



Basic Blood Bank Testing for the Clinician

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Disclosures

- None

Objectives

- By the end of this session, the attendee will be able to:
 - List the blood bank tests required before blood is available for a patient
 - State how long it takes for this testing to be done
 - Accept uncrossmatched blood when appropriate

Poll

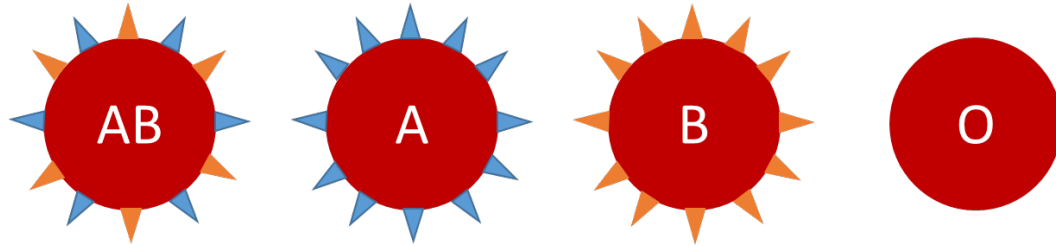


You are assessing a 75 year old with a fractured femur on the wait and see OR list. His hemoglobin is 110 g/L (chronic kidney disease). What blood bank test should you order?

- A. Group & Screen
- B. DAT
- C. Crossmatch
- D. Type & Cross

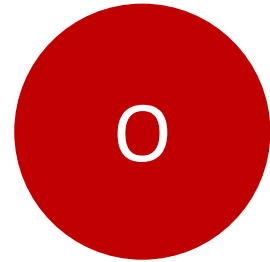
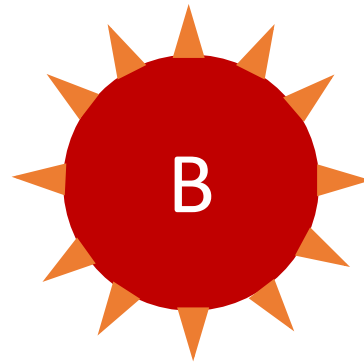
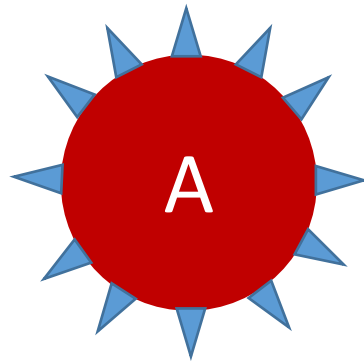
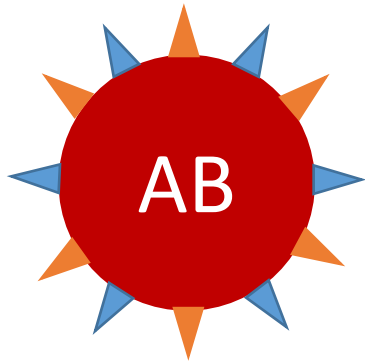
What does the Group test?

1. ABO



2. RhD

ABO

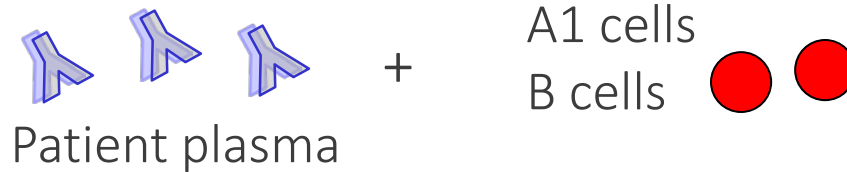


How is the ABO Group test performed?

- What ABO antigens are on patient's RBCs?

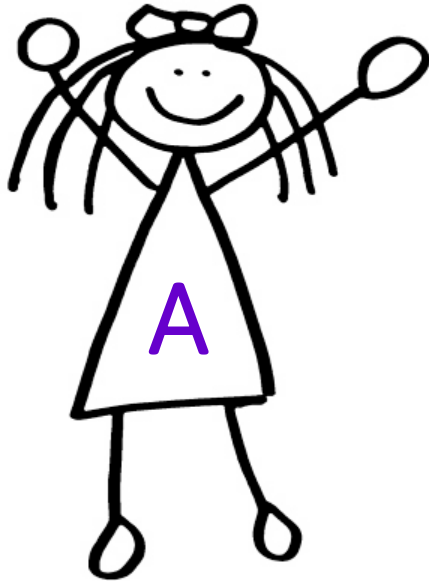


- What ABO antibodies does patient have?

