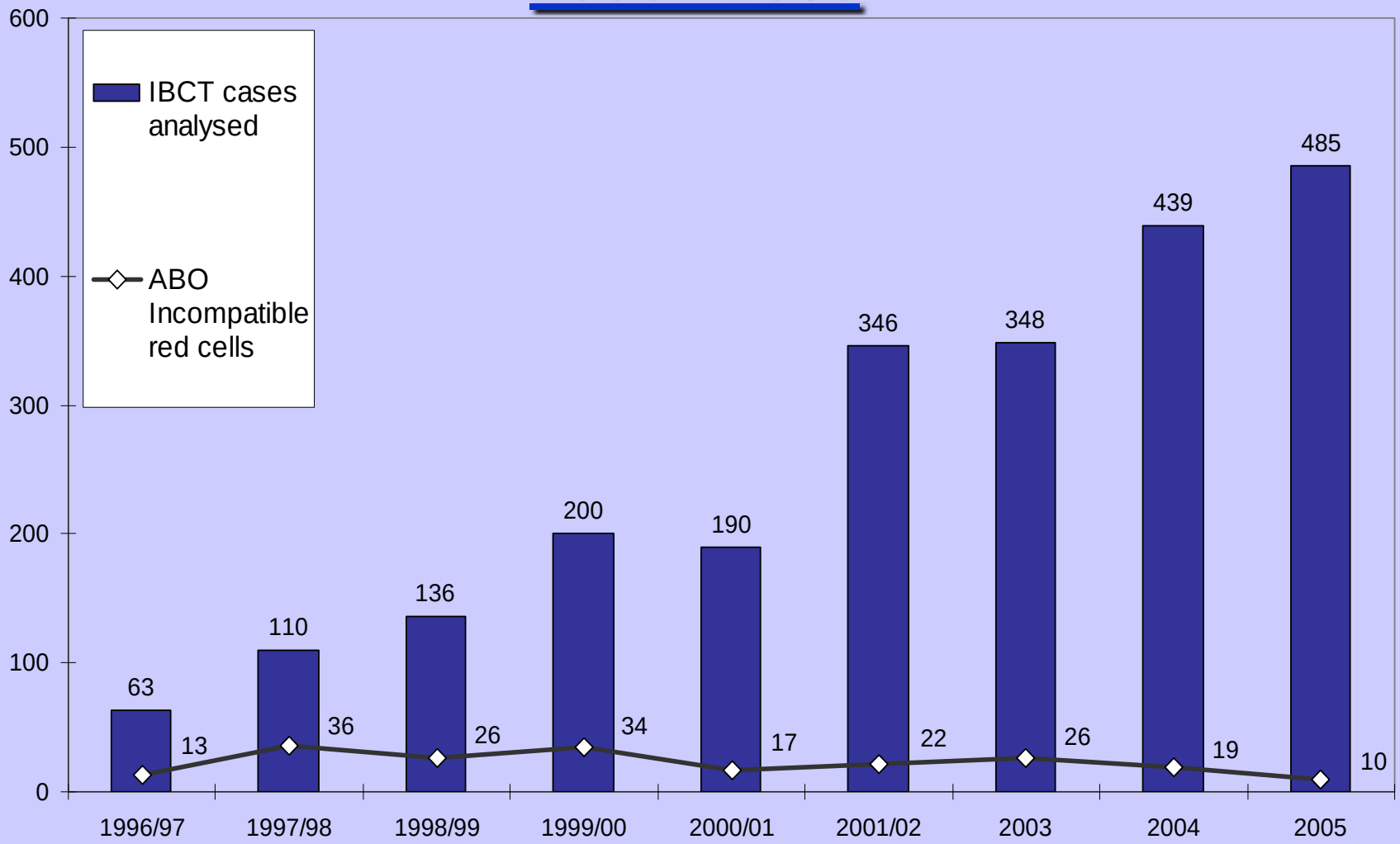
Summary of completed questionnaires (2005)



Questionnaires analysed 1996 - 2005 (n=3239)



ABO incompatible red cell transfusions 1996 - 2005



Cumulative mortality / morbidity data for IBCT cases 1996 - 2005 (n=2317)

Category	No. cases
Death definitely attributed to transfusion (imputability 3)	7
Death probably attributed to transfusion (imputability 2)	3
Death possibly attributed to transfusion (imputability 1)	12
Major morbidity	94
Minor or no morbidity	2190
Unknown outcome	11
Total	**2317**

1%

Analysis of IBCT Cases 2005

Type of Event	Number (%)
'Wrong Blood' events where a patient received a blood component intended for a different patient or of an incorrect group	87 (18%)
Other pre-transfusion testing errors – including incorrect D groups, missed allo-antibodies and missed serological incompatitbility	22 (4.5%)
Blood of the incorrect group given to recipients of ABO mismatched PBSC or one marrow transplant.	2 (0.5%)
Failure to provide blood of appropriate specification or that did not meet the patient's special requirements.	141 (29%)
Inappropriate or unnecessary transfusions.	67 (14%)
'Unsafe' transfusions where there were handling or storge errors.	79 (16%)
Events relating to administration of anti-D immunoglobulin	87 (18%)
Total	**485**

'Wrong Blood' Events - Learning Points (2)

- A final patient identification check must always be carried out before transfusion using the identity band or formally risk assessed alternative attached to the patient.
- Safety systems must be supported by training and education of all staff involved in transfusion, to ensure that correct procedures are followed.
- Routine pre-transfusion testing should not be done outside of core hours unless there are adequate numbers of appropriately skilled staff.
- Administration of blood should only take place at night when clinically essential.

