

Blood recipients : another point of view

Analysis of data from 5463 patients transfused during 2011

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Introduction

- Most blood banks dispose now on information systems that can easily and quickly provide a lot of information about transfused patients.
- That is what we did for all patients transfused during 2011 in the Liège area.
- This allowed us to better define the profile of the blood receivers' population.
- Such information may be useful not only as « *quality indicators* » for hemovigilance, but also to become aware of some truth and to draw lessons for the future.

Patients et methods

- Series N°1 : 5463 patients transfused at Liège (blood bank of the CHU) during 2011 with more than 25.000 blood units.
- Patients' distribution :
 - 2412 patients CHU
 - 3051 patients from 8 other clinics in the same geographical area
- For some comparisons, a series N°2 : 1700 patients transfused in Brussels (ULB blood bank)

We thank Dr Micheline LAMBERMONT (ULB) for providing Brussels' data.

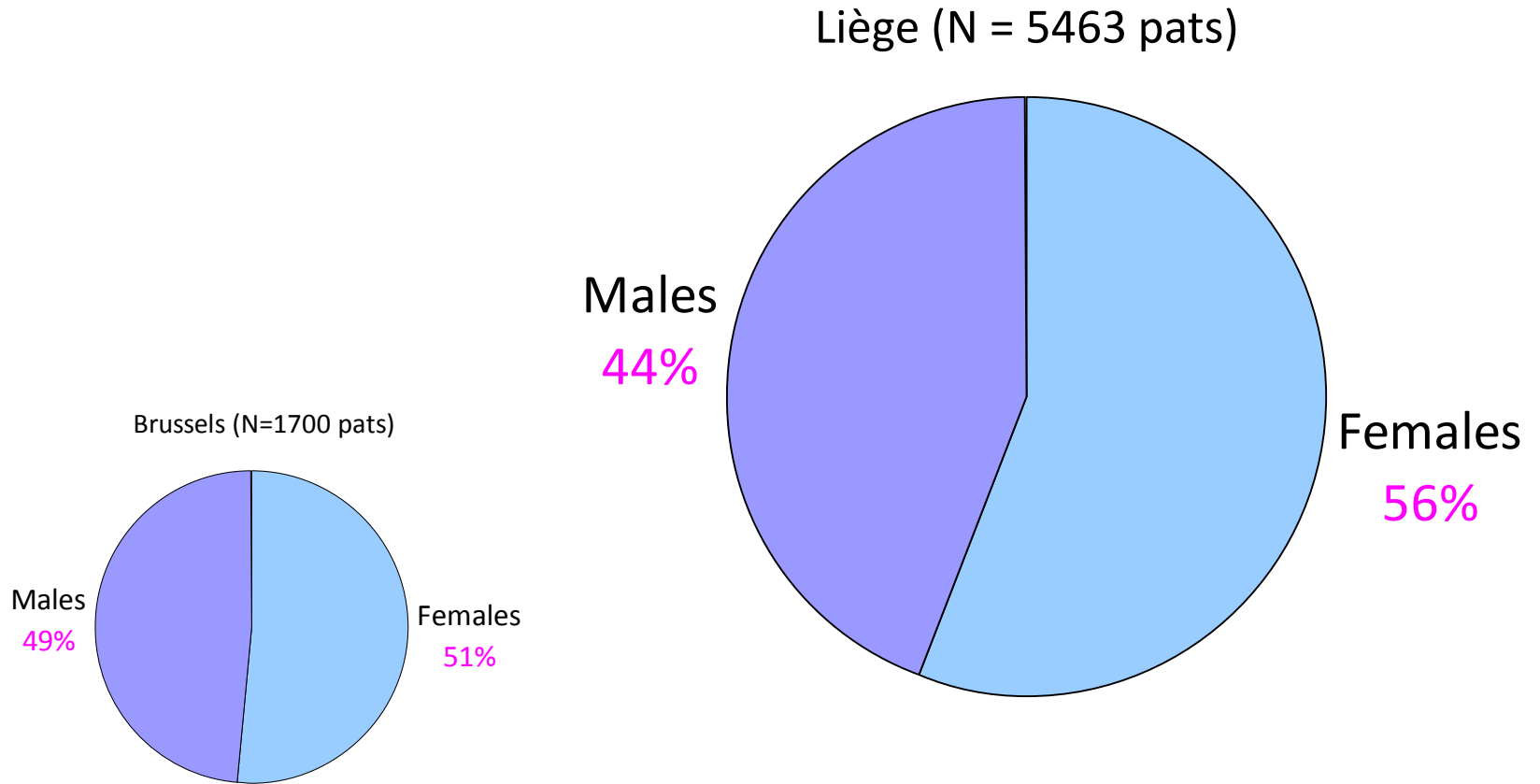
Methods

- ABO blood group (+RHK)
- Screening for Irregular Antibodies
 - Series N°1
 - Immuno-capture (Immucor) : Liège
 - Gel filtration (Bio-Rad) : Liège
 - Series N°2
 - Autovue - microcolumn agglutination (Ortho) : Bruxelles
- Identification of antibody specificity : commercial panels (Bio-Rad, Immucor, Ortho)

Analyzed parameters

- Age
- Gender
- ABOD blood group + (RH K phenotype)
- Presence of an allo-immunization
- Number of antibodies
- Antibody specificities
- Number of blood units transfused

Series : composition



About allo-immunization ...

- Sometimes alloimmunization may be a major problem for blood bankers in term of bood supply
- It is variable from one individual to another and depends on several factors :
 - *Immunological factors proper to the recipient*
 - *Factors related to the polymorphism of human blood groups*
 - *Other factors such as pathologies*

About allo-immunization ...

- Frequency of allo-immunization :
 - In the general population ⁽¹⁾ : 1-5 % immunisation
 - Surgical patients ⁽²⁾ : 8 %

- Factors related to pathology :
 - Thalassemic patients ⁽³⁾ : 5 % - 21 %
 - Sickle cell anemia ⁽⁴⁾ : 6 % - 35 % (25% median)
 - Auto-Immune Hemolytic Anemia ⁽⁵⁾ : 32 % - 75 %
 - Inflammation, diabetes mellitus, ... ?

(1) Higgins et al. Blood; 2008: 2546-53.

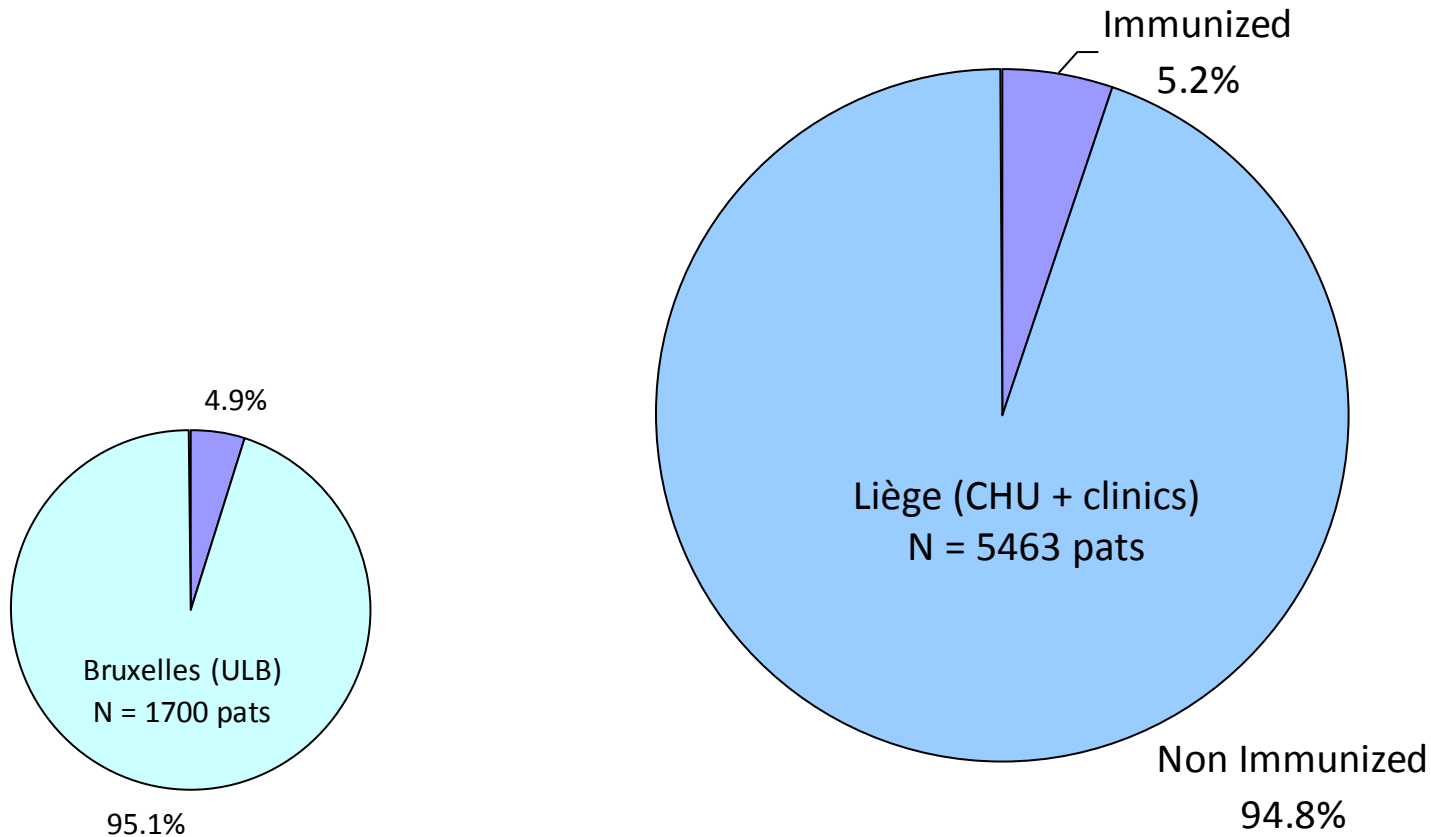
(2) Redman M. et al. Vox Sanguinis; 196; 216-20.