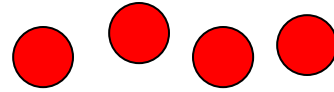
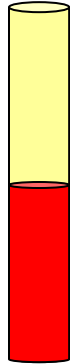


ABO Blood Group - Forward

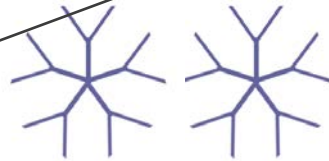
Immediate Spin



Group A Patient



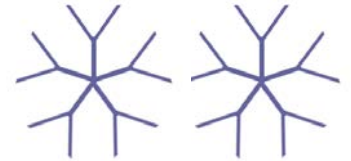
Group A RBCs
+ IgM Anti-A



**Agglutination
= Positive Test**



Group A RBCs
+ IgM Anti-B

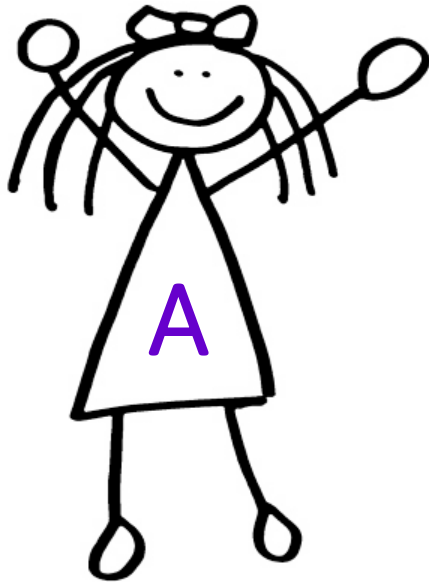


**No Agglutination
= Negative Test**

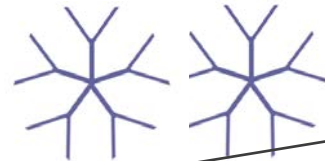
ABO Blood Group – Reverse

5 min

Immediate Spin

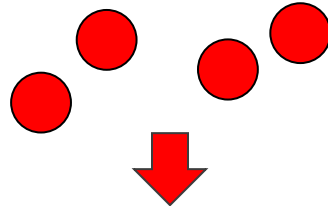


Group A Patient



Patient plasma

+ Group A1 RBCs

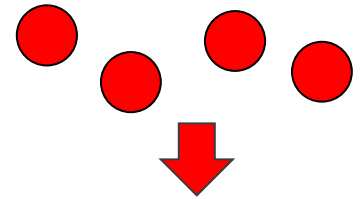


No Agglutination
= Negative Test



Patient plasma

+ Group B RBCs



Agglutination
= Positive Test

ABO Blood Group

Anti-A	Anti-B
4+	0

A1 RBCs	B RBCs
0	4+

Interpretation: Group A

Poll

Which is the universal red cell donor?

- A. Group A
- B. Group B
- C. Group O
- D. Group AB

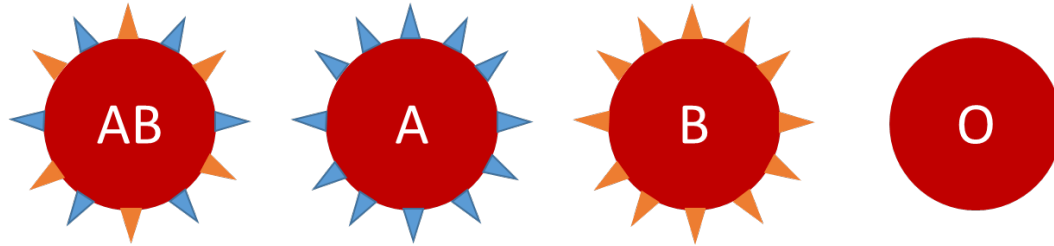
Poll

Which is the universal plasma donor?