The Canadian Transfusion Error Surveillance System

(TESS)

2005-2006

Background

- TESS is an abbreviated error tracking system designed for non-academic use
  - implement a tool for systematic capture of errors, including near-misses
  - Coding scheme comparable to what will be used in USA biovigilance network

Methods

- Actual event vs. Near-miss

Type	Description
1	Actual – harm
2	Actual – no harm
3	Near-miss – unplanned recovery
4	Near-miss - planned recovery

- Severity

Severity	Description
High	Potential for serious injury or death
Medium	Potential for minor harm
Low	No realistic potential for harm

Results
Classification of hospital size by RBC Utilization

Size	RBC Utilization per year	No.
Small	<2,000 RBC transfusions/year	3
Medium	2,000 – 10,000 RBC transfusions/year	5
Large	>10,000 RBC transfusions/year	3

Results

- 20,979 errors reported from 11 hospitals over 2 years
  - 6.8% with the potential for patient harm (high severity)
  - 0.2% with actual patient harm
  - 74% detected within 48 hours of the error
  - 85% occurred between 08:00-20:00
  - Weekday 31/day vs. weekend 25/day

Actions taken

Action	N
Product retrieved	300
Record corrected	5242
Floor/clinic notified	7051
Additional testing	814
Patient sample recollected	3969
Events with products loss	1650
Other	3451

Products destroyed

	N	$CDN
RBC	1083	348,726
FFP	479	51,253
CRYO	194	18,624
PLT	146	15,476
APH-PLT	27	14,877
CRYO-SUP	47	7,097
Total Components	**1976**	**$456,053**
Plasma derivatives	**379**	**$232,241**
TOTAL	**2355**	**$668,294**

Person Involved in Error

Job Description	N	%
Nurse	9972	47.6
Technologist	7572	36.2
MD	2149	10.3
Clerk	294	1.4
Lab Assistant	283	1.4
Supplier	197	0.9
Supervisor	32	0.2
QA/TSO	7	0.03
Other	436	2.1
TOTAL*	**20,942**	**100%**

*37 (0.2%) not

Type of errors reported

Clinical		N	%
PR	Product/Test Request	1487	7.1
SC	Sample Collection	5444	25.9
SH	Sample Handling	1832	8.7
RP	Request for Pick-up	322	1.5
UT	Unit Transfusion	4292	20.5
MS	Miscellaneous	186	0.9
	Subtotal	**13563**	**64.7**

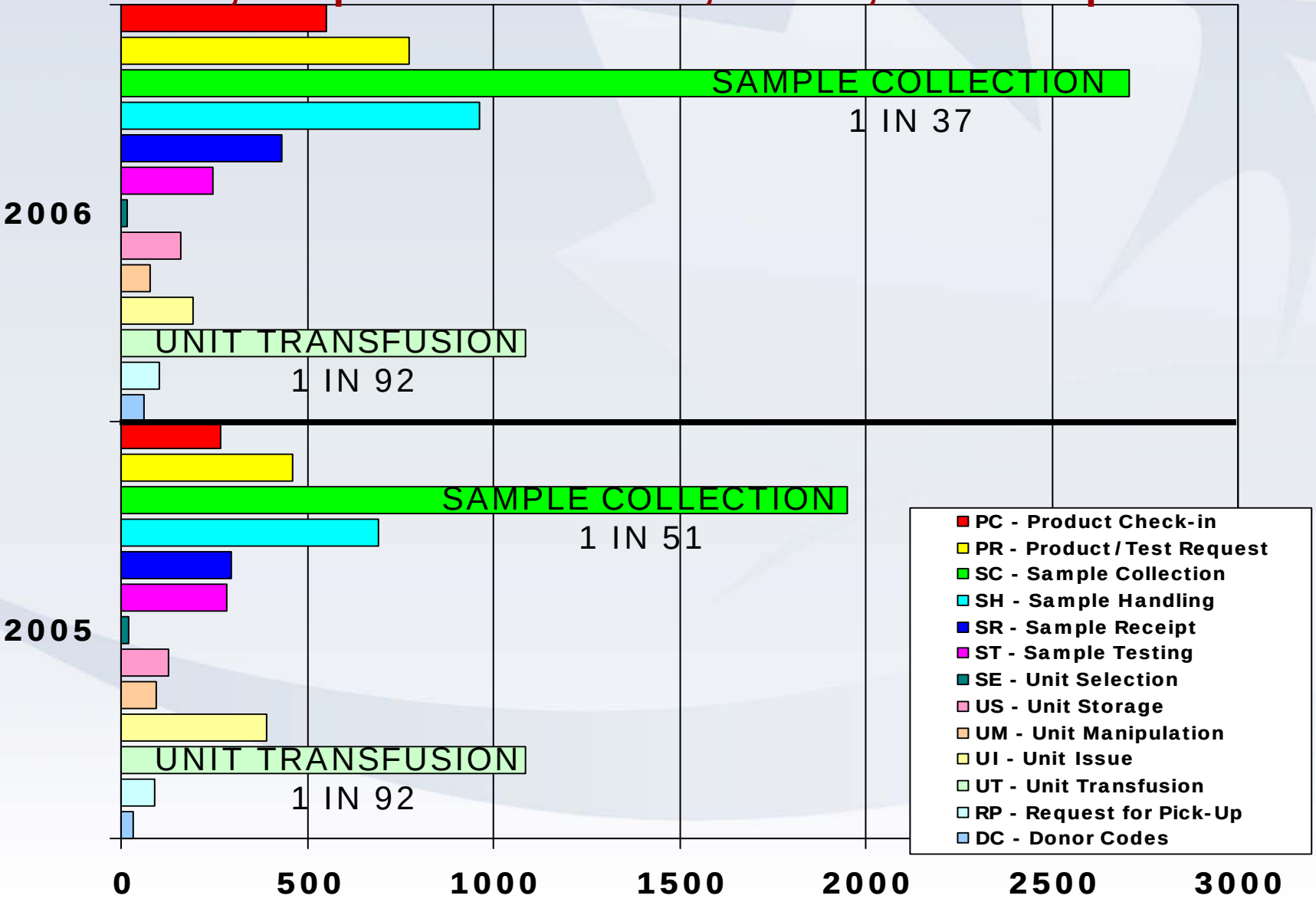
Laboratory		N	%
PC	Product Check-in	1156	5.5
DC	Donor Codes	204	1.0
SR	Sample Receipt	1114	5.3
ST	Sample Testing	2588	12.3
US	Unit Storage	636	3.0
AV	Available for Issue	149	0.7
SE	Unit Selection	79	0.4
UM	Unit Manipulation	355	1.7
UI	Unit Issue	1135	5.4
	Subtotal	**7416**	**35.3**

