

# Antibody Identification: Art or Science? A Case Study Approach

(Questions Only)

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# Preface to Online Supplement

Antibody identification and serologic problem solving involve much more than knowing how to perform the procedures. Once the mechanics of basic tests such as ABO/Rh type, direct and indirect antiglobulin tests, elutions, and adsorptions are learned, true mastery comes from understanding how and when to use the procedures to resolve unexpected reactivity in a patient's sample. This is why many say that antibody identification is an art as well as a science.

Antibody Identification: Art or Science steps in where hands-on practice struggles to go. Case studies that begin with a clinical scenario and initial test results guide the learner through a sequence of multiple choice questions that offer testing options and protocols for resolution. The difficulty of the cases ranges from basic to advanced, allowing use by multiple levels of students, residents, transfusion medicine fellows and practicing medical laboratory scientists (medical technologists).

These cases are similar in that they address alloantibodies only. Autoantibodies or other situations involving positive autologous control tests or direct antiglobulin tests are not included. Advanced techniques for alloantibody identification such as the use of chemicals, inhibition, adsorption, and adsorption/elution are presented to challenge the learner who has mastered single alloantibody cases.

Written by practicing serologists and educators, the processes in these cases represent practical and efficient paths to problem resolution. Working through the cases will supplement didactic learning in a variety of settings from formal education programs to on-the-job instruction. Each case is designed as a stand-alone lesson enabling the instructor/supervisor to use just those cases most appropriate for their learner. Through cases that present serologic problem solving as a series of logical and systematic steps, the authors hope to demonstrate that the *art* of antibody identification, as well as the science, can be a learned skill.

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## Key to Abbreviations

√	Reactive IgG-sensitized cells
AC	Autocontrol
AHG	Antihuman globulin
DAT	Direct antiglobulin test
DTT	Dithiothreitol
ER	Emergency Room
HDFN	Hemolytic disease of the fetus and newborn
IAT	Indirect antiglobulin test
IS	Immediate spin
LISS	Low ionic strength saline
NH	No hemolysis
PEG	Polyethylene glycol
RBC	Red Blood Cell (unit)
RT	Room temperature
SOP	Standard operating procedure
SP	Solid phase

## Interpretation of Agglutination Reactions

Macroscopically Observed Findings	Designation	Score
One solid agglutinate	4+	12
Several large agglutinates	3+	10
Medium-size agglutinates, clear background	2+	8
Small agglutinates, turbid background	1+	5
Very small agglutinates, turbid background	1+ <sup>w</sup>	4
Barely visible agglutination, turbid background	w+ or +/-	2
No agglutination	0	0
Mixtures of agglutinated and unagglutinated red cells (mixed field)	mf	
Complete hemolysis	H	
Partial hemolysis, some red cells remain	PH	

Used with permission from Roback JD, Grossman BJ, Harris T, Hillyer CD, eds. Technical manual. 17th ed. Bethesda, MD: AABB, 2011:874.

## **Case Study 1**

**Initial Data:**

JP is a 58-year-old male with a history of cardiovascular disease for the past 10 years. He is scheduled for his second cardiac bypass surgery. For his first surgery, 7 years ago, he received 3 units of Red Blood Cells (RBCs) postoperatively. The transfusions were unremarkable.

An order for type and crossmatch of 4 RBC units has been received in preparation for this surgery.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	4+	4+	4+	0

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	<b>1+</b>
<b>2</b>	+	0	+	+	0	0	+	0	0	+	0	+	+	0	+	0	+	+	+	+	+	<b>0</b>

1. What is JP's ABO type?

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

2. What is JP's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the initial antibody detection test, which of the following would be the MOST LIKELY interpretation of the patient's antibody status?

- A. No antibodies are present in the patient's serum.
- B. The patient has one or more alloantibody(ies) or autoantibody(ies).
- C. The patient has multiple alloantibodies.
- D. The patient has an autoantibody.

4. Which of the following antibody specificities would be a likely hypothesis based on the results of the antibody detection test and patient typing results?

- A. Anti-D.
- B. Anti-C.
- C. Anti-M.
- D. Anti-Lu<sup>a</sup>.

**Antibody Identification Panel:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>0</b>
<b>2</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	0	0	0	+	+	+	+	+	+	<b>0</b>
<b>3</b>	+	0	+	+	0	0	0	+	+	+	0	+	0	0	0	0	+	+	+	+	0	+	<b>0</b>
<b>4</b>	+	0	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	0	0	+	0	<b>0</b>
<b>5</b>	0	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	0	<b>0</b>
<b>6</b>	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>0</b>
<b>7</b>	0	0	0	+	+	+	+	+	+	0	0	+	+	+	0	+	+	0	+	0	+	0	<b>1+</b>
<b>8</b>	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	0	<b>0</b>
<b>9</b>	0	0	0	+	+	+	+	0	+	+	0	+	+	+	0	0	+	0	+	+	+	+	<b>0</b>
<b>10</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	0	+	<b>0</b>
<b>11</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	+	+	0	+	+	+	+	<b>1+</b>
<b>AC</b>																							<b>0</b>

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient’s serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient’s serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -P1, -Le<sup>b</sup>, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

5. What antibody specificity(ies) would explain ALL reactions observed in both the antibody detection test and antibody identification panel?

- A. Anti-K.
- B. Anti-C.
- C. Anti-Le<sup>a</sup>.
- D. Anti-E and anti-K.

---

6. What antibody identification panel cell is the MOST appropriate to rule out anti-M?

- A. Cell 1.
  - B. Cell 3.
  - C. Cell 7.
  - D. Cell 9.
- 

7. Given the combined results of the antibody detection test and the antibody identification panel, which of the following specificities was NOT ruled out?

- A. Anti-C.
  - B. Anti-S.
  - C. Anti-Fy<sup>a</sup>.
  - D. None of the above.
- 

8. If this laboratory had a “3 + 3 rule” for confirmation of antibody specificity, how many additional cells must be tested to complete this identification?

- A. 0.
  - B. 1.
  - C. 2.
  - D. 3.
- 

9. Given the fact that 9% of the population is K+, approximately how many ABO-compatible units should be tested to identify three antigen-negative donor units?

- A. 4.
  - B. 9.
  - C. 33.
  - D. Cannot determine with the information provided.
- 

10. Which crossmatch techniques should NOT be used with this sample?

- A. Immediate-spin crossmatch.
- B. Solid-phase IAT.
- C. Gel IAT.
- D. LISS 37 C, LISS IAT.



## **Case Study 2**

**Initial Data:**

BH, a 62-year-old female, is scheduled for knee replacement surgery tomorrow. She has had several other surgeries, some requiring blood transfusion, but no procedures in the last 3 years. She has three children.

A sample was received in the blood bank with orders for type and crossmatch of 2 units of Red Blood Cells. The following results were obtained in initial testing.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	4+	4+	3+	0

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		LISS (Test Tube)			
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IS	37 C	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	0	0	0	2+
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	+	+	+	0	0	0	1+	
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	0	0	+	0	+	0	+	+	+	0	0	0√	

1. What is BH's ABO type?

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

2. What is BH's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the initial antibody detection test (screen), which of the following would be the MOST likely interpretation of the patient's antibody status?

- A. No antibodies are present in the patient's serum.
- B. The patient has one or more alloantibodies.
- C. The patient has one or more autoantibodies.
- D. The patient has an autoantibody with one or more underlying alloantibodies.

4. Which of the following antibodies **COULD** be ruled out using these initial antibody detection test results?

- A. Anti-C.
- B. Anti-e.
- C. Anti-Jk<sup>a</sup>.
- D. None of the above could be ruled out.

5. Which of the following procedures would be the **BEST** to perform next in this case?

- A. Repeat the antibody detection cells and include an autologous control.
- B. Perform an immediate-spin crossmatch.
- C. Test an eluate from the patient's cells.
- D. Test an antibody identification panel.

**Antibody Identification Panel 1 (LISS Tube Method):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		LISS		
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37 C	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	0	0	2+
<b>2</b>	+	+	0	0	+	0	+	+	+	0	0	+	0	0	0	0	+	+	+	+	+	0	0	2+
<b>3</b>	+	0	+	+	0	0	0	+	+	+	0	+	0	0	0	0	+	+	+	0	+	0	0	1+
<b>4</b>	+	0	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	0	0	+	0	0	0√
<b>5</b>	0	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	0	0	2+
<b>6</b>	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	0	0	0√
<b>7</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	0	+	+	0	+	0	+	0	0	0	0√
<b>8</b>	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	0	0	2+
<b>9</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	0	+	0	+	+	+	+	0	0	0√
<b>10</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	+	0	0	2+
<b>11</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	0	+	+	+	0	+	+	+	0	0	2+
<b>AC</b>																						0	0	0√

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

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6. **BH's history and the results of Panel 1 are consistent with which of the following interpretations?**

- A. It is likely that BH has a single red cell alloantibody.
  - B. It is likely that BH has multiple red cell alloantibodies.
  - C. It is likely that BH has an autoantibody.
  - D. It is likely that BH has an autoantibody with one or more underlying alloantibodies.
- 

7. **Which of the following alloantibodies CANNOT be ruled out using the results of antibody detection test (screen) combined with Panel 1?**

- A. Anti-c.
  - B. Anti-Fy<sup>a</sup>.
  - C. Anti-M.
  - D. Anti-N.
- 

8. **Which of the following antibody combinations could account for all of the reactions noted in Panel 1?**

- A. Anti-C and anti-Fy<sup>a</sup>.
  - B. Anti-Fy<sup>a</sup> and anti-E.
  - C. Anti-M and anti-C.
  - D. Anti-C and anti-Jk<sup>a</sup>.
- 

9. **In order to strengthen the hypothesis of anti-C plus anti-Fy<sup>a</sup>, the medical laboratory scientist repeated the antibody identification panel using manufacturer-supplied ficin-treated cells. Assuming that the hypothesis is correct, what would you predict?**

- A. All previously reactive cells from the untreated panel would be more strongly reactive.
  - B. All previously reactive cells from the untreated panel would be more weakly reactive or not reactive at all.
  - C. Anti-C reactions would be at the same or greater strength and anti-Fy<sup>a</sup> reactions would be weakened or abolished.
  - D. Anti-Fy<sup>a</sup> reactions would be at the same or greater strength and anti-C reactions would be weakened or abolished.
- 

10. **What antibody(ies) could account for all reactions on Panel 2?**

- A. Anti-C.
- B. Anti-C plus Anti-K.
- C. Anti-Fy<sup>a</sup>.
- D. Anti-Jk<sup>a</sup>.