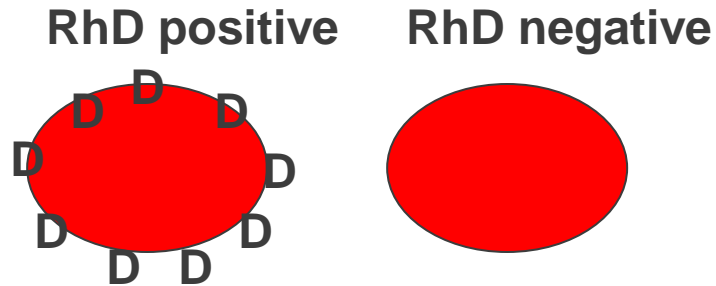
- A. Group A
- B. Group B
- C. Group O
- D. Group AB

What does the Group test?

1. ABO



2. RhD



**Anti-D
develops
only after
exposure**



Poll

How many different blood groups have been recognized?

A. 3

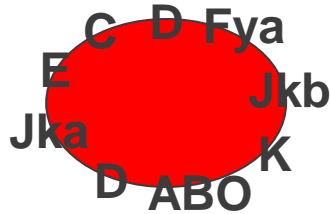
B. 15

C. 45

D. 125

Group and Screen

- Antibody Screen: screens for antibodies against non-ABO red blood cell antigens



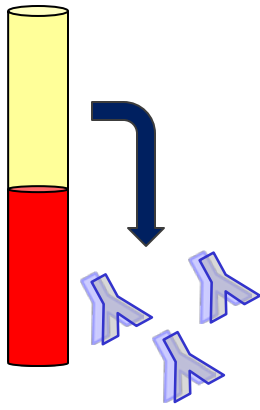
45 blood groups
380+ blood group antigens

Recognized Blood Antigen Systems

ISBT#	System Name	ISBT #	System Name	ISBT #	System Name	ISBT #	System Name
1	ABO	13	Scianna (SC)	25	Raph	37	Kanno
2	MNS	14	Dombrock (DO)	26	John Milton Hagen (JMH)	38	SID
3	P1Pk	15	Colton (CO)	27	I	39	CTL2
4	Rh	16	Landsteiner-Wiener (LW)	28	Globoside (GLOB)	40	PEL
5	Lutheran (LU)	17	Chido-Rogers (CH/RG)	29	Gil	41	MAM
6	Kell	18	H	30	Rh-associated glycoprotein (RHAG)	42	EMM
7	Lewis (LE)	19	Kx (XK)	31	Forssman (FORS)	43	ABCC1
8	Duffy (FY)	20	Gerbich (GE)	32	Junior (JR)	44	ER
9	Kidd (JK)	21	Cromer (CROM)	33	Langereis (LAN)	45	CD36
10	Diego (DI)	22	Knops (KN)	34	Vel		
11	Yt	23	Indian (IN)	35	CD59		
12	Xg	24	Ok	36	Augustine (AUG)		

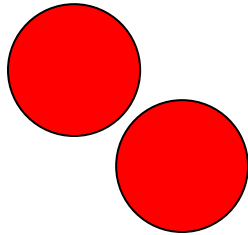
Antibody Screen

(indirect antiglobulin test – IAT)



Patient
Plasma (IgG)

+



Group O RBCs
(Screening Cell I
& II)