(3) Sirchia G. et al. Transfusion 1985; 25:110-2.

(4) Vichinsky EP et al. N Engl J Med 1990;322:1617-21.

(5) Petz LD. Et al. Immune Hemolytic Anemia; 2004.

Proportion of immunized patients



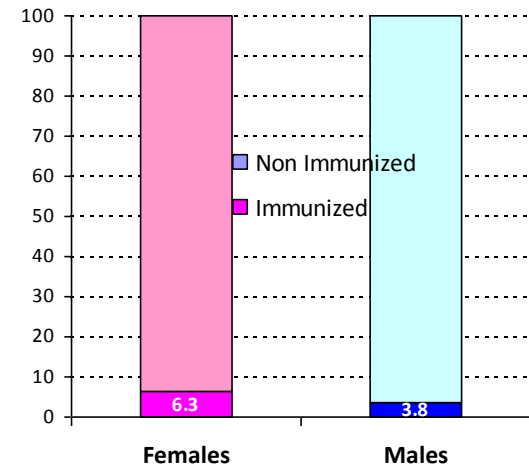
No difference between Liège and Brussels

Prop. of immunized patients / gender

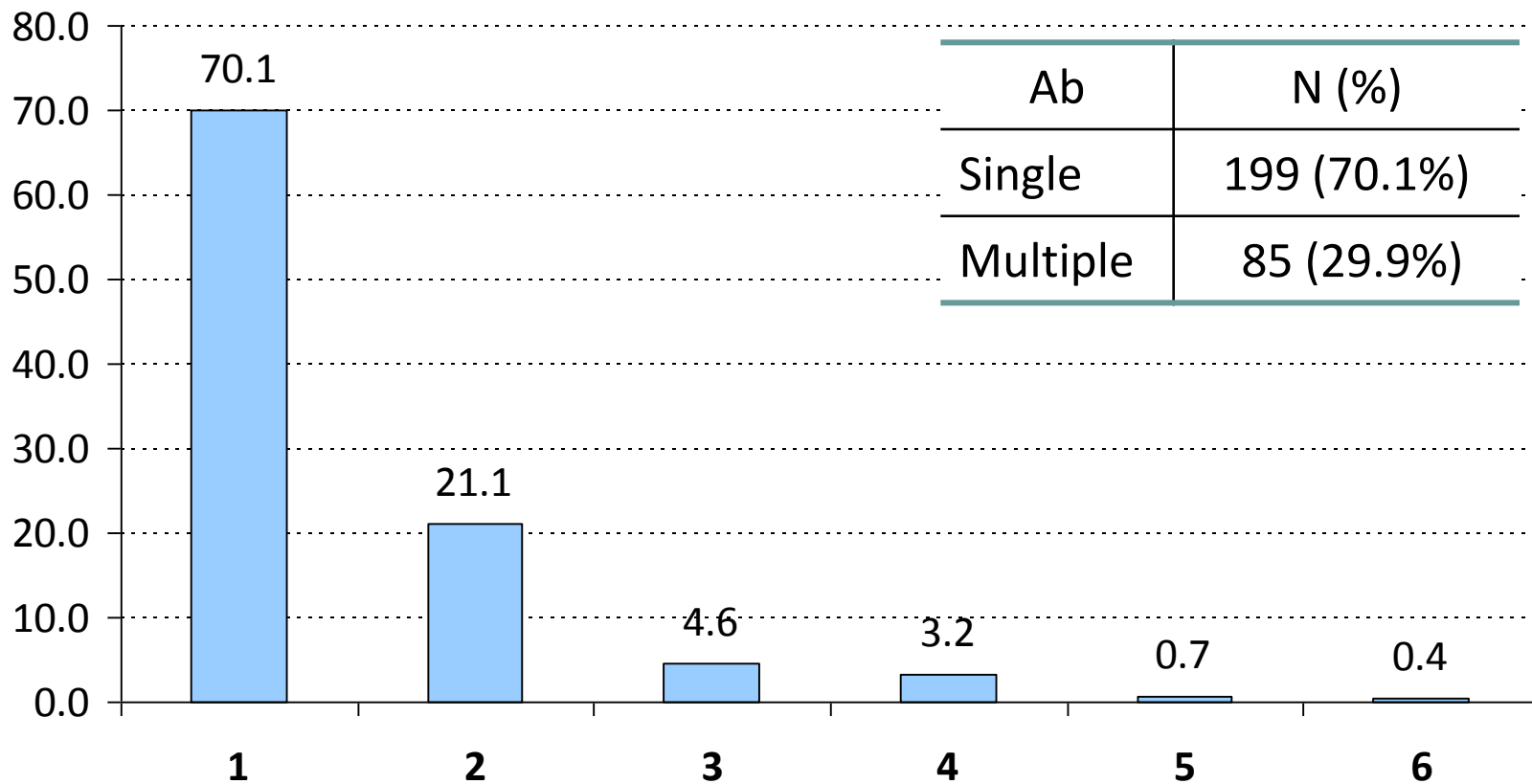
	Immunized	Non Immunized	Total	P
Females	191	2852	3043	<0.0001
Males	93	2327	2420	
Total	284	5179	5463	

- Globally = 5.2% immunized patients
- % immunized Males = 3.8%
- % immunization Females = 6.3 %

→ Females are 5* more immunized than males



Nb Ab / patient



Ab	N (%)
Single	199 (70.1%)
Multiple	85 (29.9%)

Single / multiple antibodies

	N pat.	Single (%)	Multiple (%)	p (Chi ²)
Liège	284	70.1	29.9	
Brussels	84	78.6	21.4	NS
Malaysia ⁽¹⁾	65	76.9	23.1	NS
France ⁽²⁾	1575	86.9	13.1	S*
USA ⁽³⁾	4700	69.3	30.7	NS
USA ⁽⁴⁾	5126	76.8	23.2	NS

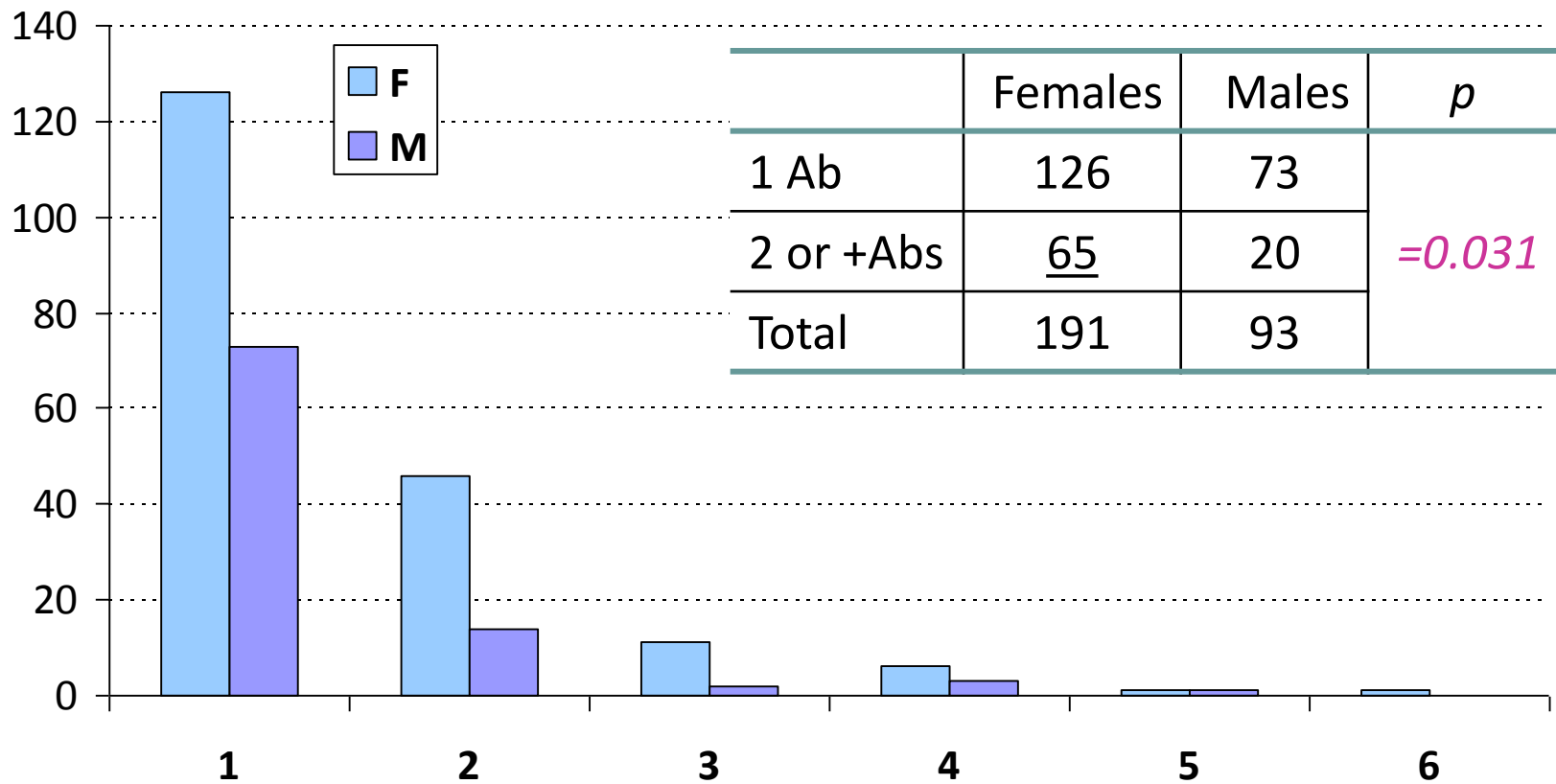
1) Fawaz Al-Joudi et al. *Asian J Transfus Sci.* 2011; 5(1):42-45.