## Antibody Identification Panel 2 (Ficin-Treated)\*:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Ficin	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	37 C	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	2+	4+
<b>2</b>	+	+	0	0	+	0	+	+	+	0	0	+	0	0	0	0	+	+	+	+	+	2+	4+
<b>3</b>	+	0	+	+	0	0	0	+	+	+	0	+	0	0	0	0	+	+	+	0	+	0	0 <sup>√</sup>
<b>4</b>	+	0	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	0	0	+	0	0 <sup>√</sup>
<b>5</b>	0	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	2+	4+
<b>6</b>	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	0	0 <sup>√</sup>
<b>7</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	0	0 <sup>√</sup>
<b>8</b>	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	0	0 <sup>√</sup>
<b>9</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	+	0	0	+	0	+	+	+	0	0 <sup>√</sup>
<b>10</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	+	0	0 <sup>√</sup>
<b>11</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	+	+	0	+	+	+	2+	4+
<b>AC</b>																						0	0 <sup>√</sup>

\*Initial panel – ficin treated by manufacturer

11. Using the results of the antibody detection test and antibody Panels 1 and 2 collectively, which of the following antibodies CANNOT be ruled out?
- Anti-E.
  - Anti-N.
  - Anti-Jk<sup>a</sup>.
  - None of the above.
12. Assume that 100 randomly selected ABO- and RH-compatible units from blood donors of European ancestry were evaluated for compatibility with this patient. [Note: the prevalence of the two antigens in this population is C+ = 70% and Fy(a+) = 66%.] Approximately how many units would be compatible with her sample?
- 10
  - 46
  - 64
  - 86

## **Case Study 3**

**Initial Data:**

BF, a 37-year-old male, is scheduled for a same-day surgical procedure for hernia repair. He has no history of significant medical problems, with the exception of injuries received during his service in the military. He was given 6 units of blood following a land mine explosion 4 years ago. At that time, his transfusions were uneventful.

A sample for “type and screen” was sent to the laboratory on the morning of the procedure. The following results were obtained.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	0	4+	4+	4+

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	<b>2+</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	+	+	+	0	<b>4+</b>

1. What is BF’s ABO type?

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

2. What is BF’s RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the antibody detection test, what hypothesis can be developed?

- A. One or more alloantibodies are present.
- B. One or more autoantibodies are present.
- C. Both A and B are potential solutions.
- D. Neither A nor B is supported by the evidence.

4. Given the initial serologic findings, what should the medical laboratory scientist do next?

- A. Perform an eluate on the patient's cells.
- B. Report the findings and do no further testing.
- C. Crossmatch 2 units of group O Red Blood Cells.
- D. Test an antibody identification panel.

**Antibody Identification Panel:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>0</b>
<b>2</b>	+	+	0	0	+	0	+	+	+	0	0	+	0	0	0	0	+	+	+	+	+	+	<b>0</b>
<b>3</b>	+	0	+	+	0	0	0	+	+	+	0	+	0	0	0	0	+	+	+	+	0	+	<b>4+</b>
<b>4</b>	+	0	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	0	0	+	+	<b>0</b>
<b>5</b>	0	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	+	<b>0</b>
<b>6</b>	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>4+</b>
<b>7</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	+	<b>2+</b>
<b>8</b>	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	+	<b>0</b>
<b>9</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	0	+	+	0	+	+	+	+	<b>0</b>
<b>10</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	+	+	<b>0</b>
<b>11</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	+	+	0	+	+	+	+	<b>2+</b>
<b>AC</b>																							<b>0</b>

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

5. Based on the antibody identification test results and the laboratory rule-out criteria listed above, which of the following cells would rule out anti-c?

- A. Cell 3.
- B. Cell 5.
- C. Cell 7.
- D. Cell 9.



6. **Note there are no cells on this panel that have a double dose of the K antigen. Which of the following statements is true regarding the K+k- phenotype?**
- A. Although the phenotype is not represented on this antibody identification panel, it is fairly common in the population.
  - B. The phenotype occurs in about 50% of the population.
  - C. The phenotype is uncommon but does occur in about 10% of the population.
  - D. The phenotype is rare due to the high prevalence of the k antigen in the population.
- 
7. **Given the results of the antibody detection and antibody identification testing, what is/are the most likely antibody(ies) present in BF's serum?**
- A. Anti-C and anti-E.
  - B. Anti-E and anti-K.
  - C. Anti-C and anti-K.
  - D. Anti-E only.
- 
8. **How many additional cells must be tested to meet the "3 + 3 rule" for anti-E?**
- A. 0
  - B. 1
  - C. 2
  - D. 3
- 
9. **Given the combined results of the antibody detection and antibody identification tests, which of the following antibodies has NOT been ruled out?**
- A. Anti-C.
  - B. Anti-M.
  - C. Anti-Fy<sup>a</sup>.
  - D. None of the above.
- 
10. **It is the policy of this laboratory to identify two antigen-negative units for patients with antibodies, even if the original order was for type and screen only. There are 30 group O+ units in the laboratory's inventory. The antigen frequencies are E antigen = 30% and K antigen = 9%. APPROXIMATELY how many of these units would be expected to be negative for the antigens to the antibodies that have been identified?**
- A. 0 - 1.
  - B. 3 - 4.
  - C. 10 - 11.
  - D. 19 - 20.

## **Case Study 4**

**Initial Data:**

SC is a 92-year-old female who is scheduled for repair of a fractured hip as soon as blood is available. The broken hip was sustained in a fall while she was visiting her daughter in another city. Because she is not being treated by her own physician, complete medical records are not available. Her daughter reports, however, that her mother had been relatively healthy during her life and has not been admitted to a hospital except for childbirth. The following results were obtained during routine pretransfusion testing.

**ABO and RH Typing:**

Forward (Cell) Typing				Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D IS	Anti-D IAT	A <sub>1</sub> Cells	B Cells
0	0	0	0√	4+	4+

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Solid Phase	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	0	+	<b>2+</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	+	+	+	+	0	<b>2+</b>

1. What is SC's ABO type?

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

2. What is SC's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the antibody detection test, which of the following choices represents the LEAST likely interpretation?

- A. One or more alloantibodies.
- B. One or more autoantibodies.
- C. Antibody to high-prevalence antigen.
- D. Antibodies to multiple low-prevalence antigens.

4. Which of the following alloantibodies can be excluded on the basis of the antibody detection test results?

- A. Anti-D.
- B. Anti-N.
- C. Anti-Fy<sup>a</sup>.
- D. None of the above.

**Antibody Identification Panel 1:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		SP	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>2+</b>
<b>2</b>	+	+	0	0	+	0	+	+	+	0	0	+	0	0	0	0	+	+	+	+	+	+	<b>2+</b>
<b>3</b>	+	0	+	+	0	0	0	+	+	+	0	+	0	0	0	0	+	+	+	0	+	+	<b>2+</b>
<b>4</b>	+	0	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	0	0	+	+	<b>2+</b>
<b>5</b>	0	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	0	<b>0</b>
<b>6</b>	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>0</b>
<b>7</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	+	<b>0</b>
<b>8</b>	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	0	<b>0</b>
<b>9</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	+	0	0	+	0	+	+	+	+	<b>0</b>
<b>10</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	0	+	<b>0</b>
<b>11</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	+	+	0	+	+	+	+	<b>2+</b>

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient’s serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient’s serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -P1, -Le<sup>b</sup>, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

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5. **Based on the results of the antibody detection and identification tests, which of the following is the MOST likely preliminary interpretation?**

- A. One or more alloantibodies to common antigens.
  - B. One or more autoantibodies.
  - C. Antibody to a high-prevalence antigen.
  - D. Antibodies to multiple low-prevalence antigens.
- 

6. **Which of the following tests could have been performed to determine whether an autoantibody might be present in the sample?**

- A. Elution studies.
  - B. Direct antiglobulin test.
  - C. Antibody identification panel using ficin-treated red cells.
  - D. Red cell antigen phenotyping.
- 

7. **What alloantibody specificity(ies) is/are MOST likely present in the patient's sample?**

- A. Anti-Jk<sup>b</sup>.
  - B. Anti-D plus anti-C.
  - C. Anti-f.
  - D. Anti-D.
- 

8. **Which alloantibody(ies) CANNOT be excluded according to the laboratory's antibody exclusion criteria?**

- A. Anti-C.
  - B. Anti-E.
  - C. Both of the above.
  - D. Neither of the above.
- 

9. **Which action would be the LEAST practical and effective way to manage excluding anti-C and anti-E in the presence of anti-D in this facility?**

- A. Test serum with one or more r'r' and r''r'' reagent cells.
- B. Test additional r'r and r''r reagent cells.
- C. No additional testing in the laboratory.
- D. Select units for transfusion that are also C-E-.

---

10. What was the MOST LIKELY source of stimulation of the antibody in this patient?

- A. Transfusion with RH+ red cell components.
- B. RH+ pregnancy without RH prophylaxis.
- C. Transfusion with RH+ platelets.
- D. RH+ pregnancy with failed RH prophylaxis.