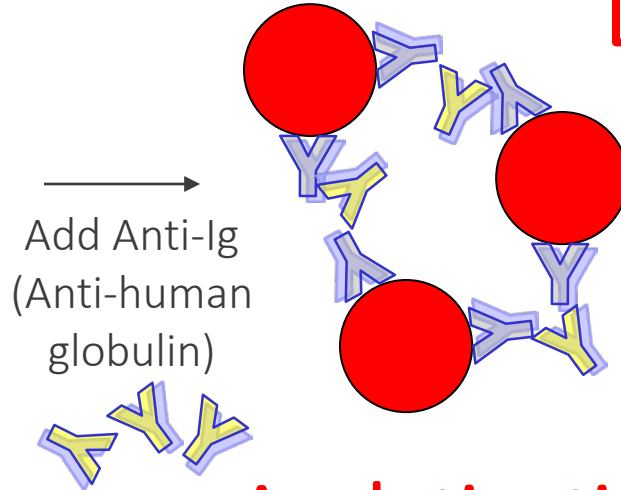
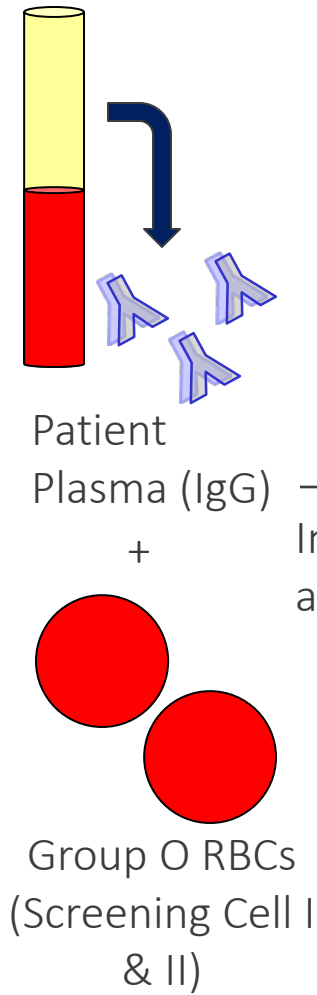


	Rh-Hr						Kell						Duffy		Kidd		Lewis		P		MNS				Lutheran		Sex-linked
	D	C	E	c	e	C ^w	K	k	Kp ^a	Kp ^b	Js ^a	Js ^b	Fy ^a	Fy ^b	Jk ^a	Jk ^b	Le ^a	Le ^b	P ₁	M	N	S	s	Lu ^a	Lu ^b	Xg ^a	
I	+	0	0	0	+	0	+	+	0	+	0	+	0	0	0	+	0	0	0	+	+	0	+	0	+	0	
II	+	+	+	+	0	0	0	+	0	+	0	+	+	+	0	+	+	+	+	+	0	+	+	0	+	+	

Antibody Screen

(indirect antiglobulin test – IAT)

45 minutes



Antibody Screen Results

- Antibody screen negative

	Rh-Hr						Kell						Duffy		Kidd		Lewis		P	MNS				Lutheran		Sex-linked	37 PEG
	D	C	E	c	e	C ^w	K	k	Kp ^a	Kp ^b	Jk ^a	Jk ^b	Le ^a	Le ^b	P ₁	M	N	S	s	Lu ^a	Lu ^b	Xg ^a	AHG				
I	+	0	0	0	+	0	+	+	0	+	0	0	0	0	0	+	+	0	+	0	+	0	0				
II	+	+	+	+	0	0	0	+	0	+	0	0	+	+	+	+	0	+	+	0	+	+	0				

Limitation: 97-98% sensitive
 (2-3% could have antibody against
 antigen not on antibody screen cells)

Crossmatch

- Detect compatibility between recipient plasma and donor red cells



Crossmatch - FAST

- Screen negative = FAST crossmatch
 - Assume no antibodies: Check ABO compatible

- Immediate spin (~5 minutes)



- Electronic crossmatch (~2 minutes)
 - Recipient ABO on 2 occasions and validated computer system to detect compatibility

“Why do I need a 2nd sample?”

- Most common cause of ABO incompatibility is human error (wrong blood in tube = 1 in 1,600)
- The “2nd sample” confirms the ABO type
 - Historical group or 2nd sample drawn independently
 - **DO NOT DRAW 2 TUBES at same time and hold one back to send later! = DANGER**
- Electronic positive patient identification (barcode technology)
↓ errors to 1 in 14,606

Antibody Screen Results

- Antibody screen positive

	Rh-Hr						Kell						Duffy		Kidd		Lewis		P	MNS				Lutheran		Sex-linked	37 PEG
	D	C	E	c	e	C ^w	K	k	Kp ^a	Kp ^b	Js ^a	Js ^b	Fy ^a	Fy ^b	JK ^a	JK ^b	Le ^a	Le ^b	P ₁	M	N	S	s	Lu ^a	Lu ^b	Xg ^a	AHG
I	+	0	0	0	+	0	+	+	0	+	0	+	0	0	0	+	0	0	0	+	+	0	+	0	+	0	0
II	+	+	+	+	0	0	0	+	0	+	0	+	+	+	0	+	+	+	+	+	0	+	+	0	+	+	3+



Chance that blood could be delayed because of extra steps to find blood!!