2) Duboeuf S et al. *TRACLI* 2012; (19):358-65.

3) Hoeltge GA et al. *Arch Pathol Lab med* 1995;119(1):42-5.

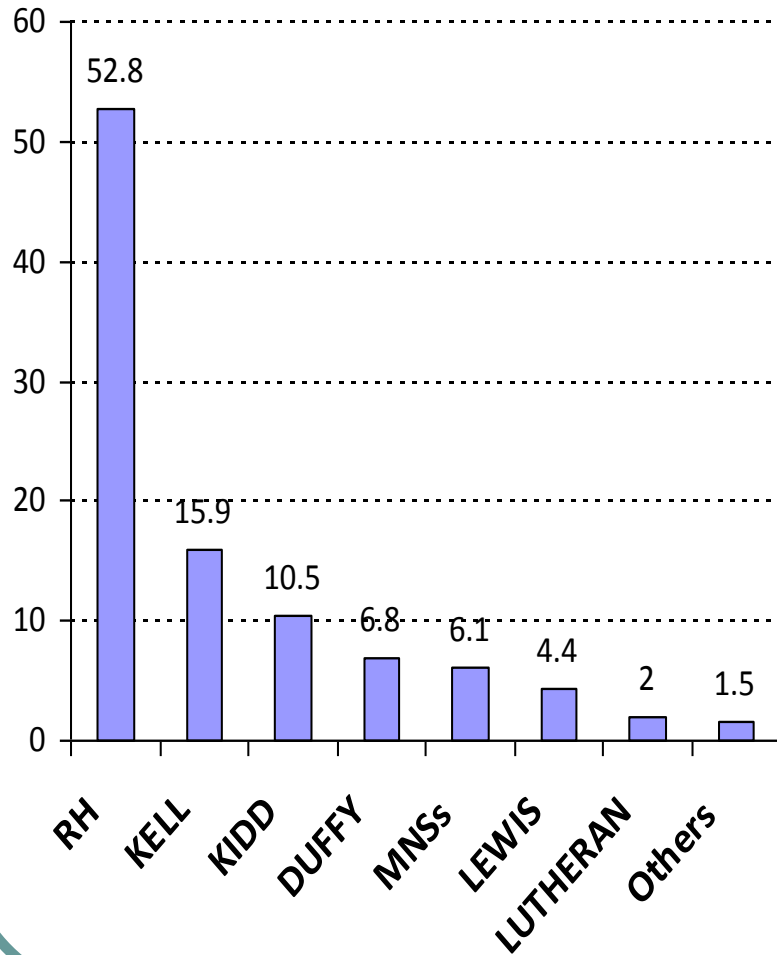
4) Petras M. et al. *Transfusion* 2012; 52:1380-2

Nb Ab/patient among F & M



Females produce S more often than males multiple Abs*

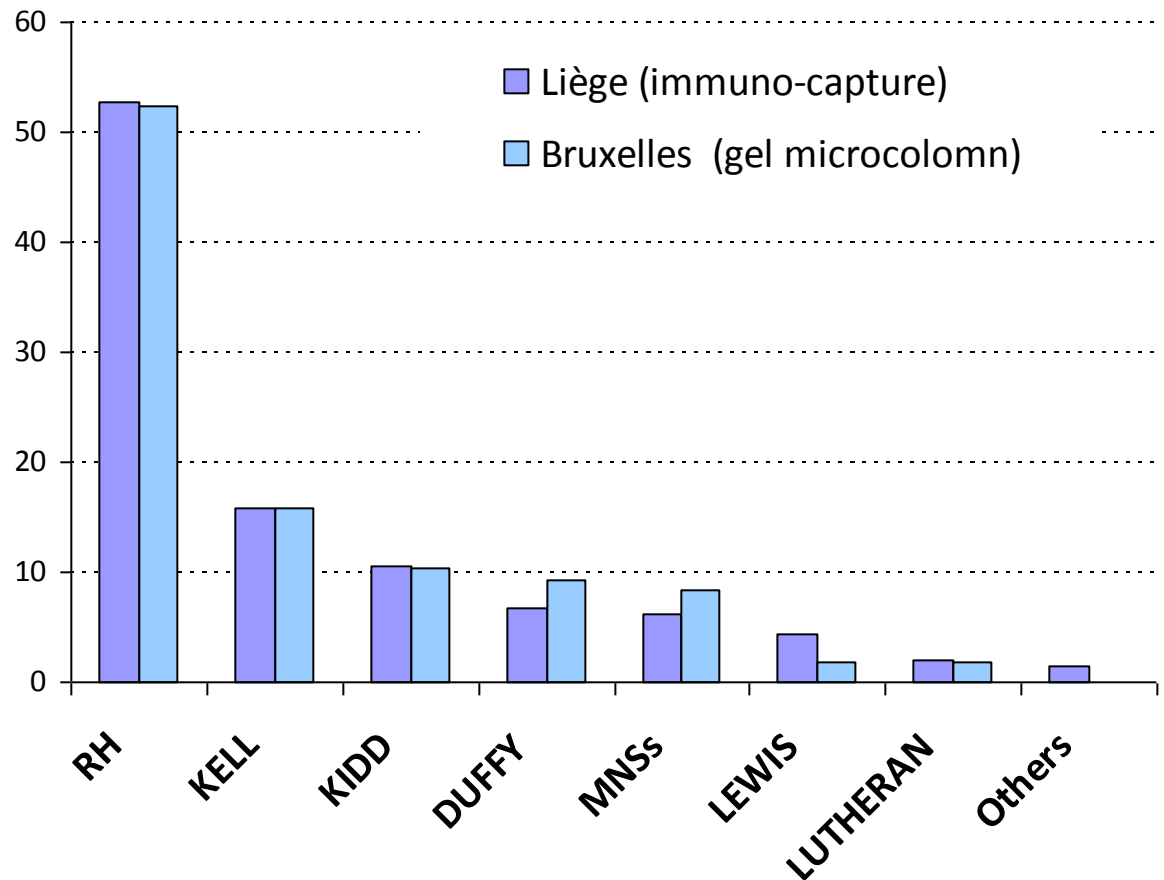
Antibody specificities



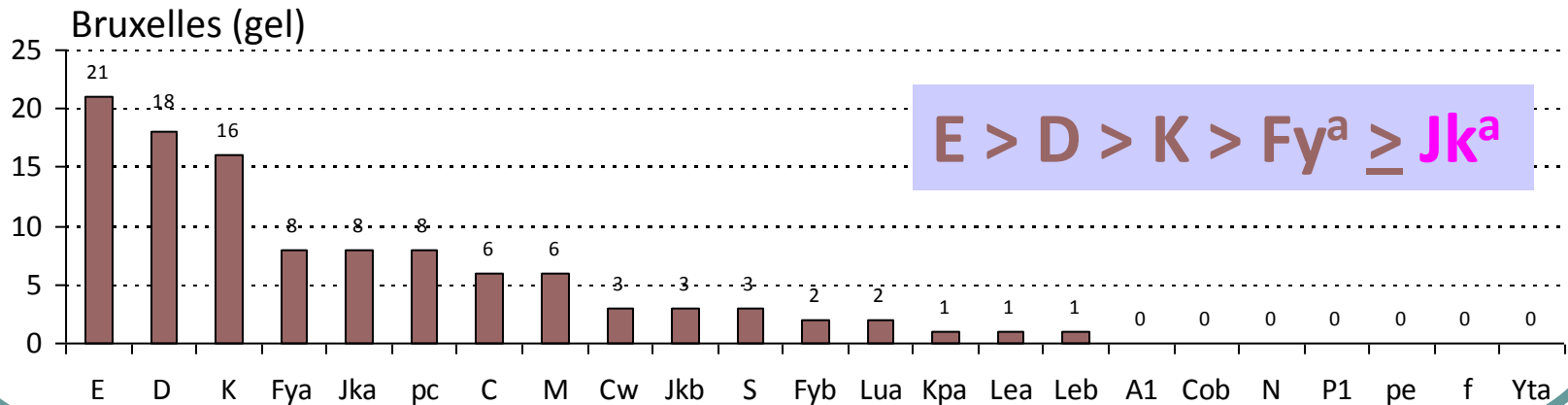
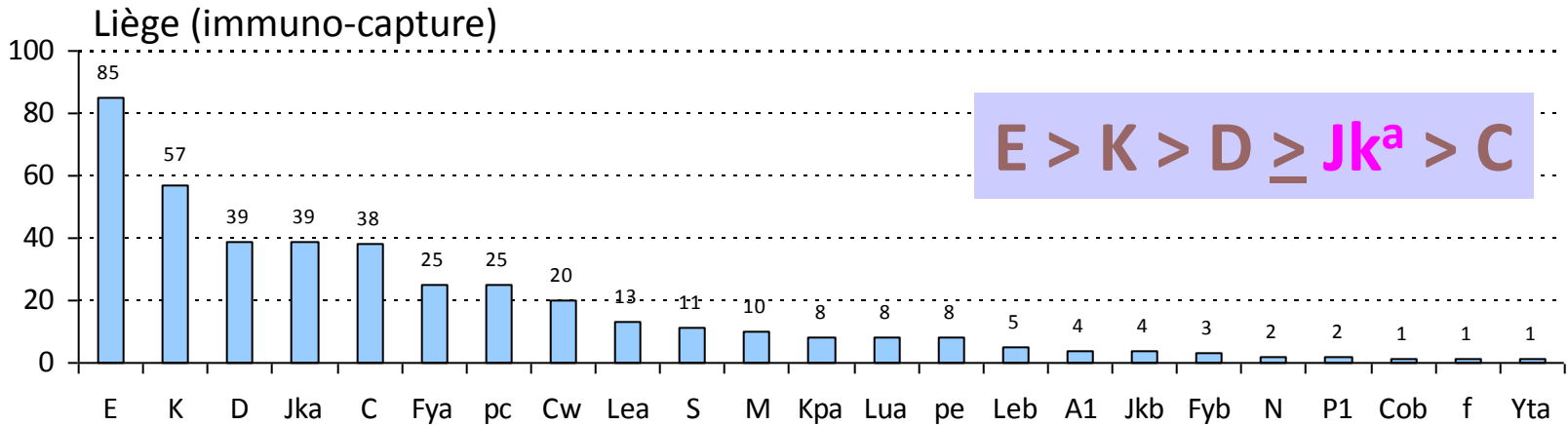
System	Nb Abs	%
RH	216	52.8
KELL	65	15.9
KIDD	43	10.5
DUFFY	28	6.8
MNSS	25	6.1
LEWIS	18	4.4
LUTHERAN	8	2.0
Others	6	1.5
Total	409	100