High Severity Top 5 List

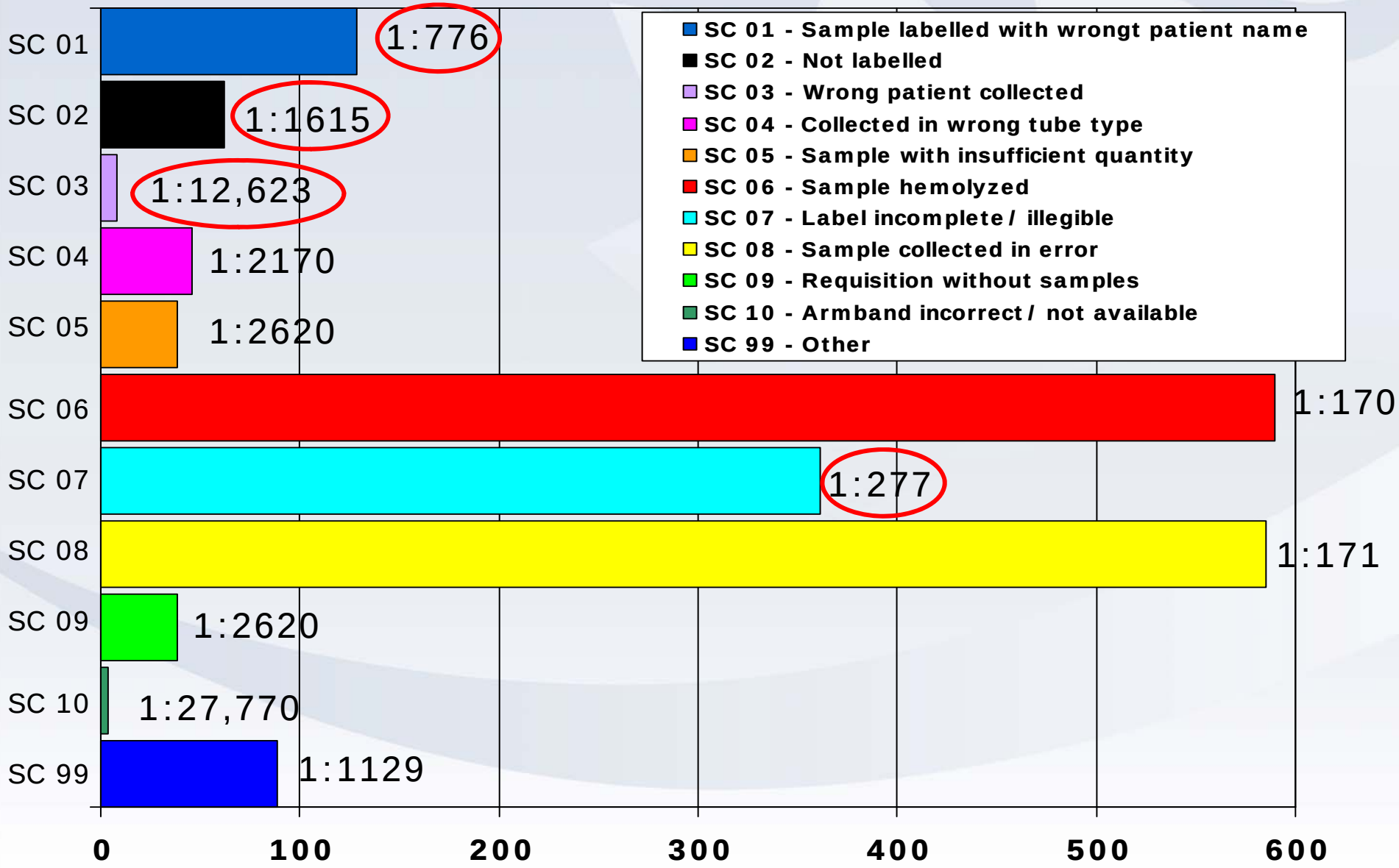
Event Type & Description		N	%
SC 01	Sample labeled with incorrect name	356	26.9
SH 02	Sample label and requisition do not match	216	16.3
SC 02	Sample with no label	181	13.7
SC 07	Other mislabeling	99	7.5
RP 01	Request for pick-up on wrong patient	83	6.3
	Subtotal	**935**	**70.6**

Rates for Event Codes per 100,000

n=436,223 products received; n=986,608 tests performed



Rates for Sample Collection Errors



Error rates by location
Sample Collection

Location	Rate	Denominator
Emergency	1 in 16	14,397
Operating room	1 in 18	749
Intensive care	1 in 29	6,996
Medical/surgical ward	1 in 30	18,740
Out patient procedures	1 in 82	9,054
Obstetrics	1 in 245	10,782
Outpatients	1 in 285	18,250

Denominator – 77,576 of 138,850 (55% of total)

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A case for controlled registration

- Jenny Huang is booked for liver resection in 2 wks
- A request is sent to the blood bank for G & screen
  - Group = A positive
  - Historical group = O positive (2 prior tests in 1984 and 1986 for obstetrical admissions)
  - Repeat group = A positive
- Specific call to the surgeon and the pre-admission centre to re-check identification pre-operatively
- 6 months later – call from medical records regarding a hybrid registration – they need to split a chart into 2

Source: Callum, JL Sunnybrook Hospital, Toronto

Patient Registration

- Processes in place to prevent registration of a patient as someone else
- Screening of patient databases for duplicates and Doppelgangers
  - Harefield Hospital, UK – 39 patients with same first/last name and date of birth
  - 37 duplicates, 1 hybrid, 1 doppelganger
- Process for unidentified patients

Source: Callum, JL Sunnybrook Hospital, Toronto

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A case for computerized POE

- A 45 year old woman day 1 post total knee replacement
- Asymptomatic anemia, hemoglobin 89 g/L
- Physician orders 2 units of blood
- 30 minutes into the first unit the patient develops severe hypoxia requiring mechanical ventilation for TRALI

Source: Callum, JL Sunnybrook Hospital, Toronto

Computerized POE

- Computerized POE reduces serious errors by 50% and all errors by 80%
  - Bates DW et al. J of Amer Med Informatics Association 1999; 6: 313-332
- Structured, legible and traceable communication
- Even better when combined with computer assisted decision support

Source: Callum, JL Sunnybrook Hospital, Toronto

A case for c

Outside guidelines!!