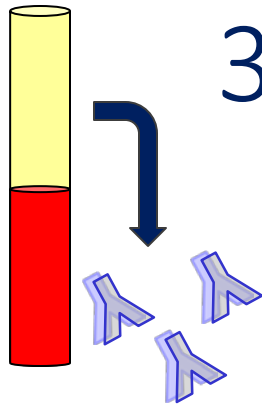
2) Find Antigen Negative Units

- Find antigen negative unit by label or by phenotyping (i.e. typing) the RBC unit in Blood Bank
- Phenotype patient

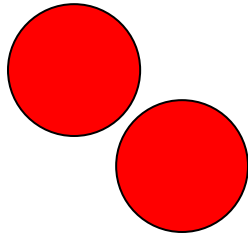


3) Full CROSSMATCH

45 minutes

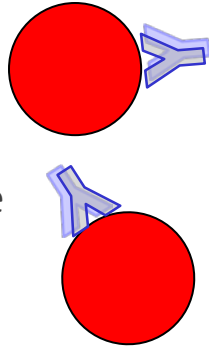


Patient Plasma
+

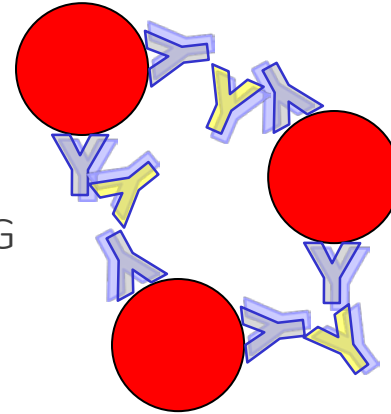


Donor RBCs

Incubate
at 37°C



Add Anti-IgG
(AHG)



**Agglutination
= Incompatible!**



Crossmatch - SLOW

- If antibody screen **positive** → **PROBLEM!!**
 1. Identify antibody (minutes to hours to days)
 2. Find antigen negative units (minutes to hours)
 3. Full crossmatch (45 minutes)
- Give Blood Bank as much notice as possible that RBC units are needed
- For surgery, Blood Bank will crossmatch units ahead of time as per the Maximum Surgical Blood Ordering Schedule (MSBOS)

What if you don't have time...

RBC Product	Turn-Around Time	Comments
Uncrossmatched blood	5 minutes	Only in emergencies (when risks of delaying transfusion outweigh risks of acute hemolysis – watch for red urine and hypotension). Also delayed hemolysis
Crossmatched RBCs	45 minutes for patients without antibodies, up to 3 hours or more for patients with antibodies	Preferred choice, as safest product available

Summary

What does the group test?	
What does the antibody screen test?	
How long does a fast crossmatch take?	
When can the Blood Bank use a fast crossmatch?	
How long does a full/slow crossmatch take?	
If there is a positive antibody screen, what does this mean for your patient?	

Summary

What does the group test?	ABO & Rh
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What does the group test?	ABO & Rh
What does the antibody screen test?	Antibodies against non-ABO antigens
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Summary

What does the group test?	ABO & Rh
What does the antibody screen test?	Antibodies against non-ABO antigens
How long does a fast crossmatch take?	2-5 minutes
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What does the group test?	ABO & Rh
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How long does a fast crossmatch take?	2-5 minutes
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How long does a fast crossmatch take?	2-5 minutes
When can the Blood Bank use a fast crossmatch?	Antibody Screen negative
How long does a full/slow crossmatch take?	45 minutes
If there is a positive antibody screen, what does this mean for your patient?	There may be a delay in blood availability 

One more practical point...

- What to do if you don't end up needing the unit?
- Return back to blood bank ASAP
 - Return within 60 minutes (CSA standards)
 - If in a cooler, return within cooler time (~ 4 hours)
- Return the products as you received them
 - RBCs in cooler: keep cooler closed, return in cooler
 - If platelets in a room temp bag, return in bag
 - If plasma in a separate bag, return in separate bag
 - If plasma in a cooler, then return in cooler