Antibody specificities / system

Between Liège and Bruxelles, there is no difference as far as the distribution of allo-antibodies per system is concerned.



Frequence & Ab specificities (Liège & Bxles)



Variation in the world ...

- **Malaysia**

F. Al-Joudi et al. Asian J Transfs Sci. 2011, 5(1):42-45

$-E > Le^a > Le^b > K > M$

- **The Netherlands**

S.Zalpuri et al. Vox sanguinis 2012; 102:144-149

$-E > K > Jk^a > C^w > M$

- **USA**

J.R. Hamilton, Transfusion and Apheresis Science 2009; 40:189-194

$-RH > K > Fy > Jk$

- **USA**

M.L. PETRAS et al. Transfusion; 2012:52:1380-2

$-D > E > K > C > Fy^a$

- **China**

Qiushi Wang et al. Transfusion Médecine and Hemotherapy 2012; 39:283-286.

$-E > c > M$

- **Saudi Arabia**

Abdel Galil M Abdel Gader et al., Transfusion and Apheresis Science (2008);39:199-204

$-K > E > D$

- **France**

DUBOEUF S. et al. TRACLI; 2012:19:358-365

$-E > K > D > M > Fy^a$

Ratio : Multiple / Single Abs

Specificity	Single	Multiple	Ratio	Frequency
C	7	31	4.43	9.3 %
C ^w	10	10	1.00	4.9 %
D	15	24	1.60	9.5 %
E	48	37	0.77	20.8 %
c	9	16	1.78	6.1 %
e	3	5	1.67	2.0 %
f	0	1	0.00	0.2 %
K	32	25	0.78	13.9 %
Kp^a	2	6	3.00	2.0 %
Fy ^a	16	9	0.56	6.1 %
Fy^b	1	2	2.00	0.7 %

Specificity	Single	Multiple	Ratio	Frequency
Jk^a	17	22	1.29	9.5 %
Jk ^b	2	2	1.00	1.0 %
Le ^a	8	5	0.63	3.2 %
Le ^b	3	2	0.67	1.2 %
M	9	1	0.11	2.4 %
N	1	1	1.00	0.5 %
P1	2	0	0.00	0.5 %
S	6	5	0.83	2.7 %
Other	8	6	1.00	3.4 %
Total	199	210	1.06	100 %

Ratio : Multiple / Single

- Antibodies more often found alone :
 - anti-E, K, Fy^a, Le^a, S
- Antibodies more often found in association :
 - anti-C, D, c, e, Kp^a, Fy^b, Jk^a
 - More frequent associations observed :
 - Anti-C+D 15
 - Anti-c+E 8
 - Anti-E + Jk^a 6
 - Anti-C+e 2
 - Anti-K+Kp^a 2
 - Anti-Lu^a+Jk^a 2

Frequency of Compatible Blood Donors (CBD)

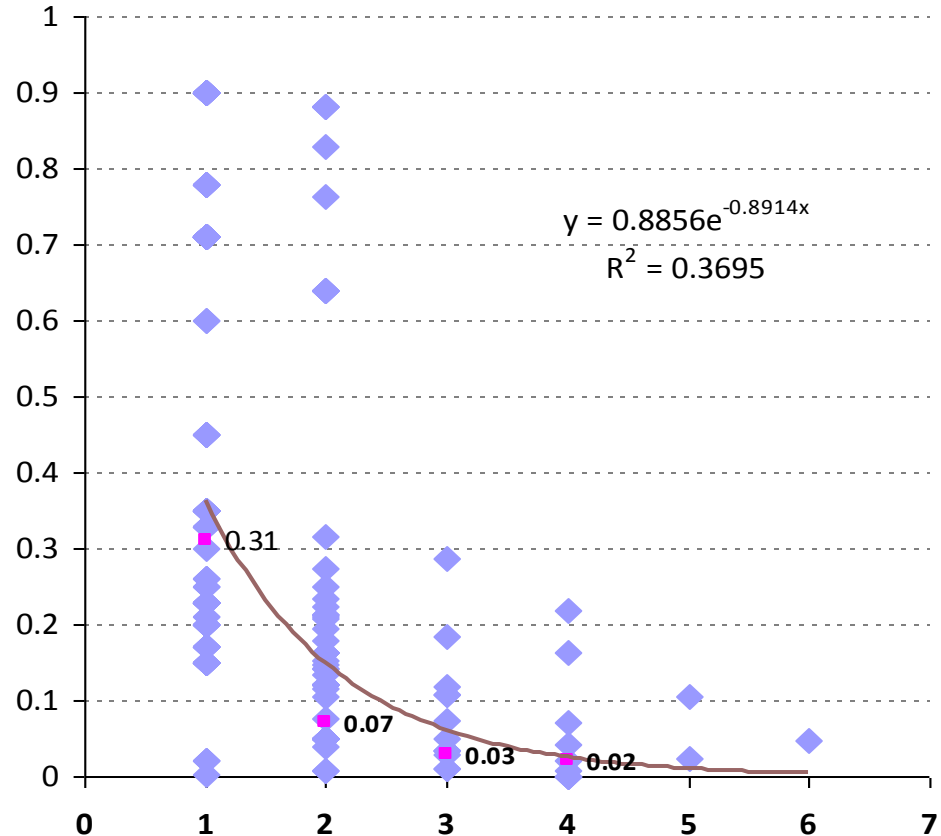
- The frequency of compatible blood donors has been calculated by multiplying the frequency of « Ag neg » corresponding to each antibody specificity : { [Ag-1]*[Ag-2]*[Ag-3]*[Ag-4]*[Ag-5]*100 }.

NB : for calculation, the ABO and RHK compatibilities were not taken into account.

ABO	RH	Ab specificities					Frequence Ag neg					% CBD
		Ab1	Ab2	Ab3	Ab4	Ab5	Ag1	Ag2	Ag3	Ag4	Ag5	
A	pos	C ^w					1	1	1	1	1	98
O	pos	e					0	1	1	1	1	2
O	pos	K	Kp ^a				0.9	1	1	1	1	88
O	pos	C	pe				0.3	0	1	1	1	1
O	pos	E	K	S			0.7	0.9	0.5	1	1	29
O	neg	D	C	Fy ^b			0.2	0.3	0.2	1	1	1
A	pos	C	e	Jk ^b	S		0.3	0	0.3	0.5	1	0
O	pos	E	C ^w	K	Fy ^a		0.7	1	0.9	0.4	1	22
O	pos	E	c	C ^w	K	Kp ^a	0.7	0.2	1	0.9	1	10

% of compatible blood donors (CBD)