## **Case Study 5**

**Initial Data:**

LN, a 25-year-old woman who is pregnant with her second child, had routine orders for a “type and screen,” with the following results:

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
4+	0	4+	0	4+

**Antibody Detection Test (Screen):**

							MNS				LU		P	Lewis		Kell		Duffy		Kidd		LISS			
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IS	37 C	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	0	0	0	0√
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	+	+	+	0	0	2+	3+	
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	0	+	0	+	+	0	+	+	+	0	2+	3+	

1. What is LN’s ABO type?

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

2. What is LN’s RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. What would be the MOST LIKELY interpretation of the antibody detection test results?

- A. A single alloantibody to a common antigen.
- B. An antibody directed against an antigen of high prevalence.
- C. Multiple alloantibodies to common antigens.
- D. Cannot differentiate between A and C.



---

4. What is the MOST PROBABLE immunoglobulin class of the antibodies?

- A. IgA.
- B. IgE.
- C. IgG.
- D. IgM.

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -P1, -Le<sup>b</sup>, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

---

5. Given the results of the antibody detection test, which of the following antibodies is TENTATIVELY ruled out?

- A. Anti-E.
- B. Anti-M.
- C. Anti-Fy<sup>a</sup>.
- D. Anti-Jk<sup>a</sup>.

---

6. Assuming the patient has a single alloantibody, which of the following antibodies would be the MOST LIKELY initial hypothesis?

- A. Anti-E.
- B. Anti-c.
- C. Anti-M.
- D. Anti-Lu<sup>b</sup>.

---

7. Because we have not eliminated the possibility of multiple antibodies in this case, what antibodies could BEST account for the reactions seen in the antibody detection test?

- A. Anti-c and anti-Jk<sup>a</sup>.
- B. Anti-E and anti-K.
- C. Anti-c and anti-Le<sup>b</sup>.
- D. Anti-D and anti-c.

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

8. Which of the following conclusions is supported by the reactions noted in the antibody identification panel?

- A. The patient has an autoantibody.
- B. The possibility of multiple antibodies has been eliminated.
- C. No additional cells need to be tested.
- D. The panel results are consistent with anti-c.

9. Which of the following antibodies **CANNOT** be ruled out using the results of the antibody detection and identification panel results combined?

- A. Anti-D.
- B. Anti-E.
- C. Anti-M.
- D. Anti-Fy<sup>a</sup>.

10. The medical laboratory scientist has hypothesized that the patient has anti-c and has begun the process of selecting cells to rule out other antibody specificities including anti-Le<sup>b</sup>, anti-S, and anti-Jk<sup>a</sup>. Which of the cells in the table below should the medical laboratory scientist choose to rule out anti-Jk<sup>a</sup>?

Antigen Typing	c	Jk <sup>a</sup>	Jk <sup>b</sup>
Cell 1	+	+	0
Cell 2	0	+	0
Cell 3	0	+	+
Cell 4	+	0	+

- A. Cell 1.
- B. Cell 2.
- C. Cell 3.
- D. Cell 4.

---

11. Many laboratories follow the “3 + 3 rule.” When the medical laboratory scientist concluded that the patient had an anti-c, did the results conform to this rule?

- A. Yes.
- B. No, he/she would have to test additional c+ cells.
- C. No, he/she would have to test additional c- cells.
- D. No, he/she would have to test additional c+ and c- cells.

---

12. Which of the following is true regarding the results of LN’s RH phenotyping, shown below?

Anti-C	Anti-E	Anti-c	Anti-e	Anti-K
4+	0	0	4+	4+

- A. It provides evidence to confirm the anti-c conclusion.
- B. The data are inconsistent with an anti-c conclusion.
- C. Neither A nor B.
- D. Cannot determine with data provided.

---

13. Given the results of the phenotyping above, what is/are the patient’s POSSIBLE RH phenotypes using Fisher-Race nomenclature?

- A. DCe/DCe.
- B. DCe/Ce.
- C. Both A and B are possible.
- D. Neither A nor B are possible.

---

14. How is DCe/Ce expressed in the Weiner nomenclature?

- A. R<sub>1</sub>r’.
- B. R<sub>0</sub>r’.
- C. R<sub>1</sub>r.
- D. None of the above.

---

15. What is the approximate frequency of the R<sub>1</sub>r’ phenotype in populations of European ancestry?

- A. 0.02.
- B. 0.31.
- C. 0.37.
- D. 0.42.

---

16. In the presence of anti-c, what other RH antibody(ies) would be difficult to rule out if the laboratory policy required the use of a double-dose cell?

- A. Anti-C.
- B. Anti-E.
- C. Anti-e.
- D. Both anti-C and anti-E.

---

17. According to AABB *Standards for Blood Banks and Transfusion Services*, if LN required Red Blood Cells, what additional step(s) MUST be performed to provide suitable blood for transfusion?

- A. Select ABO-compatible c- units.
- B. Crossmatch donor units including use of 37 C and IAT phases of testing.
- C. Neither A nor B.
- D. Both A and B.

---

18. Given the frequency of the c antigen (80% in the population of European ancestry), approximately how many RBC units would have to be tested to find three c- units?

- A. 2.
- B. 5.
- C. 15.
- D. 20.

## **Case Study 6**

**Initial Data:**

BC, a 25-year-old African American female, has presented to the emergency department at a local hospital with severe vaginal bleeding. She is 17 weeks pregnant. This is her first pregnancy and she has no history of transfusion or transplantation.

Specimens have been drawn for laboratory testing, including an order for a type and antibody detection test (results below).

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
4+	0	0	0	4+

1. What is BC's ABO type?

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

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	<b>2+</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	+	+	+	0	<b>2+</b>

2. What is BC's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the antibody detection test, what hypothesis can be proposed?

- A. One or more alloantibodies are present.
- B. One or more autoantibodies are present.
- C. Both A and B are potential solutions.
- D. Neither A nor B is supported by the evidence.

## Antibody Identification Panel 1:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
1	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	1+
2	+	+	0	0	+	0	+	+	+	0	0	+	0	0	0	0	+	+	+	+	+	0
3	+	0	+	+	0	0	0	+	+	+	0	+	0	0	0	0	+	+	+	0	+	0
4	+	0	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	0	0	+	2+
5	0	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	2+
6	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	1+
7	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	2+
8	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	1+
9	0	0	0	+	+	+	+	0	+	0	0	+	+	+	0	0	+	0	+	+	+	2+
10	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	+	1+
11	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	+	+	0	+	+	+	2+
AC																						0

## Laboratory Protocol:

The following antibodies can be initially ruled out **ONLY** if the patient's serum does **NOT** react with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum does **NOT** react with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

## 4. Which of the following sets of antibodies CAN be ruled out using these initial panel results?

- A. Anti-M, anti-s, anti-K, and anti-Le<sup>a</sup>.
- B. Anti-D, anti-c, anti-S, and anti-k.
- C. Anti-Lu<sup>a</sup>, anti-f, anti-Le<sup>b</sup>, and anti-C<sup>w</sup>.
- D. All of the above can be ruled out.

## 5. Given these initial serologic findings, which of the following is the MOST likely initial hypothesis?

- A. The patient has anti-Le<sup>a</sup> and anti-K.
- B. The patient has anti-M and anti-K.
- C. The patient has anti-Le<sup>a</sup> and anti-Le<sup>b</sup>.
- D. The patient has anti-Le<sup>a</sup> and anti-Lu<sup>a</sup>.

**Extended Testing:**

The emergency department (ED) staff determined that the patient experienced miscarriage. The transfusion service staff informed the ED personnel of the positive antibody screen. The patient's nurse said that transfusions would not be needed, but the patient's obstetrician is interested in knowing the antibody identification. The technologist tested an additional antibody identification panel using a saline tube technique.

**Antibody Identification Panel 2:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Saline		
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37 C	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	1+	3+
<b>2</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	0	0	1+
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	+	0	0	+	0	0	0√
<b>4</b>	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	+	+	+	0	0	0√
<b>5</b>	0	0	+	+	+	+	+	+	0	+	0	+	0	+	0	+	0	+	0	+	0	+	0	1+
<b>6</b>	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	0	0	0√
<b>7</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	+	0	+	0	+	+	0	0	0	0	1+
<b>8</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	0	0	1+
<b>9</b>	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	0	+	+	0	+	0	1+	3+
<b>10</b>	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	+	+	0	+	0	+	0	1+	3+
<b>11</b>	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	+	0	0	0	+	+	0	0	1+
<b>AC</b>																						0	0	0√

6. What is the advantage of using tube testing techniques in addition to gel in the investigation of this case?

- A. Tube testing may provide additional information regarding the phase of reactivity.
- B. Tube testing is easier to perform.
- C. Tube testing is more stable over time.
- D. None of the above.

7. Which of the following antibodies that were not initially ruled out with Panel 1 can be ruled out by Panel 2?

- A. Anti-Fy<sup>b</sup>.
- B. Anti-Lu<sup>a</sup>.
- C. Anti-K.
- D. Anti-Jk<sup>a</sup>.

8. Individuals with which of the following genotypes would be the MOST likely to produce antibodies in the Lewis system?

- A. *LeLe Sese*.
- B. *lele sese*.
- C. *LeLe sese*.
- D. *LeLe Sese*.



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9. **What data in BC's history would increase the probability of her producing Lewis system antibodies?**

- A. Current pregnancy.
- B. African American ethnicity.
- C. Both of the above.
- D. Neither of the above.

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10. **Based on the serologic findings, can you accurately predict BC's Lewis genotype?**

- A. Yes.
- B. No.

## **Case Study 7**

**Initial Data:**

RY, a 36-year-old male, has been in an automobile accident. Two units of Red Blood Cells Leukocytes Reduced are ordered STAT. He denies having a previous transfusion. He has a number of previous hospital admissions with no record of clinically significant antibodies.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
4+	0	3+	2+	4+

1. How would you interpret RY's ABO forward (cell) type?

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

2. How would you interpret the ABO reverse (serum) type?

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

3. What is the BEST next step in this case?

- A. Report RY's type as group A.
- B. Report RY's type as group O.
- C. Hypothesize that the reverse typing is incorrect and investigate.
- D. Hypothesize that the forward typing is incorrect and investigate.