- A 45 year old woman day 2 p al knee replacement
- Asymptomatic anemia, hemoglobin 89 g/L
- Physician orders 2 units of blood
- 30 minutes into the first unit the patient develops severe hypoxia requiring mechanical ventilation for TRALI

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A case for double grouping

- 62 year old male admitted to CCU from the ER
  - For urgent cardiac surgery planned in AM
- Group in the ER = A positive
- Confirmatory group requested from CCU = O positive
- Repeat 3rd group = O positive

Source: Callum, JL Sunnybrook Hospital, Toronto

Double grouping policy

- **Group O**
- **Group A, B, AB & concordant group on file**
  - No confirmatory group required
- **Group A, B, AB – 1st time**
  - If transfusion requested ask for confirmatory sample
  - If no time to repeat group, issue group O blood
  - Requires good communication
  - Don’t accept 2 samples at the same time

Source: Callum, JL Sunnybrook Hospital, Toronto

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EXAMPLE

Positive Impact of Online Inter-Hospital Consultation of Transfusion History on Incidence of Red Cell ABO Mistransfusions, AHTR and DHTR in Québec

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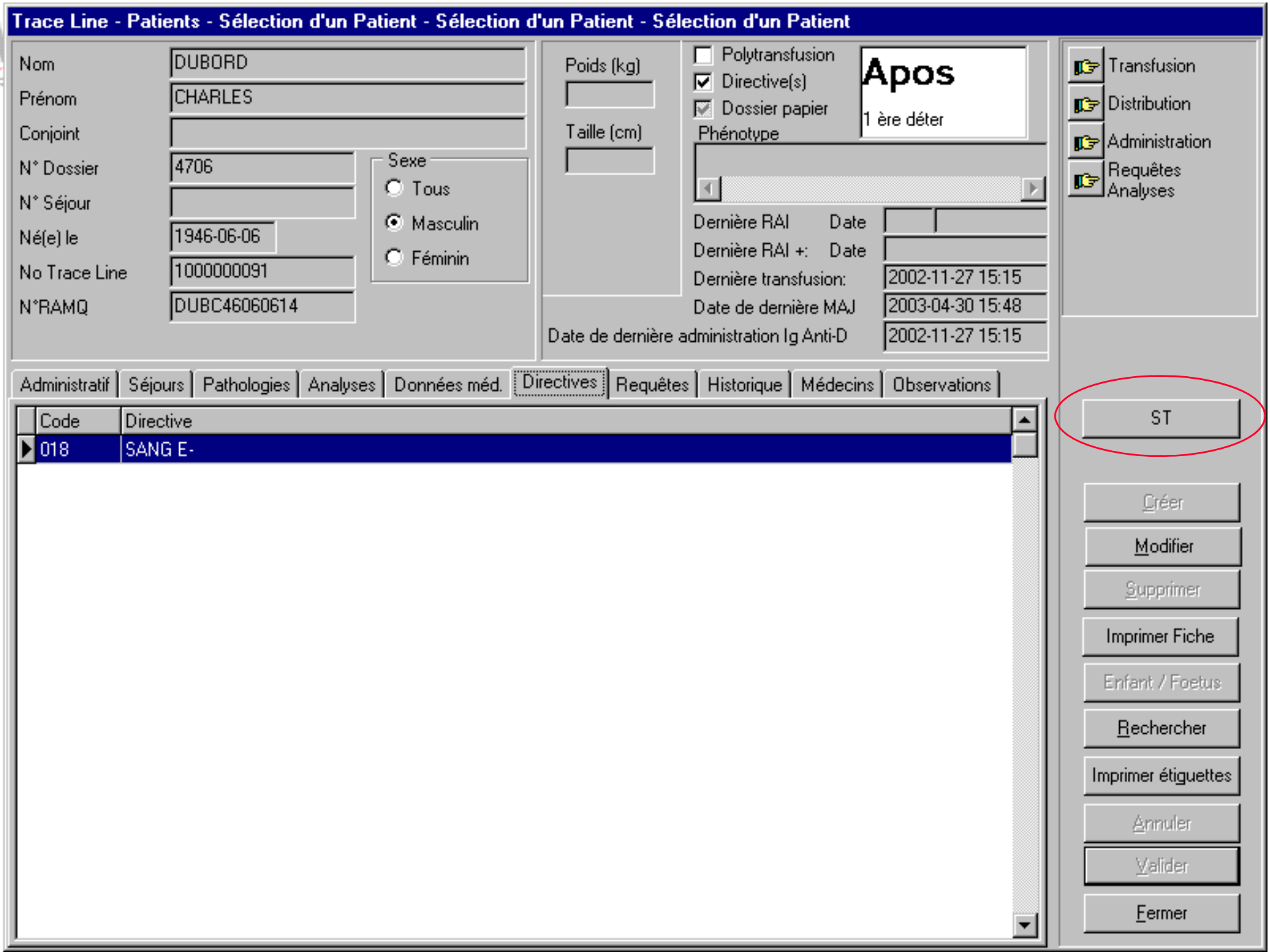
Online transfusion history

- In the period May 2003- Nov. 2005
  - All Québec hospitals were progressively computerized with the same blood bank software

- A query tool was added
  - Each hospital can query the BB database of all other hospitals to see if patient is present
  - If so information will appear on screen:
    - Blood group, irregular antibodies
    - Previous transfusions
    - Previous transfusion reactions, special requirements
  - This information can be compared with current info or test results on patients