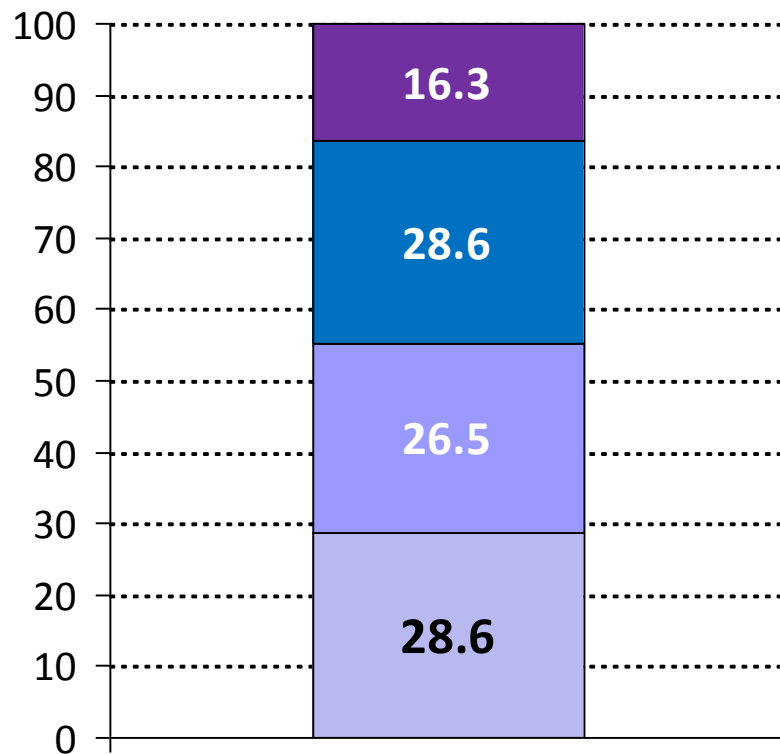
- The % of CBD (median) decreases exponentially when the number of Abs increases but $r^2 = 0.37$.
- Median
 - 1 Ab = 31 %
 - 2 Ab = 7 %
 - 3 Ab = 3 %
- **Because it also strongly depends on the Abs' specificity**



% of Compatible Blood Donors (CBD) / Abs

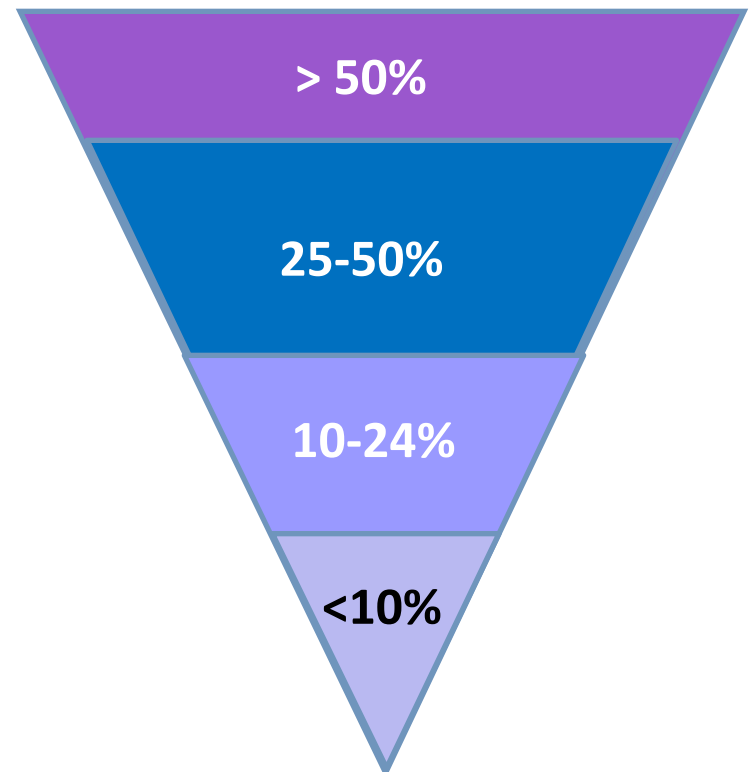
n .	Ab1	Ab2	Ab3	Ab4	Ab5	Ag-1	Ag-2	Ag-3	Ag-4	Ag-5	CBD (%)
1Ab	e					0.02	1	1	1	1	2
	C ^w					0.98	1	1	1	1	98
2Ab	C	e				0.33	0.02	1	1	1	0.7
	K	Kp ^a				0.90	0.98	1	1	1	88
3Ab	D	C	Fy ^b			0.15	0.33	0.20	1	1	1
	E	K	S			0.71	0.90	0.45	1	1	29
4Ab	C	e	Jk ^b	S		0.33	0.02	0.26	0.45	1	0.1
	E	C ^w	K	Fy ^a		0.71	0.98	0.90	0.35	1	22
5Ab	E	pc	K	Kp ^a	Jk ^a	0.71	0.17	0.90	0.98	0.23	2.5
	E	c	C ^w	K	Kp ^a	0.71	0.17	0.98	0.90	0.98	10

Frequency of compatible blood donors



% Immunized receivers

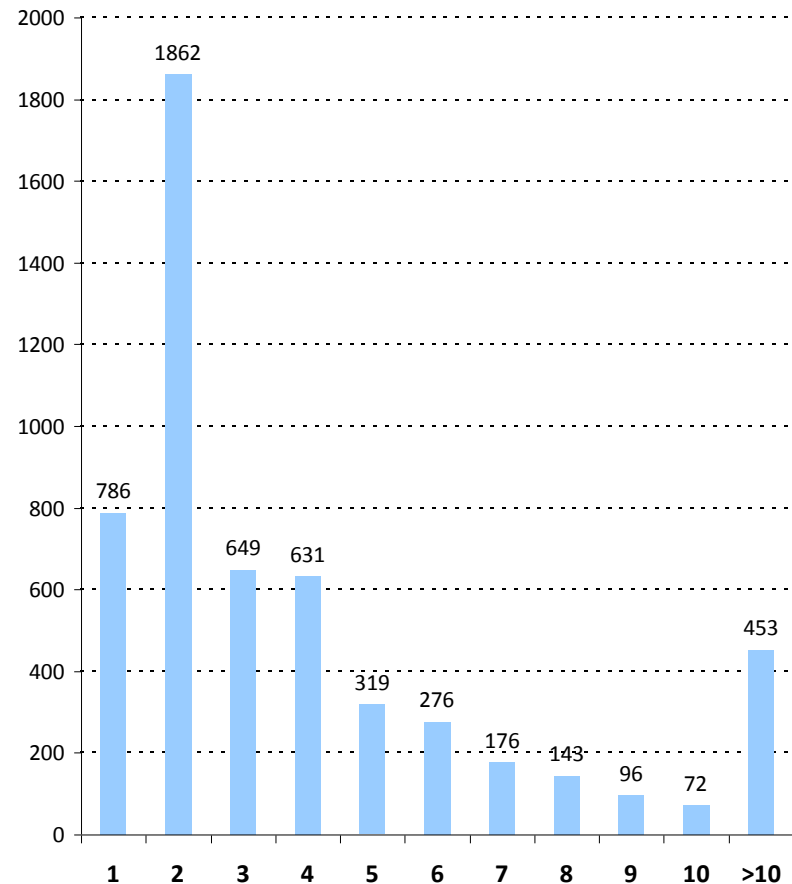
% Compatible blood donors



* without ABO & RHK

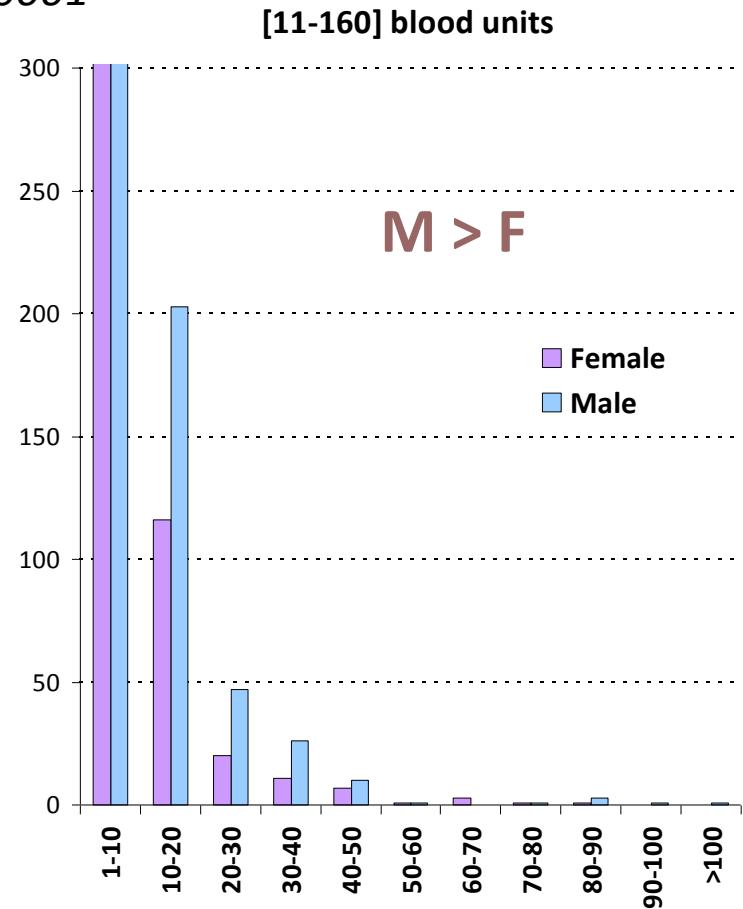
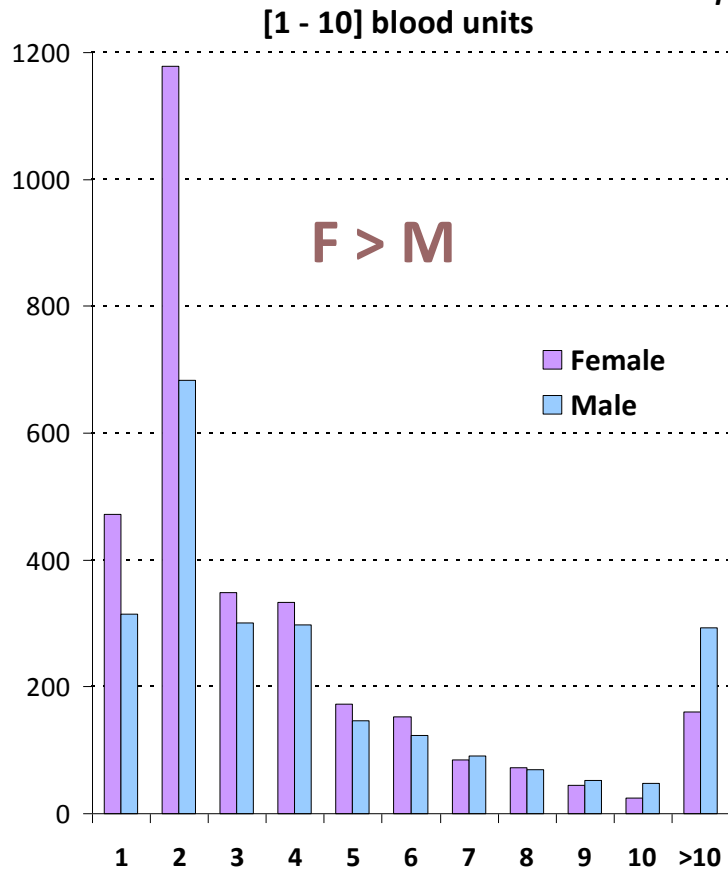
Nb RBC transfused / patient