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG (Test Tube)		
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37 C	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	2+	NH	1+
<b>2</b>	+	0	+	+	0	0	0	+	0	+	0	+	+	0	+	0	+	+	+	+	0	0	NH	0√
<b>3</b>	0	0	0	+	+	+	+	0	+	0	0	+	0	0	+	0	+	0	+	+	+	3+	NH	1+

4. Given the results of the antibody detection test, which of the following would be the MOST LIKELY interpretation of the patient’s antibody status?

- A. No antibodies are present in the patient’s serum.
- B. The patient has one or more alloantibodies and/or autoantibodies.
- C. The patient has one or more autoantibodies.
- D. The patient has an autoantibody with one or more underlying alloantibodies.

5. Given the reactivity of the initial antibody detection test, what is the MOST LIKELY immunoglobulin class of the antibody(ies)?

- A. IgG.
- B. IgM.
- C. IgA.
- D. IgE.

6. Of the following, which would be the BEST next step(s) in this case?

- A. An antibody identification test using polyethylene glycol (PEG).
- B. An autocontrol.
- C. Both A and B.
- D. Neither A nor B.

**Antibody Identification Panel 1—PEG Technique:**

	RH					MN				P	Lewis		Kell		Duffy		Kidd		PEG		
	D	C	E	c	e	M	N	S	s	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37 C	IAT
1	+	+	0	0	+	+	+	+	+	0	+	0	0	+	0	+	0	+	2+	NH	1+
2	0	0	0	+	+	+	0	+	0	+ <sup>w</sup>	0	+	+	0	+	+	+	0	3+	NH	1+
3	0	0	+	+	0	0	+	0	+	+ <sup>s</sup>	0	+	+	+	+	0	0	+	0	NH	0√
4	+	+	0	0	+	+	0	+	+	0	0	0	0	+	+	+	+	+	3+	NH	1+
5	0	0	+	+	+	+	+	0	+	0	0	+	0	+	0	+	0	+	2+	NH	1+
6	0	+	0	0	+	0	+	0	+	+	0	+	+	+	+	+	+	+	0	NH	0√
7	+	0	+	+	0	+	0	0	+	0	0	+	0	+	0	+	+	0	3+	NH	1+
8	0	0	0	+	+	+	0	+	0	0	0	+	0	+	+	0	0	+	3+	NH	1+
9	+	+	0	+	+	+	+	0	+	+	+	0	0	+	0	+	+	0	2+	NH	1+
10	+	0	+	+	0	0	+	+	+	+	+	0	0	+	+	0	+	0	0	NH	0√
11	+	0	0	+	+	0	+	0	0	+ <sup>s</sup>	0	+	0	+	0	0	+	+	0	NH	0√
AC																			0	NH	0√

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

---

7. **Given the results of the antibody detection and identification tests, what is/are the MOST LIKELY antibody specificity(ies)?**

- A. Anti-M.
- B. Anti-S.
- C. Anti-K and anti-Fy<sup>b</sup>.
- D. Anti-M and anti-S.

---

8. **Which of the following alloantibodies COULD BE ruled out using the results of the antibody detection test combined with results of Panel 1?**

- A. Anti-K.
- B. Anti-Fy<sup>b</sup>.
- C. Anti-M.
- D. Anti-S.

---

9. **Which of the following tests should be performed to resolve/complete the antibody identification in this case?**

- A. Rule out anti-Fy<sup>b</sup>.
- B. Rule out anti-S.
- C. Antigen type the patient for M.
- D. All of the above.

## Antibody Identification Panel 2—Prewarmed Saline IAT:

Panel	RH					MNS				P	Lewis		Lell		Duffy		Kidd		Prewarmed Saline IAT
	D	C	E	c	e	M	N	S	s	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	
1	+	+	0	0	+	+	+	+	+	0	+	0	0	+	0	+	0	+	0√
2	0	0	0	+	+	+	0	+	0	+ <sup>w</sup>	0	+	+	0	+	+	+	0	0√
3	0	0	+	+	0	0	+	0	+	+ <sup>s</sup>	0	+	+	+	+	0	0	+	0√
4	+	+	0	0	+	+	0	+	+	0	0	0	0	+	+	+	+	+	0√
5	0	0	+	+	+	+	+	0	+	0	0	+	0	+	0	+	0	+	0√
6	0	+	0	0	+	0	+	0	+	+	0	+	+	+	+	+	+	+	0√
7	+	0	+	+	0	+	0	0	+	0	0	+	0	+	0	+	+	0	0√
8	0	0	0	+	+	+	0	+	0	0	0	+	0	+	+	0	0	+	0√
9	+	+	0	+	+	+	+	0	+	+	+	0	0	+	0	+	+	0	0√
10	+	0	+	+	0	0	+	+	+	+	+	0	0	+	+	0	+	0	0√
11	+	0	0	+	+	0	+	0	0	+ <sup>s</sup>	0	+	0	+	0	0	+	+	0√
AC																			0√

10. In order to determine the reactivity of the antibody at 37 C, the medical laboratory scientist repeated the panel using a prewarmed saline IAT procedure. Given the results of this panel, which of the following can be concluded?

- A. The anti-M is reactive at 37 C.
- B. M- blood should be selected for transfusion.
- C. The anti-M hypothesis should be rejected.
- D. None of the above.

11. Now that the medical laboratory scientist has determined that the anti-M did not show reactivity at 37 C, he/she repeated the reverse typing using a prewarmed technique. Using the results below, how should the reverse typing be interpreted?

Prewarmed Technique for Reverse Typing	
A <sub>1</sub> Cells	B Cells
0	3+

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

- 
12. **Given the results of the antibody detection and identification testing, what type of crossmatch could avoid the reactivity of the anti-M?**
- A. Saline IAT.
  - B. PEG at IS only.
  - C. PEG at IS, 37 C, and IAT.
  - D. Immediate spin.

## **Case Study 8**



**Initial Data:**

GP, a 57-year-old male, has been admitted for routine surgery. His medical history is unremarkable and he reports that he is currently in good health. He has no history of previous serologic problems but does report that he had received blood transfusions after an injury during the Vietnam War.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	4+	0	4+	0

**Antibody Detection Test (Screen):**

							MNS				LU		P	Lewis		Kell		Duffy		Kidd		LISS
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	<b>1+</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	+	+	+	+	<b>3+</b>

1. What is GP's ABO type?

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

2. What is GP's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine from the data provided.

3. Given the results of the antibody detection test, what hypothesis can be proposed?

- A. One or more alloantibodies are present.
- B. One or more autoantibodies are present.
- C. Both A and B are potential solutions.
- D. Neither A nor B are supported by the evidence.

4. Which of the following would be the MOST informative step to be performed next?

- A. Direct antiglobulin test.
- B. Eluate.
- C. Antibody identification panel.
- D. Red cell phenotyping.

**Antibody Identification Panel 1:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		LISS	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>1+</b>
<b>2</b>	+	+	0	0	+	0	+	+	+	0	0	+	0	0	+	0	+	+	+	+	+	+	<b>1+</b>
<b>3</b>	+	0	+	+	0	0	0	+	+	+	0	+	0	+	0	0	+	+	+	0	+	+	<b>3+</b>
<b>4</b>	+	0	0	+	+	+	+	+	0	+	0	+	+	0	+	0	+	0	0	0	+	+	<b>1+w</b>
<b>5</b>	0	+	0	+	+	+	+	+	0	+	0	+	+	0	0	0	+	+	0	+	0	+	<b>0√</b>
<b>6</b>	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>0√</b>
<b>7</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	+	<b>0√</b>
<b>8</b>	0	0	0	+	+	+	+	+	+	+	0	+	0	0	0	0	+	+	0	+	0	+	<b>0√</b>
<b>9</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	+	0	0	+	0	+	+	+	+	<b>0√</b>
<b>10</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	+	+	<b>0√</b>
<b>11</b>	+	+	0	+	+	0	+	+	+	+	0	+	0	+	0	+	+	0	+	+	+	+	<b>0√</b>
<b>AC</b>																							<b>0√</b>

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

5. Based on the results of the antibody detection and identification tests, which of the following appears to be present?

- A. One or more alloantibodies to common antigens.
- B. One or more autoantibodies.
- C. Antibody to high-prevalence antigen.
- D. Antibodies to multiple low-prevalence antigens.

6. Which antibody specificity(ies) has a perfect “pattern of fit” for the reactions seen?

- A. Anti-f
- B. Anti-Le<sup>a</sup>, anti-Le<sup>b</sup>.
- C. Anti-D.
- D. None.

7. According to facility policy, what alloantibody specificities are ruled out using the results of the antibody identification panel?

- A. Anti-C.
- B. Anti-E.
- C. Both anti-C and anti-E.
- D. Neither anti-C nor anti-E.

8. Which of the following additional tests could be used to potentially rule out these antibody specificities and could be performed in a reasonable time frame in most routine transfusion services?

- A. Test additional r'r and r''r cells in LISS.
- B. Test additional r'r and r''r cells in ficin.
- C. Test rare r'r' and r''r'' cells in LISS.
- D. Type the patient's cells for C and E antigens.

9. Given the additional typing of GP's cells shown below, which antibody specificities can be ruled out?

		Anti-E
<b>GP's red cells</b>	0	3+
<b>Positive control</b>	4+	4+
<b>Negative control</b>	0	0

- A. Anti-C.
- B. Anti-E.
- C. Anti-C and anti-E.
- D. Neither anti-C nor anti-E.

10. In a case such as GP's where no exact fit is found and no specificity is evident, what additional step could be MOST informative?

- A. Test a panel in another media.
- B. Perform a direct antiglobulin test.
- C. Perform a complete red cell phenotype.
- D. Obtain a more complete patient history.