Trace Line - Patients - Sélection d'un Patient - Sélection d'un Patient - Sélection d'un Patient
Nom
DUBORD
Prénom
CHARLES
Conjoint
N° Dossier
4706
N° Séjour
Né(e) le
1946-06-06
No Trace Line
1000000091
N°RAMQ
DUBC46060614
Sexe
Tous
Masculin
Féminin
Poids (kg)
Taille (cm)
Polytransfusion
Directive(s)
Dossier papier
Apos
1 ère déter
Phénotype
Dernière RAI
Date
Dernière RAI +:
Date
Dernière transfusion:
2002-11-27 15:15
Date de dernière MAJ
2003-04-30 15:48
Date de dernière administration Ig Anti-D
2002-11-27 15:15
Transfusion
Distribution
Administration
Requêtes Analyses
Administratif
Séjours
Pathologies
Analyses
Données méd.
Directives
Requêtes
Historique
Médecins
Observations
Code
Directive
018
SANG E-
ST
Créer
Modifier
Supprimer
Imprimer Fiche
Enfant / Foetus
Rechercher
Imprimer étiquettes
Annuler
Valider
Fermer

HDN - Sommaire transfusionnel

Usager(s) Trouvé(s)

Nom, prénom	S	NAM	Né(e) le	Nom de la mère, prénom
DUBORD CHARLES	M	DUBC46060614	1946/06/06	DUBORD MARYVONNE

Sélectionez un usager pour obtenir son Sommaire transfusionnel.

HDN - Sommaire transfusionnel

Prénom, Nom	S	NAM	Né(e) le	Prénom de la mère, nom
CHARLES DUBORD	M	DUBC46060614	1946/06/06	MARYVONNE DUBORD

Sommaire des analyses | Produit(s) labile(s) | Produit(s) stable(s)

Centre de soins : FORMATION ENFANT-JESUS — **Dossier numéro :** 4606

Date	ABO/Rh	RAI	Anticorps	Phénotype(s)
2003/04/24	A POSITIF	Positif	Anti-E Anti-K	C+ c+ E- e+ K- k+

Directive(s)	Réac.tr.	IgAnti-D
SANG K- , SANG E-	NON	

Centre de soins : FORMATION ST-JUSTINE — **Dossier numéro :** 4806

Date	ABO/Rh	RAI	Anticorps	Phénotype(s)
2002/11/27	A POSITIF 1ère Déter	Positif	Anti-Jka Anti-K	

Directive(s)	Réac.tr.	IgAnti-D
SANG Jka- , SANG D- , SANG K-	OUI	

Centre de soins : FORMATION ST-SACREMENT — **Dossier numéro :** 4706 — **Décédé(e) le:** 2003/04/27

Date	ABO/Rh	RAI	Anticorps	Phénotype(s)
2002/11/27	A POSITIF 1ère Déter			

Directive(s)	Réac.tr.	IgAnti-D
SANG E-	NON	2002-11-27

SOMMAIRE TRANSFUSIONNEL

SOMMAIRE TRANSFUSIONNEL

Methods

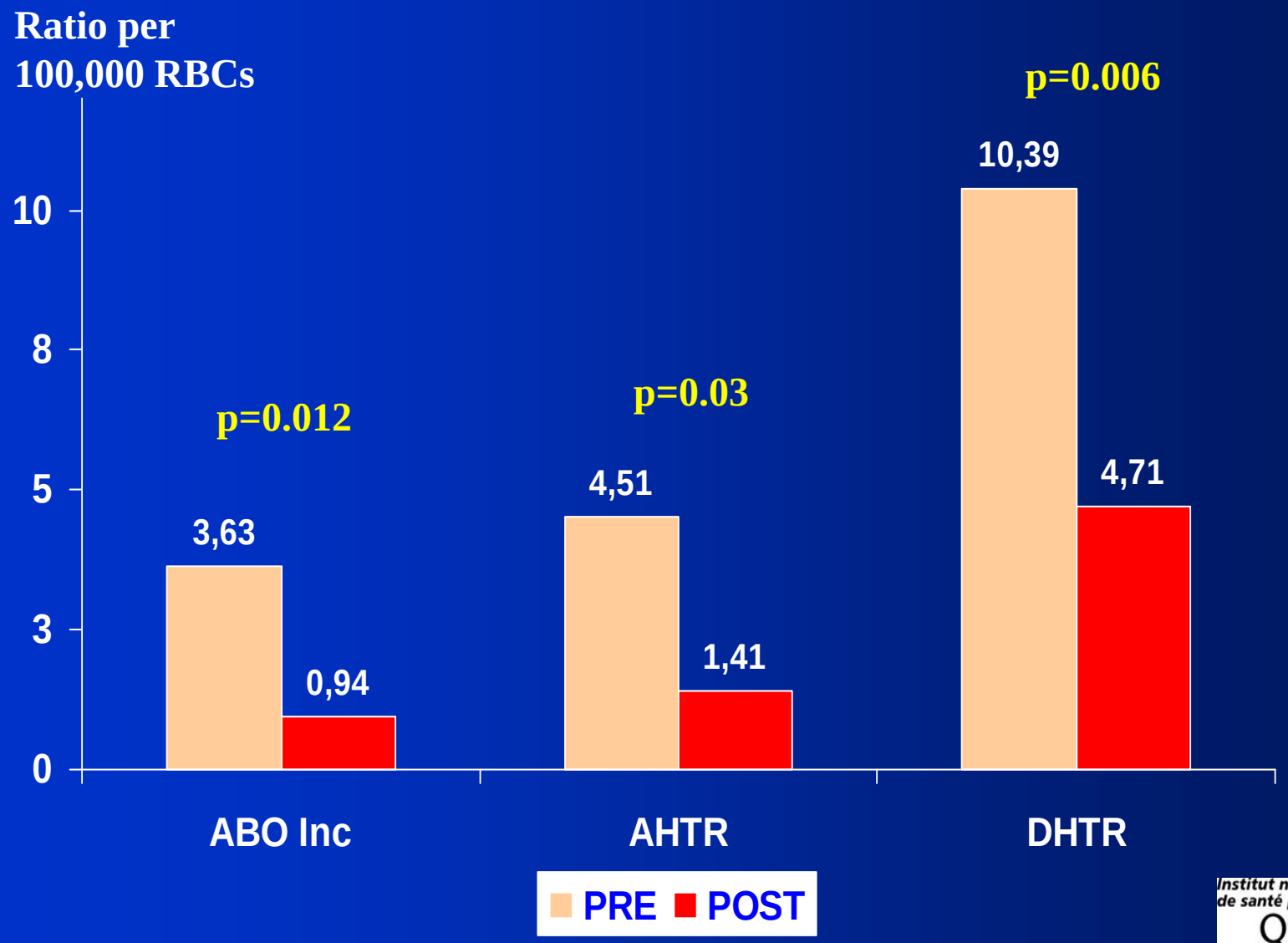
- Each hospital contacted to collect:
  - Exact date when consultation of transfusion history started or
  - Month when started
    - 15th of the month was used