- Total ± 25.460 blood units were transfused in 2011.
- **48.5%** of patients received [1-2] blood units;
- **91.7%** of patients received [1-10] blood units (→16.192 BU)
- **8.3%** of patients received [10-160] blood units (→9.268 BU)



Nb RBC transfused / patient / gender

$P < 0.0001$



Nb CE transfused (median) & other parameters

	Gender		
	All	F	M
Q1 (25%)	2	2	2
Median	3	2	<u>3</u>
Q3 (75%)	5	4	6
<i>p</i>	<i><0.0001</i>		

Nb CE transfused (median) & other parameters

	Gender			ABO blood group			
	All	F	M	A	AB	B	O
Q1 (25%)	2	2	2	2	2	2	2
Median	3	2	<u>3</u>	<u>2</u>	3	3	3
Q3 (75%)	5	4	6	5	6	5	6
<i>p</i>	<i><0.0001</i>			<i>0.02</i>			

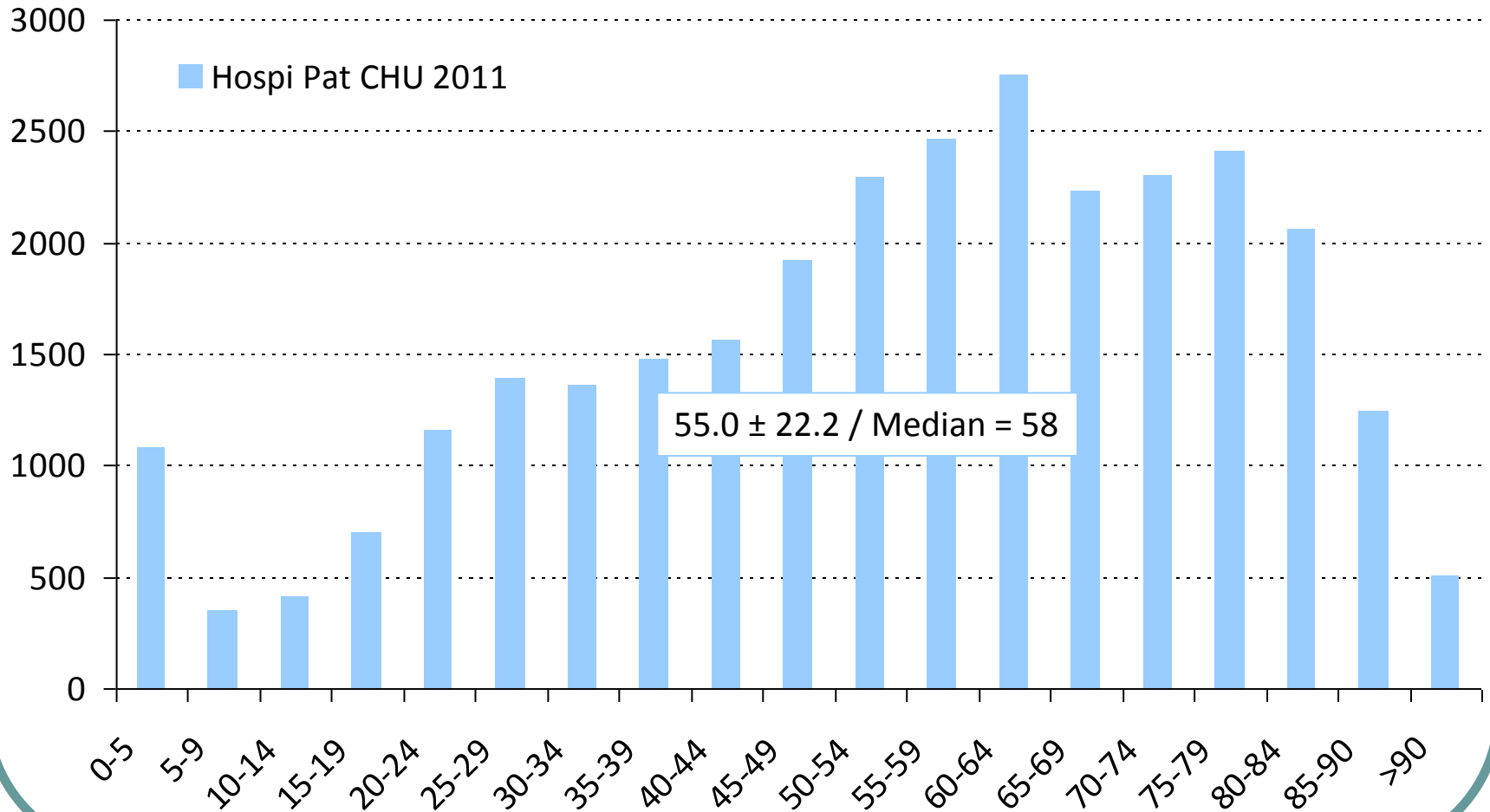
Nb CE transfused (median) & other parameters

	Gender			ABO blood group				Immunizat.	
	All	F	M	A	AB	B	O	Imm	N.Im
Q1 (25%)	2	2	2	2	2	2	2	2	2
Median	3	2	<u>3</u>	<u>2</u>	3	3	3	<u>4</u>	3
Q3 (75%)	5	4	6	5	6	5	6	8	5
<i>p</i>	<i><0.0001</i>			<i>0.02</i>				<i><0.0001</i>	

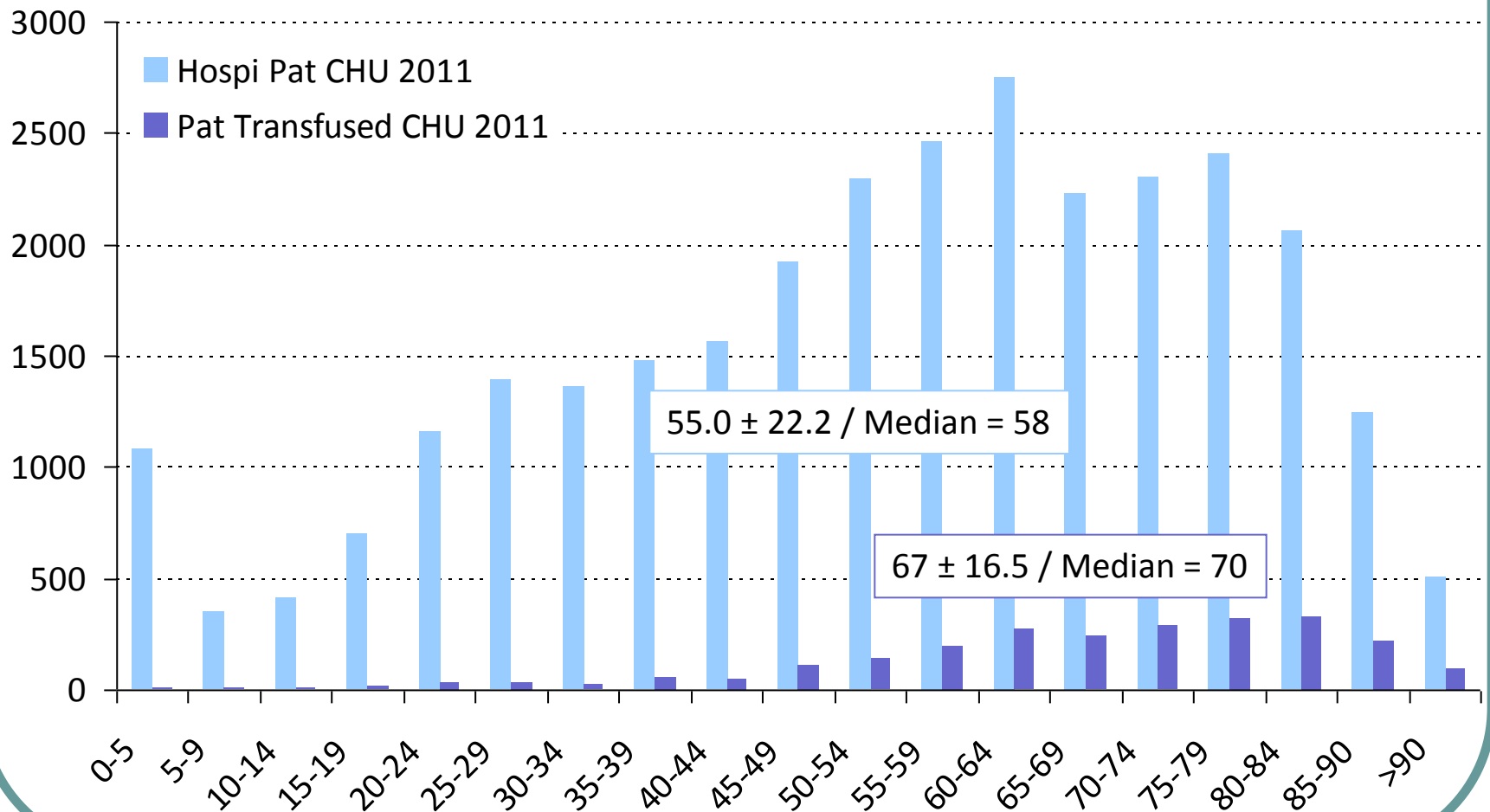
Nb CE transfused (median) & other parameters