**Antibody Identification Panel 2:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>3+</b>
<b>2</b>	+	+	0	0	+	0	+	+	+	0	0	+	0	0	+	0	+	+	+	+	+	+	<b>3+</b>
<b>3</b>	+	0	+	+	0	0	0	+	+	+	0	+	0	+	0	0	+	+	+	0	+	+	<b>3+</b>
<b>4</b>	+	0	0	+	+	+	+	+	0	+	0	+	+	0	+	0	+	0	0	0	+	+	<b>3+</b>
<b>5</b>	0	+	0	+	+	+	+	+	0	+	0	+	+	0	0	0	+	+	0	+	0	+	<b>0√</b>
<b>6</b>	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>0√</b>
<b>7</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	+	<b>0√</b>
<b>8</b>	0	0	0	+	+	+	+	+	+	+	0	+	0	0	0	0	+	+	0	+	0	+	<b>0√</b>
<b>9</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	0	0	+	0	+	+	+	+	<b>0√</b>
<b>10</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	+	+	<b>0√</b>
<b>11</b>	+	+	0	+	+	0	+	+	+	+	0	+	0	+	0	+	+	0	+	+	+	+	<b>3+</b>
<b>AC</b>																							<b>0√</b>

11. Given the combined serologic results (antibody detection, patient phenotyping, and antibody identification panels), what can the technologist conclude regarding the specificity of the antibody(ies) in GP's serum?

- A. Anti-C is present.
- B. Anti-E is present.
- C. Anti-D is present.
- D. Anti-C, anti-E, and anti-D are present.

12. What is the MOST likely explanation for the lack of positive reactivity with Cell 11 in the initial LISS panel?

- A. Donor sample was not added to the test.
- B. Antibody did not react with single dose of D antigen.
- C. The test cell is actually D- (error by manufacturer).
- D. The test cell carries a variant D antigen.

## **Case Study 9**

**Initial Data:**

JD is a 15-year-old female of European ancestry who is scheduled for orthopedic surgery. This is her second surgery in 3 months following a motor vehicle accident. She received 2 units of Red Blood Cells (RBCs) after her last surgery. Pretransfusion testing was uneventful at that time. Pretransfusion testing for this surgery follows:

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	4+	3+	4+	0

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	E	c	e	F	M	N	S	S	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	+	+	<b>0</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	0	+	+	0	<b>1+</b>

1. What is JD’s ABO type?

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

2. What is JD’s RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the antibody detection test, what hypothesis can be generated?

- A. One or more alloantibodies are present.
- B. One or more autoantibodies are present.
- C. Both A and B are potential solutions.
- D. Neither A nor B is supported by the evidence.

4. Of the following, which would be the MOST informative step to be performed next?

- A. Test a routine antibody identification panel using Gel IAT.
- B. Repeat the antibody detection test using a three-cell screen.
- C. Test a routine antibody identification panel using LISS IAT.
- D. Repeat the antibody detection test using LISS IAT.

**Antibody Identification Panel 1:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	<b>0</b>
<b>2</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	<b>0</b>
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	+	0	0	+	<b>0</b>
<b>4</b>	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	+	+	+	<b>0</b>
<b>5</b>	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	<b>0</b>
<b>6</b>	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	<b>0</b>
<b>7</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	0	<b>1+</b>
<b>8</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	<b>0</b>
<b>9</b>	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	0	+	+	+	0	<b>0</b>
<b>10</b>	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	+	+	0	+	0	+	<b>1+</b>
<b>11</b>	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	<b>0</b>
<b>AC</b>																						<b>0</b>

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially be ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

5. Based on the combined results of the antibody detection and identification (Panel 1) tests, which of the following appears to be present?

- A. One or more alloantibodies to common antigens.
- B. Antibody to a low-prevalence antigen.
- C. Antibody to a high-prevalence antigen.
- D. Autoantibody.

6. Given the results of the initial testing what antibodies CANNOT be ruled out?

- A. Anti-D.
- B. Anti-E.
- C. Anti-K.
- D. Anti-Fy<sup>a</sup>.

7. Given the results of the PEG panel (Panel 2), what is the MOST probable antibody specificity?

- A. Anti-K.
- B. Anti-Le<sup>b</sup>.
- C. Anti-C.
- D. Anti-E.

**Antibody Identification Panel 2:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG		
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IS	37 C	IAT
1	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	NH	0√
2	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	0	NH	0√
3	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	+	0	0	+	0	NH	0√
4	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	+	+	+	0	NH	0√
5	0	0	+	+	+	+	+	+	0	+	0	+	0	+	0	+	0	+	0	+	+	W+	NH	W+
6	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	0	NH	0√
7	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	0	1+	NH	1+
8	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	0	NH	0√
9	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	0	+	+	+	0	0	NH	0√
10	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	+	+	0	+	+	0	1+	NH	1+
11	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	0	NH	0√
AC																						0	NH	0√

8. What could explain why the antibody reactivity was seen at immediate spin?

- A. The anti-E is an IgM, newly formed antibody.
- B. There is another cold-reactive autoantibody in addition to anti-E.
- C. There is another cold-reactive alloantibody in addition to anti-E.
- D. Anti-E is an IgG antibody.

**Extended Testing:**

The medical laboratory scientist decides to conduct a saline test tube panel to assess reactivity at room temperature and 37 C incubation to further confirm the initial conclusion and provide additional evidence that no other antibody specificities were present.



## Antibody Identification Panel 3:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Saline			
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37C	IAT	
1	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	0	0	0√
2	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	0	0	0	0√
3	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	+	0	0	+	0	0	0	0√
4	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	+	+	+	+	0	0	0√
5	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	W+	1+	W+	
6	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	0	0	0√	
7	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	0	1+	2+	1+	
8	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	0	0	0√	
9	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	+	0	+	+	0	0	0	0	0√
10	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	+	+	+	0	+	0	1+	2+	1+	
11	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	0	0	0	0√
AC																						0	0	0√	

## Laboratory Protocol:

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

9. Given the data from Panel 3 as compared to the results in Panel 1 with gel and Panel 2 with PEG, what antibody specificity is MOST likely responsible for the reactivity noted?

- A. Anti-K.
- B. Anti-Le<sup>b</sup>.
- C. Anti-C.
- D. Anti-E.

10. What additional testing from the list below will further confirm specificity of the antibody?

- A. Antigen type patient's cells.
- B. Test a panel of additional selected cells.
- C. Repeat the panel using enzyme-treated cells.
- D. None of the above.

## **Case Study 10**

**Initial Data:**

BH is a 42-year-old male with Crohn’s disease. He has undergone several surgeries for treatment of this problem and received blood during the most recent of these surgeries, 4 years ago. He is currently undergoing evaluation for unexplained anemia. His current hemoglobin level is 7.9 g/dL. His physician has ordered transfusion of 2 units of Red Blood Cells.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	0	4+	4+	4+

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	+	0√
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	+	+	+	+	0	2+

1. What is BH’s ABO type?

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

2. What is BH’s RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the antibody detection test, what hypothesis can be generated?

- A. One or more alloantibodies are present.
- B. One or more autoantibodies are present.
- C. Both A and B are potential solutions.
- D. Neither A nor B are supported by the evidence.

4. Given the results of the antibody detection test, which of the following antibodies can be ruled out?

- A. Anti-E.
- B. Anti-M.
- C. Anti-Fy<sup>a</sup>.
- D. None of the above.

5. What would be the MOST INFORMATIVE step to be performed next?

- A. Perform antibody identification panel with an autologous control.
- B. Phenotype the patient for antigens that correspond to commonly found clinically significant red cell alloantibodies.
- C. Repeat the antibody detection test using a LISS tube procedure.
- D. Run a selected cell panel of cells known to be negative for high-prevalence antigens.

**Antibody Identification Panel 1:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0√
<b>2</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	+w
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	+	0	0	+	0√
<b>4</b>	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	+	+	+	0√
<b>5</b>	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	1+
<b>6</b>	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	0√
<b>7</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	0	2+
<b>8</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	0√
<b>9</b>	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	0	+	+	+	0	+w
<b>10</b>	+	0	+	+	0	0	0	+	+	+	0	+	+	+	0	0	+	+	0	+	0	2+
<b>11</b>	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	0√
<b>AC</b>																						0√

6. Based on the results of the antibody detection AND identification tests, which of the following appears to be present?

- A. One alloantibody to a common antigen.
- B. More than one alloantibody to a common antigen.
- C. One alloantibody to low-prevalence antigen.
- D. Autoantibody only.

7. The reactivity in the antibody detection test and the antibody identification panel are consistent with which of the following possible antibodies?

- A. Anti-E and anti-K.
- B. Anti-E and anti-Jk<sup>a</sup>.
- C. Anti-Jk<sup>a</sup> and anti-Lu<sup>a</sup>.
- D. Anti-E and an antibody against a low-prevalence antigen.

8. What test would be the BEST next step to provide data to support or refute the initial hypothesis?

- A. Phenotype the patient for E and Jk<sup>a</sup> antigen.
- B. Test an antibody panel using an enhancement medium such as ficin.
- C. Perform an eluate on the patient's cells and test with an antibody identification panel.
- D. No additional testing is required.

9. What can be concluded from Panel 2 results?

- A. The ficin panel is NOT consistent with either the anti-E or the anti-Jk<sup>a</sup> hypothesis.
- B. The ficin panel is consistent with the anti-E and anti-Jk<sup>a</sup> hypothesis.
- C. The ficin panel is consistent with the anti-E hypothesis but not with the anti-Jk<sup>a</sup> hypothesis.
- D. The ficin panel does not provide data that are helpful in the solution of this case.

**Antibody Identification Panel 2:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Ficin	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	37 C	IAT
1	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	0√
2	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	0	2+
3	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	+	0	0	+	0	0√
4	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	+	+	+	0	2+
5	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	2+	3+
6	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	0	2+
7	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	0	2+	3+
8	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	0	0√
9	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	0	+	0	+	+	0	0	2+
10	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	0	+	+	0	+	0	2+	3+
11	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	0	2+
AC																						0	0√

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10. Given the combined serologic test results, which statement is TRUE regarding ruling out other antibody specificities?