- Pre and post consultation files created
  - Adverse reactions
  - RBC units transfused

Effect of inter-hospital online transfusion history consultation

		ABO-INC	AHTR	DHTR	RBCs transfused
Pre	N	29	36	83	798,521
	ratio	1 : 27,535	1 : 22,181	1 : 9,621	
Post	N	2	3	10	212,104
	ratio	1 : 106,052	1 : 70,701	1 : 21,210	

Effect of inter-hospital online transfusion history consultation



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A case for bedside verification

Question	Baseline	
	Area 1†	Area 2†
Q1. Is the patient wearing a wristband?	117/124 (94)	111/134 (83)
Q2. Can the patient respond verbally and appropriately to questions about his or her identity?	84/124 (68)	78/134 (58)
Q3. Did the staff ask the patient to state his or her first name and surname and check these two data were the same on the wristband?‡	13/84 (15)	14/78 (18)
Q4. Did the staff check the patient's surname and first name were the same on the wristband and on the label attached to the unit by the blood bank?	96/117 (82)	103/111 (93)
Q5. Did the staff check the patient's hospital number was the same on the wristband and on the label attached to the unit by the blood bank?	93/117 (79)	101/111 (91)
Q6. Did the staff check the unit number was the same on the blood bag and on the label attached to the unit by the blood bank?	116/124 (94)	122/134 (91)

Murphy MF, et al. Transfusion 2007; 47: 771-780.

Source: Callum, JL Sunnybrook Hospital, Toronto

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C3-5
Pocket PC
TMC-2
AL.220
0982
13011970
BEWITCHED
Jeannie
13-Jan-1970
F
SUNNYBROOK & WOMEN'S HEALTH SCIENCES CENTRE
BBANK
TUESDAY,
Case#: 7006914
Loc: C3
DOB: 12-12-52
Product: RED CELLS
Patient Group: AB
Donor Group: AB
UNIT # S000123
RHD: NEG
RHD: NEG
has been prepared for
atient.
Date:
CHECK PATIENT AND UNIT I.D.
Complete infusion within four hours.
Compatibility Label
Barcode
RETURN PRODUCT TO BLOOD BANK IF
REACTION IS SUSPECTED.
ATTACH TO BLOOD PRODUCT
BLOOD BANK


Lattice
MediCopia
barcode printing
for
accurate labeling

NEWER WRISTBANDS

Effectiveness of barcode technology

Audit measures: blood sample collection	Manual (n=30)	Barcode (n=30)
Patient asked to state full name	17 (57%)	25 (83%)
Patient asked to state date of birth	15 (50%)	25 (83%)
Patient wearing an ID wristband	3 (10%)	30 (100%)
Patient ID on wristband checked	1/3 (33%)	30 (100%)
Sample tube labeled immediately	28 (93%)	30 (100%)
Patient's DOB entered correctly on the sample tube	29 (97%)	30 (100%)
Patient's gender entered correctly on the sample tube	16 (53%)	30 (100%)

Source: Turner CL, Casbard AC, Murphy MF. Barcode technology: its role in increasing the safety of blood transfusion. Transfusion 2003;43:1200-1209.

Effectiveness of barcode technology

Audit measures: blood administration	Manual (n=51)	Barcode (n=51)
Patient asked to state full name	7 (14%)	51 (100%)
Patient asked to state date of birth	45 (88%)	51 (100%)
Patient wearing an ID wristband	45 (88%)	50 (98%)
Patient ID on wristband cross-referenced with patient-stated ID	0 (0%)	51 (100%)
Expiry date of blood checked	49 (96%)	51 (100%)
Special requirements on the blood pack cross-referenced with any indicated on the transfusion report form	44 (86%)	49 (96%)
Special requirements on the blood pack cross-referenced with any requested on the prescription	5 (10%)	21 (41%)

Source: Turner CL, Casbard AC, Murphy MF. Barcode technology: its role in increasing the safety of blood transfusion. Transfusion 2003;43:1200-1209.

RFID

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BEDSIDE COMPATIBILITY TEST

SAFETY CARD AB

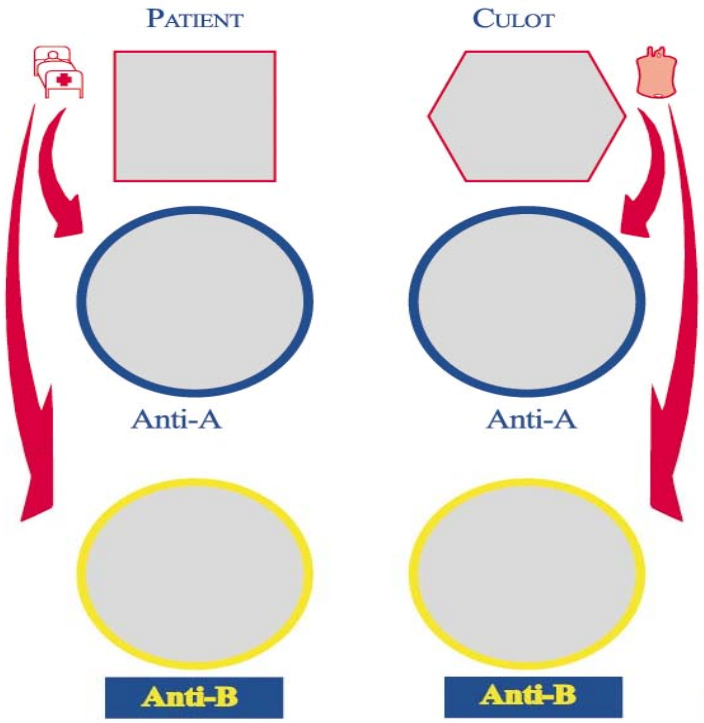
DIAGAST

Patient (Nom & Prénom) :