	Gender			ABO blood group				Immunizat.		Hemato Pts	
	All	F	M	A	AB	B	O	Imm	NIm	All	HSC G
Q1 (25%)	2	2	2	2	2	2	2	2	2	2	3
Median	3	2	<u>3</u>	<u>2</u>	3	3	3	<u>4</u>	3	3	<u>7</u>
Q3 (75%)	5	4	6	5	6	5	6	8	5	5	17
<i>p</i>	<i><0.0001</i>			<i>0.02</i>				<i><0.0001</i>		<i><0.0001</i>	

Age of hospitalized patients (CHU, 2011)



Age of hospitalized / transfused (6.2%)



« Transfused patients are 5* older than hospitalized patients »

Proportion of Pats. transfused / age

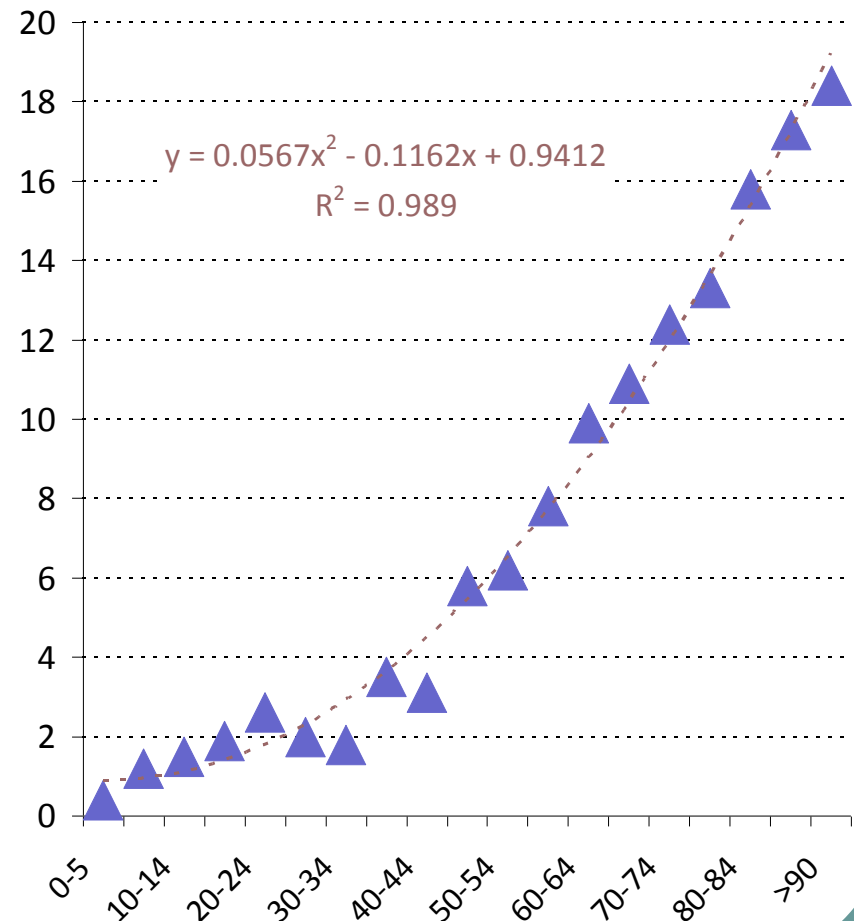
- *The proportion of transfused patients increases significantly with age ($r^2=0.98$).*

- Probability to be transfused is :

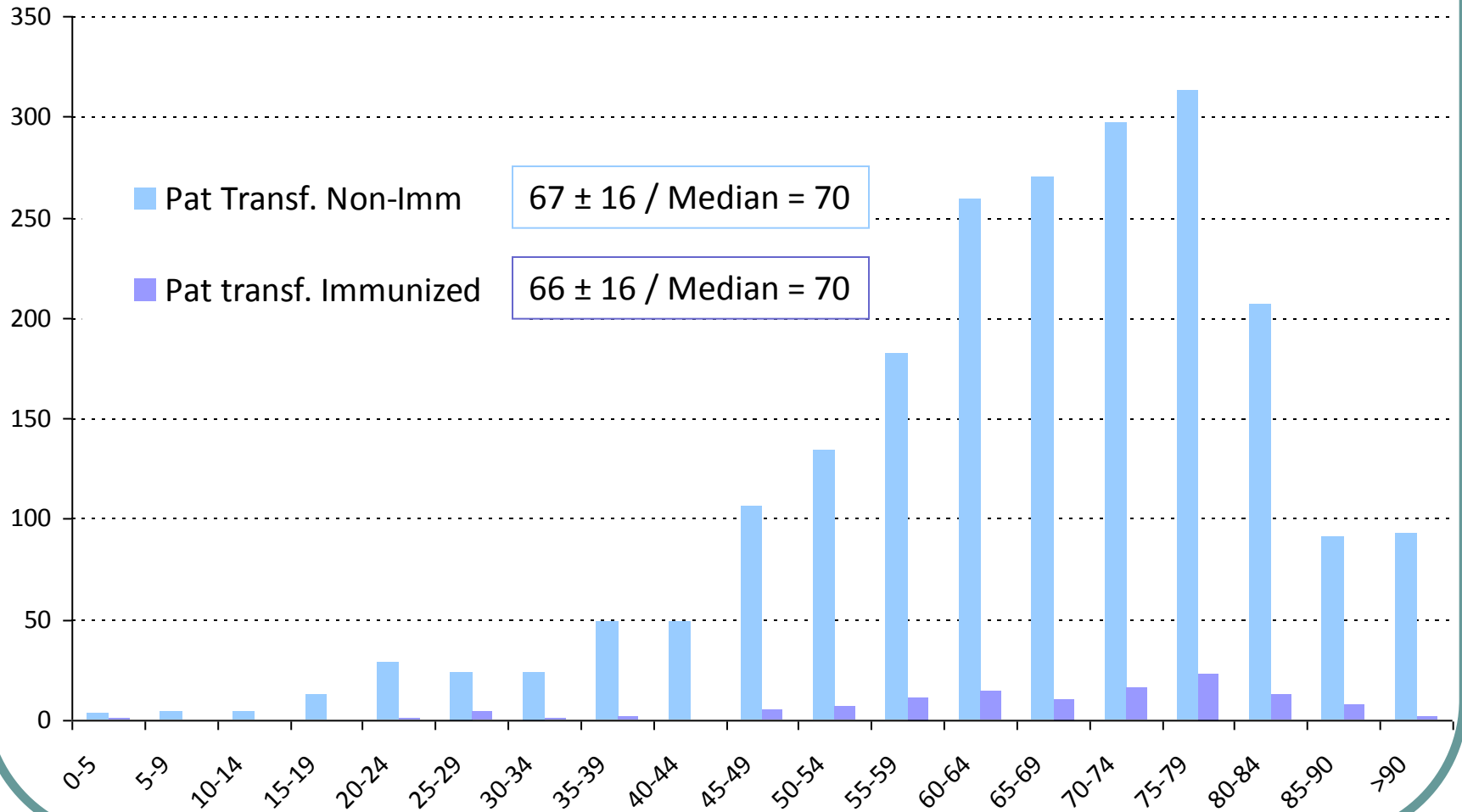
- $\pm 5\%$ [45-49 y.o.];
- $\pm 10\%$ [65-69 y.o.]
- $\pm 20\%$ [>90 y.o.]

- Also observed by :

- QUARANTA JF et al. TRACLI 2009; 16:21-29 /
- SEIFRIED E et al. Vox sanguinis 2010; 100:20-21 /
- DESALVO F. Blood Transfusion 2011; 9:413-8.
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Age of transfused / immunized pats.