- A. Anti-Fy<sup>a</sup> is best excluded using a ficin panel.
- B. Anti-c is best excluded using a PEG panel.
- C. Anti-Fy<sup>b</sup> is best excluded using a PEG panel.
- D. Anti-S is best excluded using a ficin panel.

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11. What additional testing would be MOST informative for the final resolution of this case?

- A. Test one additional E<sup>-</sup>, Jk(a<sup>-</sup>) cell in ficin.
- B. Test one additional E<sup>-</sup>, Jk(a<sup>-</sup>) cell in PEG.
- C. Test two additional E<sup>+</sup>, Jk(a<sup>-</sup>) cells in ficin.
- D. None of the above.

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12. Many people in BH's church group want to donate blood for him. There are 200 potential donors in this group. Given the phenotype frequencies (group O = 45%; Jk(a<sup>-</sup>) = 25%; and E<sup>-</sup> = 70%), approximately how many of these individuals would be suitable?

- A. 8
- B. 12
- C. 16
- D. 24

## **Case Study 11**

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**Initial Data:**

HW, a 76-year-old female of European ancestry, was admitted with acute gastrointestinal bleeding. The patient could recall no history of transfusion but reported having five pregnancies resulting in three live births and two stillborn infants. All births were at home and there was no prenatal testing with any of the pregnancies. No serologic records were available.

The physician ordered three units of Red Blood Cells (RBCs) to be transfused as soon as they were available. Initial serologic testing results were as follows:

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
4+	0	4+	0	4+

1. What is HW's ABO type?

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

2. What is HW's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	0	+	+	0	0	+	0
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	2+
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	0	0	+	0	+	0	+	+	+	w+



**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>**.

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

3. Given the results of the antibody detection test, which of the following antibodies **CANNOT** be ruled out?

- A. Anti-E.
- B. Anti-S.
- C. Anti-Fy<sup>b</sup>.
- D. None of the above can be ruled out.

**Antibody Identification Panel 1:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
1	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	+	0	0	+	0
2	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	2+
3	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	0	+	0	+	2+
4	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	0	+	+	0
5	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	w+
6	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	2+
7	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	0	1+
8	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	0
9	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	+	+	0	+	0	0
10	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	0	+	+	+	+	0	1+
11	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	0
AC																						0

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>**.

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>**.

4. Given the combined information from the antibody detection test and Panel 1 results, which of the following antibodies CAN be ruled out?

- A. Anti-E.
- B. Anti-Jk<sup>a</sup>.
- C. Anti-Fy<sup>b</sup>.
- D. None of the above can be ruled out.

5. Which of the following antibody specificities or combined specificities is/are the MOST consistent with the serologic evidence in the antibody detection test and Panel 1?

- A. Anti-Fy<sup>b</sup> alone.
- B. Anti-Fy<sup>b</sup> and anti-E combined.
- C. Anti-E alone.
- D. Anti-E and anti-K combined.

**Antibody Identification Panel 2:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		LISS			
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IS	37 C	IAT	
1	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	+	0	0	+	0	0	0	0 <sup>√</sup>
2	0	0	0	+	+	+	+	0	+	0	+	+	0	+	+	+	+	+	+	+	0	0	0	2+	
3	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	0	+	0	+	0	0	2+	
4	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	0	+	+	0	0	0 <sup>√</sup>	
5	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	0	w+	w+	
6	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	0	0	2+	
7	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	0	0	w+	1+	
8	0	0	0	+	+	+	+	0	+	0	+	+	0	+	0	+	+	+	0	0	+	0	0	0 <sup>√</sup>	
9	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	+	+	0	+	0	0	0	0 <sup>√</sup>	
10	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	+	+	+	+	+	0	0	w+	1+	
11	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	0	0	0 <sup>√</sup>	
AC																						0	0	0 <sup>√</sup>	

6. What do the results of Panel 2, Panel 1, and the antibody detection test tell the medical laboratory scientist?

- A. Rule out anti-Fy<sup>b</sup>.
- B. Rule out anti-K.
- C. The anti-E and anti-K hypothesis is strengthened.
- D. None of the above.

## Antibody Identification Panel 3:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Ficin
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	+	0	0	+	0√
<b>2</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	2+
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	0	+	0	+	2+
<b>4</b>	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	0	0	+	0√
<b>5</b>	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	2+
<b>6</b>	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	2+
<b>7</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	0	3+
<b>8</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	0√
<b>9</b>	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	+	+	0	+	0	0√
<b>10</b>	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	+	+	+	+	+	0	3+
<b>11</b>	+	0	0	+	+	+	0	+	0	0	0	+	+	0	0	+	0	0	0	+	+	0√
<b>AC</b>																						0√

7. What can be concluded from the results of the ficin IAT panel (Panel 3) results?

- A. Anti-Fy<sup>b</sup> can be ruled out.
- B. The panel suggests the presence of a third antibody.
- C. The panel is consistent with the anti-E and anti-K hypothesis.
- D. None of the above.

8. Which of the cell(s) tested in gel would be MOST suitable to rule out anti-Fy<sup>b</sup> as a possible specificity?

- A. Cell 1.
- B. Cell 3.
- C. Cell 1, 3, or 4.
- D. None of the cells are suitable.

**Additional Data:**

Anti-Fy<sup>b</sup> was ruled out and the patient received units of ABO-compatible blood that was negative for both E and K antigens.

9. **It is now 3 years later and HW has been admitted for elective surgery. The physician has ordered 3 RBC units for the surgery, scheduled for the next day. The admission antibody detection test is negative. Which of the following would be a suitable approach?**
- A. Select ABO-compatible donor units. Perform an immediate-spin or computer crossmatch and issue blood if verified to be ABO compatible.
  - B. Select ABO-compatible donor units. Perform a serologic crossmatch including 37 C and IAT phases and issue blood if compatible at all phases of the crossmatch.
  - C. Select donor units that are ABO compatible and negative for both E and K antigens. Perform an immediate-spin or computer crossmatch and issue blood if verified to be ABO compatible.
  - D. Select donor units that are ABO compatible and negative for both E and K antigens. Perform a serologic crossmatch including 37 C and IAT phases and issue blood if compatible at all phases of the crossmatch.

## **Case Study 12**

**Initial Data:**

DB, a 25-year-old male of European ancestry, was admitted to the hospital after a motorcycle accident. There are no records of previous transfusion. His hemoglobin level is 9.5 g/dL.

Two units of Red Blood Cells have been ordered. Initial serologic testing results were as follows:

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	0	4+	4+	4+

1. What is DB's ABO type?

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

2. What is DB's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		LISS			
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P1	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37 C	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	0	0	+	+	0	+	0	+	+	0	0	+	0	0	0	0√
<b>2</b>	+	0	+	+	0	0	+	0	+	+	0	+	+	+	0	+	+	+	+	+	0	2+	2+	2+	
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	0	0	+	0	+	0	+	+	+	0	0	0√	

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the corresponding antigens: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

3. Given the results of the antibody detection test alone, which of the following antibodies CANNOT be ruled out?

- A. Anti-Le<sup>a</sup>.
- B. Anti-E.
- C. Anti-Jk<sup>a</sup>.
- D. All of the above.

4. Given the data from the antibody detection test, including rule-out results, pattern of fit, and phases of reactivity, which of the following antibodies would be MOST consistent with the findings?

- A. Anti-Le<sup>a</sup>.
- B. Anti-E.
- C. Anti-S.
- D. Anti-K.

**Antibody Identification Panel 1:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		LISS			
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37 C	IAT	
1	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	+	0	0	+	0	0	0	0√
2	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	+	0	w+	0	0√
3	0	0	0	+	+	+	0	+	0	+	0	+	+ <sup>S</sup>	0	0	+	0	0	+	+	0	+	3+	3+	3+
4	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	0	+	+	0	0	0	0√
5	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	0	0	0	0√
6	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	+	1+	0	0√
7	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	+	0	0	0	0√
8	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	2+	2+	1+	
9	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	+	+	0	+	0	2+	2+	1+	
10	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	+	+	+	+	+	+	0	1+	0	0√
11	+	0	0	+	+	+	0	+	0	0	0	+	+ <sup>S</sup>	0	+	0	+	0	0	+	+	3+	3+	3+	
AC																						0	0	0√	

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the corresponding antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, -Jk<sup>b</sup>, and -P1.**

5. Given the combined information from the antibody detection and Panel 1 results, which of the following antibodies CAN be ruled out?

- A. Anti-S.
- B. Anti-Le<sup>a</sup>.
- C. Anti-K.
- D. None of the above can be ruled out.

6. Which of the following antibody specificities or combined specificities is/are the MOST consistent with the serologic evidence in the antibody detection test and Panel 1 combined?

- A. Anti-P1.
- B. Anti-Le<sup>b</sup>.
- C. Anti-E.
- D. Anti-P1 and anti-K.

7. The medical laboratory scientist has decided to type the patient's red cells for the P1 antigen. Using the antibody identification panel for this case, which panel cell would be the BEST choice for the positive control for the patient P1 phenotyping procedure?

- A. 1
- B. 2
- C. 3
- D. 8

8. Given the results of DP's P1 phenotype (Table 1) what should the medical laboratory scientist do next?

- A. Conclude the testing, perform an immediate-spin crossmatch, and release crossmatch-compatible units.
- B. Rule out anti-P1 as a possible antibody and revise the hypothesis.
- C. Rule out remaining clinically significant antibodies that have not been ruled out in the antibody detection and antibody identification tests.
- D. None of the above.

**Table 1. DP's Phenotype Results**

Red Cells Tested	Anti-P1
DP	0
P1+ control	3+
P1- control	0



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9. Which of the following statements is true regarding alloanti-P1?