Culot Globulaire N°:

Nom de jeune fille :

Date de naissance :



Noter avec 1 X la réaction positive sinon noter 0

Patient ⟷ Culot

(se référer à la notice)

1. Déposer 1 goutte de sang du patient dans ☐ et 1 goutte de sang du culot dans ⬡.
2. Déposer 1 goutte de solution saline dans les 4 alvéoles.
3. Prélever et déposer le sang en une seule fois dans chaque alvéole de la même colonne, puis mélanger en évitant toute contamination.
4. Lire les réactions après 1 minute, si une réaction est négative poursuivre **obligatoirement la lecture à 3 minutes**, puis interpréter.

*«Pour un même réactif (même couleur), toute réaction positive avec le culot à transfuser et négative avec le patient **interdit la transfusion**.»*

En cas de doute, contacter le médecin encadrant la transfusion.

Conclusion : transfuser OUI - NON

LOT / ⌛

Réalisé au lit du patient par (Nom) :

Date : **Heure :** **Signature :**

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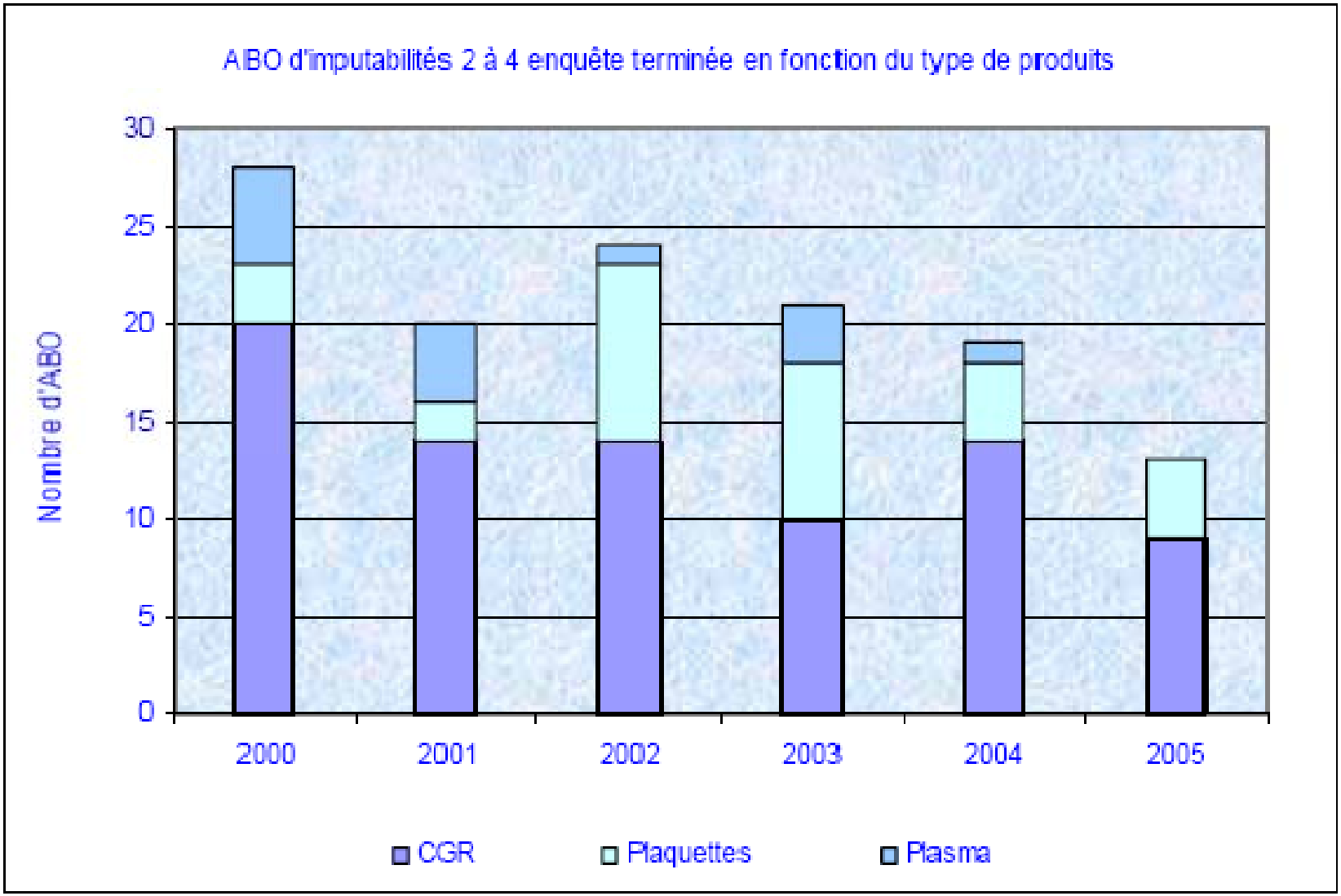

Source: AFSSAPS. Rapport d'hémovigilance 2005.

CAUTION

Bedside test can be source of errors

- 39.8% of pictures of tests interpreted erroneously by a sample of nurses in Grenoble
  - Dujardin PP et al. Errors in interpreting the pretransfusion bedside compatibility test. Vox Sang 2000;78:37-43
- 14.6% of tests performed resulted in error in compatibility interpretation and 17.7% of tests were technically inadequate
  - Ingrand P et al. Reliability of the bedside compatibility test: association with transfusion practice and training. Transfusion 1998;38:1030-1036

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FLAGGING / WARNING

Source: Murphy MF et al. Prevention of bedside errors in transfusion medicine (PROBE-TM) study: a cluster-randomized, matched-paired clinical areas trial of a simple intervention to reduce errors in the pretransfusion bedside check. Transfusion 2007;47:771-780

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FLAGGING DOES NOT WORK

TABLE 6. Summary of correct audits per matched clinical area during the 2-week period immediately after the introduction of the intervention (Weeks 3 and 4) for the single question: "Did the nurse check the wristband against the blood bag label?"