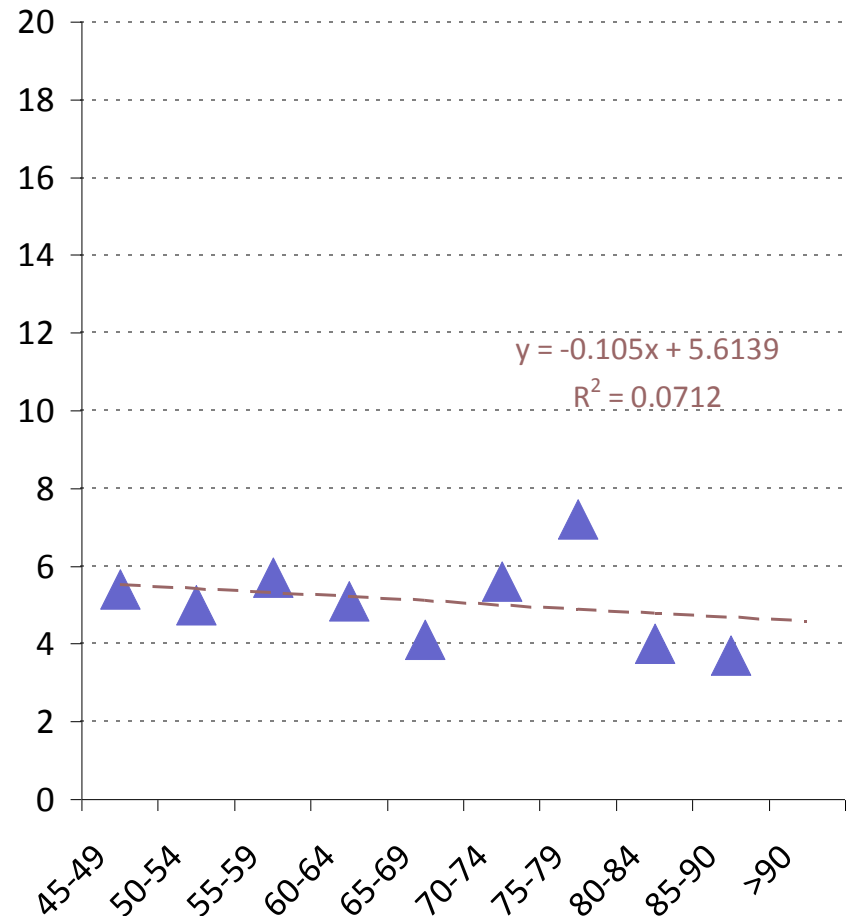


Proportion of Immunized pts. / age (CHU,2011)

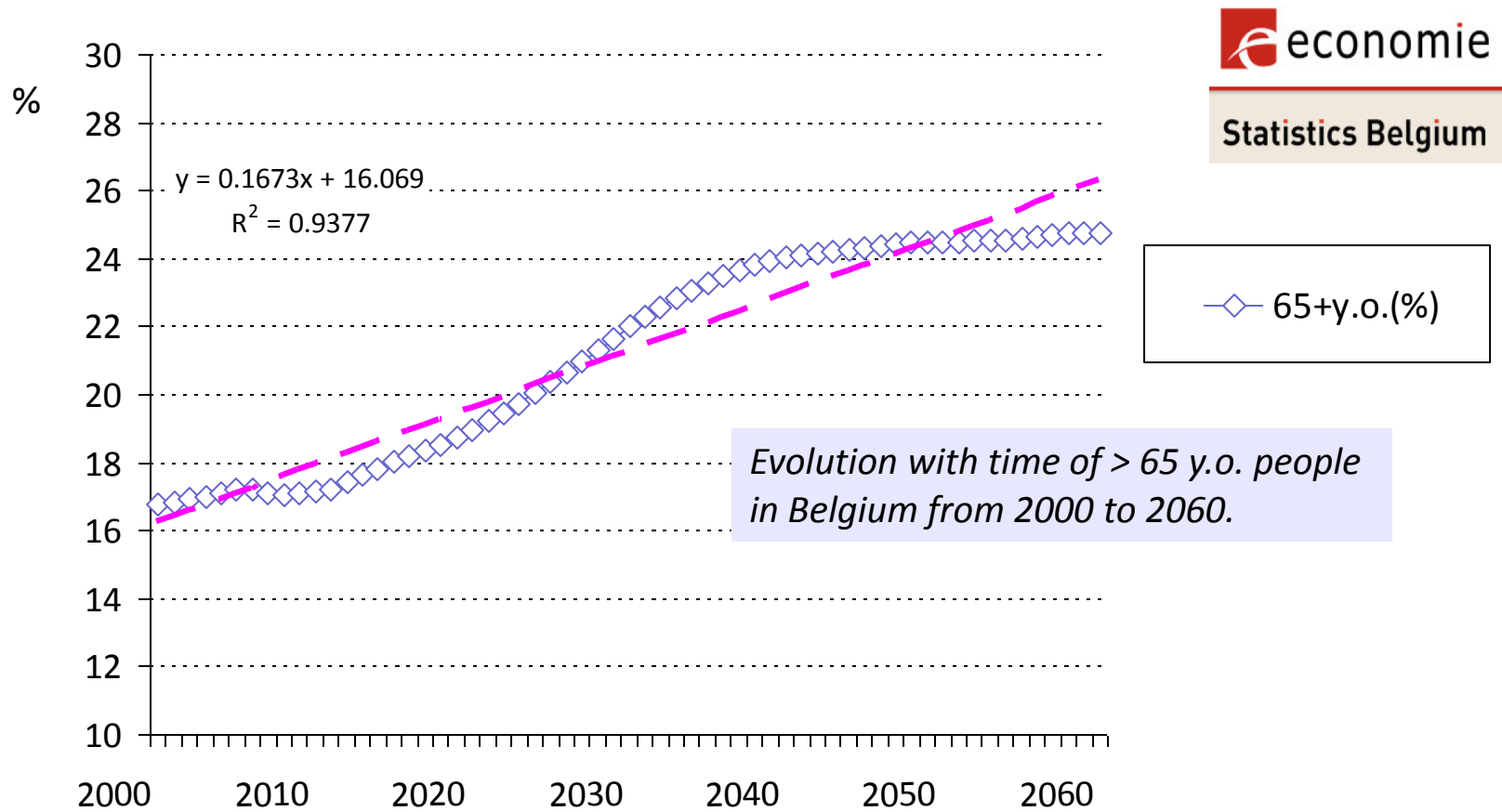
- Among transfused patients, the proportion of immunized patients does not decrease with age but remains quite stable (around 5%) from [45-50] y.o. to [80-85] y.o.

« Allo-immunization does not decline with age ⁽¹⁾ »

1) Seifried E et al. Vox sanguinis 2010; 100:20-21.

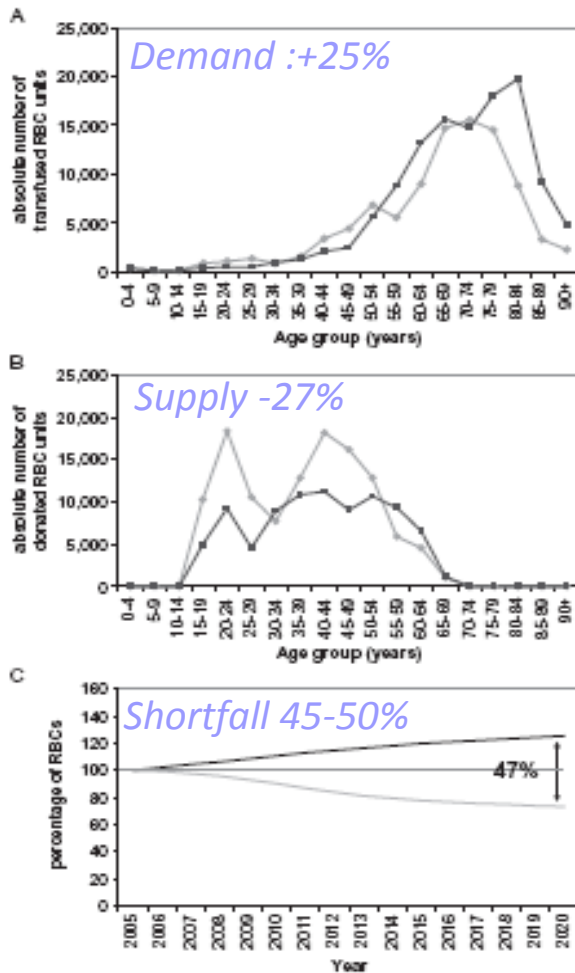


Population ageing in Belgium



Implications of demographics on future blood supply : a population-based cross-sectional study.

A. Greinacher, et al. *Transfusion* (2011); 51:702-709



Between 2005 and 2020 :

- For pat > 55 y.o., the demand will increase of +25%
- Blood donations will decrease of 27%
- Both effect → shortfall [45-50%].

Conclusion (1)

- These observations are not « new » but they are however interesting.
- The rate of allo-immunization may be considered as a *quality indicator* of the transfusion policy applied by the blood bank. The rate of 5% is not surprising in such an heterogeneous population of blood recipients. Of course, it should remain as low as possible since the difficulty to provide compatible blood increases with the number of antibodies.
- Like others, we found that females are more often immunized than males and produce S* more multiple antibodies.
- The immunization profile in term of *single* and *multiple* immunization allowed us to identify the most frequent Abs combinations and therefore to be careful when selecting blood phenotypes.

Conclusion (2)

- As expected, RH and Kell are the most immunogenic systems. The differences observed (Lg-Bx) in the frequency of individual antibody specificities are more than probably related to technical considerations and concerns « serological » rather than « clinically significant » antibodies.
- There are some differences in the number of blood units received according to gender, immune status, and pathologies.....
- **In our population of blood receivers, the need of transfusion increases with age but the rate of immunization does not decrease. So, taking into account the demographic changes foreseeable in the next years, one should be careful to change right now our policy of blood consumption.**