- A. P1 antigen strength is significantly diminished when red cells are treated with ficin.
  - B. Usually, the antibody is optimally reactive at the IAT phase of testing.
  - C. The antibody is frequently implicated in hemolytic disease of the fetus and newborn (HDFN).
  - D. The antibody is often naturally occurring in the serum of P1- individuals.
- 

10. The medical laboratory scientist is attempting to rule out anti-K but does not have a source of rule-out cells that are P1- and K+. Which of the following tests would be useful to help detect anti-K if it is present in combination with anti-P1?

- A. Retest the original panel after treating the panel cells with ficin.
- B. Neutralize the anti-P1 with commercial P1 substance and retest the panel.
- C. Perform an autoadsorption and retest the adsorbed serum.
- D. Retest the panel, reducing the incubation temperature to 4 C.

## **Case Study 13**

**Initial Data:**

Two units of Red Blood Cells Leukocytes Reduced have been ordered for CR, a 74-year-old female of European ancestry with myelodysplastic syndrome. She last received a transfusion at the facility 2 months ago. At that time, an anti-Fy<sup>a</sup> was identified in her plasma. Her hemoglobin level is 7.5 g/dL.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
4+	0	4+	0	4+

**1. What is CR's ABO type?**

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

**2. What is DB's RH type?**

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	+	0	0	+	<b>3+</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	+	0	+	+	+	+	+	0	<b>2+</b>
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	0	0	+	0	+	0	+	+	+	<b>0</b>

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum/plasma is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-D, -C, -e, -N, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

3. Given the results of the antibody detection test, which of the following antibodies CAN be ruled out?

- A. Anti-Le<sup>a</sup>.
- B. Anti-S.
- C. Anti-Jk<sup>a</sup>.
- D. None of the above.

4. What additional testing would provide the BEST information for the resolution of this case?

- A. A routine commercial antibody identification panel.
- B. A panel of selected Fy(a-) cells.
- C. A panel of selected Fy(a-), S- cells.
- D. A ficin-treated panel.

**Antibody Identification Panel 1:**

	RH							MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	C <sup>w</sup>	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
1	+	+	0	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	0
2	+	+	+	0	0	+	0	+	+	+	0	0	+	0	0	0	0	+	0	+	+	+	3+
3	0	0	0	+	+	+	0	0	+	+	+	0	+	0	0	0	0	+	0	+	0	+	0
4	0	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	+	0	+	0
5	+	0	0	+	+	0	0	+	+	0	+	0	+	+	+	0	0	+	0	+	+	0	0
6	0	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	+	0	0	+	+	+	0
7	0	+	0	0	+	+	+	+	+	0	+	0	+	+	0	+	+	+	0	+	0	+	0
AC																							0

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and selected cell panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

5. Given the combined information from the antibody detection test and identification panel (Panel 1) results, which of the following statements is true?

- A. Anti-E can be ruled out.
- B. Anti-Le<sup>a</sup> can be ruled out.
- C. Both can be ruled out.
- D. Neither can be ruled out.

6. Which of the following antibody specificities is MOST consistent with the serologic evidence in Panel 1?

- A. Anti-C<sup>w</sup>.
- B. Anti-Lu<sup>a</sup>.
- C. Anti-P1.
- D. Autoanti-I.

7. Given the results of the antibody detection test and identification panel (Panel 1), which of the following antibodies has NOT been ruled out?

- A. Anti-C.
- B. Anti-S.
- C. Anti-K.
- D. Anti-Jk<sup>a</sup>.

8. At this point, what additional testing would be MOST useful to confirm the anti-C<sup>w</sup> hypothesis?

- A. Phenotype the patient for the C<sup>w</sup> antigen.
- B. Test selected C<sup>w</sup>+, Fy(a+) cells.
- C. Test selected C<sup>w</sup>+, Fy(a-) cells.
- D. Test selected C<sup>w</sup>-, Fy(a-) cells.

**Antibody Identification Panel 2:**

	RH							MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test	
	D	C	C <sup>w</sup>	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	+	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>3+</b>
<b>2</b>	+	+	+	0	0	+	0	+	+	+	0	0	+	0	0	0	+	0	+	0	+	+	+	<b>3+</b>

9. Once the presence of anti-C<sup>w</sup> is confirmed, what additional tests should be performed in order to provide suitable blood for the patient?

- A. A crossmatch including both 37 C and IAT phases of testing.
- B. Selection of Fy(a-) donor units.
- C. Selection of C<sup>w</sup>- donor units.
- D. All of the above.

10. **CR has clinical signs of anemia including shortness of breath and tachycardia. Based on the hemoglobin results and her deteriorating clinical condition, the physician has ordered 2 RBC units to be administered STAT. No commercial anti-C<sup>w</sup> is available in your laboratory to type donor units. Which of the following would be the BEST next step in providing suitable blood for CR?**
- A. Delay transfusion until Fy(a-), C<sup>w</sup>- blood can be obtained from the local donor facility (estimated to take 5-8 hours).
  - B. Release units that are immediate-spin crossmatch-compatible (ABO compatible).
  - C. Perform an antiglobulin crossmatch using randomly selected units. Type the compatible units with anti-Fy<sup>a</sup> and anti-C.
  - D. Ask the physician to sign an emergency release while commercial anti-C<sup>w</sup> is being obtained.

## **Case Study 14**

**Initial Data:**

GH, a 23-year-old female, is scheduled for orthopedic surgery on her hip. She was born with congenital hip malformations. This will be her third surgical procedure to repair the joint; her last surgery was 1 year ago. Each of the two prior surgeries required transfusion of 2 units of Red Blood Cells (RBCs). Her physician has ordered 2 units to be available for this procedure.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	0	4+	4+	4+

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	0	+	0	+	+	+	0	+	+	+	0	0	+	<b>3+</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	0	+	+	0	<b>0</b>

1. What is GH's ABO type?

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

2. What is GH's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the antibody detection test, what is the MOST likely hypothesis?

- A. One or more alloantibodies are present.
- B. One or more autoantibodies are present.
- C. Both A and B are likely solutions.
- D. Neither A nor B is supported by the evidence.



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4. Based on the results of the antibody detection test, which of the following antibodies is NOT likely to be present?

- A. Anti-e.
- B. Anti-K.
- C. Anti-Fy<sup>a</sup>.
- D. Anti-c.

---

5. Which of the following tests would be the next BEST step in this case?

- A. Test a gel panel with an autocontrol.
- B. Test a LISS IAT panel with an autocontrol.
- C. Test a ficin panel.
- D. Repeat the antibody detection using PEG IAT.

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

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6. What alloantibody specificity is suggested by the results of Panel 1?

- A. Anti-D.
- B. Anti-D and anti-E.
- C. Anti-e.
- D. Anti-c and anti-e.

## Antibody Identification Panel 1:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	<b>3+</b>
<b>2</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	<b>3+</b>
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	+	0	0	+	<b>3+</b>
<b>4</b>	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	+	+	+	<b>3+</b>
<b>5</b>	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	<b>3+</b>
<b>6</b>	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	<b>3+</b>
<b>7</b>	0	0	+	+	+	0	0	+	0	+	0	+	0	+	0	+	0	+	0	+	0	<b>3+</b>
<b>8</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	<b>3+</b>
<b>9</b>	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	0	+	0	+	0	<b>3+</b>
<b>10</b>	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	+	+	+	0	+	0	<b>0</b>
<b>11</b>	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	<b>3+</b>
<b>AC</b>																						<b>0</b>

7. Given the combined results of the antibody detection test and Panel 1, which of the following alloantibodies can be excluded?

- A. Anti-C.
- B. Anti-s.
- C. Anti-K.
- D. Anti-Fy<sup>a</sup>.

8. Of the following, which is the next BEST step in the resolution of this antibody problem?

- A. Test an antibody identification panel from a different manufacturer using gel IAT.
- B. Select units that are negative for the e antigen and perform a full serologic crossmatch.
- C. Select units that are negative for the e antigen and perform a computer crossmatch to confirm ABO compatibility.
- D. Test a panel of selected e- cells.

## Antibody Identification Panel 2:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	+	0	+	+	0	0	+	+	+	+	0	+	0	+	0	0	+	0	+	+	0	0	
<b>2</b>	+	0	+	+	0	0	+	0	0	+	0	+	+	0	+	+	+	+	+	+	0	+	1+
<b>3</b>	+	0	+	+	0	0	0	+	+	0	0	+	+	0	0	0	+	+	+	+	+	0	0
<b>4</b>	+	0	+	+	0	0	+	0	+	+	0	+	+	+	0	0	+	+	+	0	+	+	+W

9. Given the results of the antibody detection test and both Panel 1 and Panel 2, which of the following antibodies was ruled out?

- A. Anti-C.
- B. Anti-K.
- C. Anti-Jk<sup>b</sup>.
- D. None of the above.

10. Which of the antibodies listed below would be the MOST likely given the pattern of reactivity observed in Panel 2?

- A. Anti-C.
- B. Anti-K.
- C. Anti-s.
- D. Anti-Jk<sup>b</sup>.

## Antibody Identification Panel 3:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1 exp</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	0	+	0	+	+	+	0	0	
<b>2 exp</b>	+	0	+	+	0	0	+	+	0	+	0	+	+	0	+	0	+	+	+	+	+	0	0
<b>3 exp</b>	+	0	+	+	0	0	0	+	+	0	0	+	+	0	0	0	+	+	+	+	+	+	+W
<b>4 exp</b>	+	0	+	+	0	0	+	0	+	+	0	+	+	+	0	0	+	+	0	+	+	+	+W

11. The medical laboratory scientist has tested all the available in-date e- cells but has found four cells that recently expired and have no evidence of deterioration. What can be concluded by the reactions seen when testing these cells with the patient's serum (Panel 3)?

- A. Anti-C is ruled out.
- B. Anti-s is ruled out.
- C. Anti-K is ruled out.
- D. Nothing can be concluded because the cells were not in date.

12. The medical laboratory scientist phenotyped the patient's red cells using available antisera. Given the results of the phenotype testing (Table 1), what can be concluded?