	No extra label			Extra label				
Hospital comparison pair	Number correct	Total	Percent	Number correct	Total	Percent	Difference (%), extra – no extra	95% CI
1	4	4	100	10	10	100	0	–34 to 34
2	0	0		4	4	100		
3	2	2	100	1	1	100	0	–32 to 32
4	5	5	100	5	6	83	0	–21 to 21
5	2	8	25	0	5	0	0	–29 to 29
5 (second set of clinical areas)	3	10	30	2	10	20	0	–19 to 19
6	10	10	100	10	10	100	–10	–34 to 14
7	9	10	90	9	10	90	0	–17 to 17
8	10	10	100	10	10	100	–10	–34 to 14
8 (second set of clinical areas)	10	10	100	10	10	100	0	–17 to 17
8 (third set of clinical areas)	6	8	75	10	10	100	0	–17 to 17
9	10	10	100	9	10	90	–10	–34 to 14
10	7	9	78	9	10	90	–10	–53 to 33
11	10	10	100	10	10	100	–10	–34 to 14
12	6	10	60	7	10	70	–20	–59 to 19
Total	94	116	81	106	126	84	–6	–14 to 2

Source: Murphy MF et al. Prevention of bedside errors in transfusion medicine (PROBE-TM) study: a cluster-randomized, matched-paired clinical areas trial of a simple intervention to reduce errors in the pretransfusion bedside check. Transfusion 2007;47:771-780

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MECHANICAL SYSTEMS

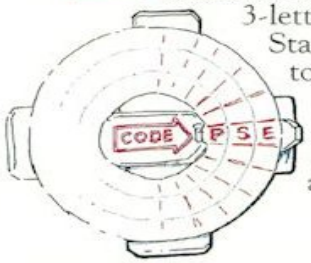
Instructions For Blood Bank

BLOODLOC™ Safety System

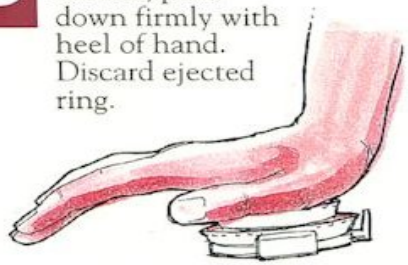
Physical barrier between wrong unit of blood and patient stops accidents

1 In addition to standard identification, specimens received MUST have both a 3-letter code and drawer's initials. Enter the 3-letter code in patient's current blood bank records.

2 To set lock turn dials clockwise to line up 3-letter code. Starting with top dial, line up first letter with point of arrow.

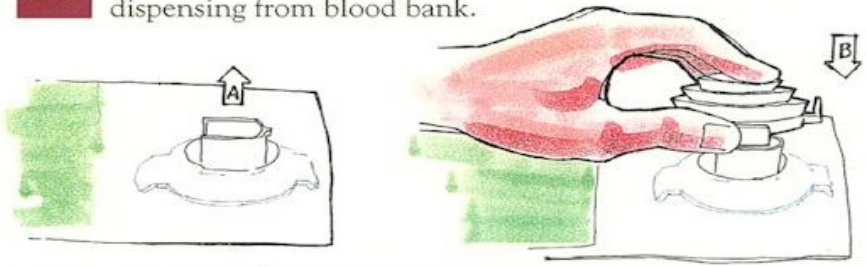


3 On hard level surface, press down firmly with heel of hand. Discard ejected ring.



4 Place crossmatched RBCs in plastic bag.

5 Insert back of lock (A) through hole of plastic bag and press on front(B). Then scramble all three dials before dispensing from blood bank.



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Errors and their prevention

- Error tracking systems
- Controlled patient registration
- Computerized physician order entry
- Double grouping
- Transfusion registry
- PPI for samples and pick-up slips
- PPI bedside check
- Bedside compatibility test
- Barrier systems for bedside check
- Controlled satellite fridges

Controlled satellite fridges

UK – NATIONAL PATIENT SAFETY AGENCY 2004

The NPSA's conclusion from this study, therefore, is that:

a) the use of technology to prevent mismatching is both desirable and achievable;

b) there is not a single technology that meets all the requirements for patient identification and matching with care in the NHS:

- barcoding is currently the best technology for labelling patients and specimens because the technology is readily available, relatively cheap and has a good track record in health care;
- radio tagging (RFID) is a more sophisticated and potentially more powerful technology but is currently relatively expensive, lacks specific standards and may face negative patient perceptions related to fears of covert tracking. However, this is a rapidly developing area;
- biometrics are increasingly used in our lives and because of this the technology may become more generally accepted. Also biometrics uses a unique personal identifier for matching purposes and eliminates one stage at which error can occur, namely that of translating information into a barcode or a radio tag.

c) the appropriate approach may therefore be a mix of technologies; each mix appropriate to the particular circumstances. The mix may change and develop over time with the development of technology and public acceptance.

d) the process for implementing technology needs to be carried out on a well defined and planned basis, taking into account, for example, the area of use, the specific requirements, risk assessment, staff support and training and the involvement of patients.

Blood Safety

- HIV Ab, HIV NAT
- HCV Ab, HCV NAT
- HBsAg, HBcAb
- Syphilis
- HTLV-1/2 Ab
- WNV NAT
- CMV Ab
- Parvovirus B19 (Fractionated only)
- Leukoreduction
- Dual arm cleansing
- Diversion pouch
- Bacterial culture

- Chagas' testing
- Solvent detergent treated pooled plasma
- Pathogen inactivated platelets
- Male only plasma for transfusion
- Male only PLT for transfusion….
- Pathogen inactivated whole blood…

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CONCLUSION

- INVEST IN TRANSFUSION SAFETY AT THE HOSPITAL

- GET ELECTRONIC

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