- A. Anti-C has been ruled out.
- B. Typing is consistent with the anti-e and anti-Jk<sup>b</sup> hypothesis.
- C. Anti-Jk<sup>b</sup> has been ruled out.
- D. Anti-e has been ruled out.

**Table 1. GH's Phenotype Results**

RBCs Tested	Anti-C	Anti-e	Anti-c	anti-E	Anti-Jk <sup>b</sup>
GH	0	0	4+	4+	0
Pos control	4+	4+	4+	4+	2+
Neg control	0	0	0	0	0

13. Given the fact that anti-K and anti-C could not be ruled out, what would the next BEST step be in finding compatible blood for this patient?

- A. Give crossmatch-compatible units that are e<sup>-</sup> and Jk(b<sup>-</sup>).
- B. Select units that are e<sup>-</sup>, Jk(b<sup>-</sup>), C<sup>-</sup>, and K<sup>-</sup> and crossmatch.
- C. Adsorb the anti-e from the patient's serum and repeat panels to rule out anti-C and anti-K.
- D. Refer the patient to an outside laboratory for testing.

13. Given the frequencies listed below, approximately how many ABO-compatible units would have to be tested to find one e<sup>-</sup>, C<sup>-</sup>, K<sup>-</sup>, Jk(b<sup>-</sup>) unit for this patient?

Frequencies:  
 e<sup>-</sup>C<sup>-</sup> 2%  
 K<sup>-</sup> 91%  
 Jk(b<sup>-</sup>) 26%

- A. 50.
- B. 100.
- C. 150.
- D. 200.

## **Case Study 15**

**Initial Data:**

BB is a 73-year-old male of European ancestry with coronary artery disease. He was last transfused at your facility 10 years ago. At that time, the antibody detection test was negative. BB is scheduled for redo cardiovascular surgery tomorrow. His hemoglobin is 10.7 g/dL and 4 units of Red Blood Cells Leukocytes Reduced are ordered for surgery. Initial pretransfusion testing results follow.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A, Cells	B Cells
4+	4+	4+	0	0

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		SP
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	K	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	+	0	0	+	<b>0</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	+	0	+	+	+	+	+	0	<b>0</b>
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	0	+	+	0	+	0	+	+	+	<b>0</b>

1. What is BB's ABO type?

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

2. What is BB's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the ABO and RH typing, what other testing would be recommended at this point if not already conducted in the pretransfusion testing provided?

- A. Antibody identification panel.
- B. Anti-A,B.
- C. RH control.
- D. None of the above.

**Antibody Detection Test:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		SP
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	K	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	+	0	0	+	<b>0</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	+	0	+	+	+	+	+	0	<b>0</b>
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	0	0	+	0	+	0	+	+	+	<b>0</b>

**Laboratory Protocol:**

The following antibodies can be initially ruled out ONLY if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>**.

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

4. Given the results of the antibody detection test, which of the following antibodies CANNOT be ruled out?

- A. Anti-Jk<sup>a</sup>.
- B. Anti-K.
- C. Anti-Fy<sup>b</sup>.
- D. All antibodies can be ruled out.

5. Given that there is no evidence of red cell alloantibodies and no history of previous antibodies, your institutional routine crossmatch procedure is tube testing at immediate spin (IS). Given the results of the crossmatch below, which of the following tests should be conducted next?

- A. Antibody identification panel in solid phase (SP).
- B. Repeat antibody detection test using a tube method.
- C. Direct antiglobulin test (DAT).
- D. None; put the unit from Donor 3 back in the refrigerator and select another unit.

	IS Crossmatch
Donor 1	0
Donor 2	0
Donor 3	3+
Donor 4	0

Antibody Detection Repeated Using Polyethylene Glycol (PEG) Tube Test:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG		
	D	C	E	c	E	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	K	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37 C	IAT
1	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	+	0	0	+	0	NH	0√
2	+	0	+	+	0	0	+	0	+	0	0	+	+	+	0	+	+	+	+	+	0	0	NH	0√
3	0	0	0	+	+	+	0	+	0	+	0	+	0	0	+	0	+	0	+	+	+	0	NH	0√

6. Given the results of the second antibody detection test (PEG tube test), which of the following antibodies CANNOT be ruled out?

- A. Anti-Jk<sup>a</sup>.
- B. Anti-K.
- C. Anti-Fy<sup>b</sup>.
- D. All antibodies can be ruled out.

7. Of the following, which is the MOST LIKELY cause of the positive crossmatch with Donor 3?

- A. Donor 3 has a positive DAT.
- B. Antibody to low-prevalence antigen.
- C. Antibody to high-prevalence antigen.
- D. Cold-reactive autoantibody.



8. Which of the following tests should be performed NEXT to test the hypothesis that this is an antibody to a low-prevalence antigen?

- A. Test the serum with a routine antibody identification panel using a PEG tube method.
- B. Test the serum with a selected panel of cells that are positive for low-prevalence antigens.
- C. Chemically treat the red cells from Donor 3 and repeat the crossmatch.
- D. Type the donor unit for low-prevalence antigens.

**Extended Testing:**

Based on the IS reactivity, the medical laboratory scientist suspected an antibody to a low-prevalence antigen in the MNS system. To test this hypothesis, the medical laboratory scientist decided to treat the red cells from Donor 3 with ficin and test the patient's serum using a saline test tube method.

	IS	37 C	IAT
Donor 3 — Ficin treated	3+	3+	2+
Autologous cells — Ficin treated	0	0	0√

9. What can be concluded from these results?

- A. The antigen is most likely NOT in MNS system.
- B. The antigen is most likely in MNS system.
- C. The antigen is denatured by ficin.
- D. The antigen is not low prevalence.

**Extended Testing:**

Before sending the specimen to the IRL, the medical laboratory scientist reviews the inventory of panels in the refrigerator and finds a few selected cells to test. See Selected Cell Panel 1.

**Selected Cell Panel 1 – Transfusion Service:**

	RH							MNS				LU		P	Kell		Duffy		Kidd		Additional Typing	PEG Tube		
	D	C	C <sup>w</sup>	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>		IS	37 C	IAT
1	+	+	0	0	0	+	0	+	+	+	+	+	+	+	0	+	0	+	+	+		0	NH	0√
2	+	+	+	0	0	+	0	+	+	+	0	0	+	0	0	+	0	+	+	+		0	NH	0√
3	0	0	0	+	+	+	+	0	+	+	+	0	+	0	0	+	0	+	0	+	Kp(a+)	0	NH	0√
4	0	0	0	0	+	+	+	+	+	0	+	0	+	+	0	+	0	+	0	+	V+VS+	0	NH	0√
5	+	0	0	+	+	0	0	+	+	0	+	0	+	+	0	+	0	+	+	0	Js(a+)	0	NH	0√

10. Given the results of the Selected Cell Panel 1, what should the medical laboratory scientist do next?

- A. Conclude that no antibodies to antigens of low prevalence are present.
- B. Send the sample to an IRL.
- C. Assume the reactions with Donor 3 were an artifact and select another unit to crossmatch.
- D. Discuss results with the supervisor/medical director.

**Extended Testing:**

This medical director decided to send the sample to an IRL because it is likely the patient will require many transfusions. A segment from the incompatible unit was sent to the IRL along with the patient sample. The IRL medical laboratory scientist reviewed the inventory and selected cells to test (Selected Cell Panel 2).

**Selected Cell Panel 2 – Immunohematology Reference Lab Results:**

	RH							MNS				LU		P	Kell		Duffy		Kidd		Additional Typing			Saline Tube		
	D	C	C <sup>v</sup>	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>		IS	37 C	IAT		
1	+	+	0	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	+	+	+	Di(a+)	0	0	0√	
2	+	+	0	0	0	+	0	+	+	+	0	0	+	0	+	0	+	+	+	+	+	WES(a+)	0	0	0√	
3	0	0	0	+	+	+	+	0	+	+	+	0	+	0	+	0	+	0	+	0	+	Wr(a+)	3+	3+	2+	
4	0	0	0	0	+	+	+	+	+	0	+	0	+	+	0	+	0	+	0	+	+	BARC+	0	0	0√	
5	+	0	0	+	+	+	0	+	+	0	+	0	+	+	0	+	0	+	+	0	+	Be(a+)	0	0	0√	

11. Which of the following antibody specificities is the MOST consistent with the serologic evidence in the Selected Cell Panel 2?

- A. Anti-Di<sup>a</sup>.
- B. Anti-WES<sup>a</sup>.
- C. Anti-Be<sup>a</sup>.
- D. Anti-Wr<sup>a</sup>.

12. Which of the following tests would provide evidence to confirm or refute the anti-Wr<sup>a</sup> hypothesis?

- A. Test additional selected Wr(a+) cells.
- B. Type Donor 3 with commercial anti-Wr<sup>a</sup>.
- C. Both of the above.
- D. No additional testing is necessary.

13. Which of the following is TRUE regarding anti-Wr<sup>a</sup>?
- A. The antibody is extremely uncommon.
  - B. It is NOT clinically significant.
  - C. A full crossmatch would be required to select units for transfusion.
  - D. Compatible donor units would be difficult to find.

## **Case Study 16**

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**Initial Data:**

CP, a 60-year-old male of European ancestry, was admitted with chest pain and shortness of breath. There is no record of him in the transfusion service. His hemoglobin level is 8.2 g/dL and his hematocrit is 24%. Two units of Red Blood Cells Leukocytes Reduced are ordered for transfusion when ready. Pretransfusion testing follows.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
4+	0	3+	0	4+

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG		
	D	C	E	C	e	f	M	N	S	S	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37 C	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	+	+	0	NH	3+
<b>2</b>	+	0	+	+	0	0	+	0	+	0	+	+	+	0	+	0	+	0	+	+	0	0	NH	3+

1. What is CP's ABO type?

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

2. What is CP's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the antibody detection test, what hypothesis can be generated?

- A. One or more alloantibodies are present.
- B. One or more autoantibodies are present.
- C. Both A and B are potential solutions.
- D. Neither A nor B is supported by the evidence.

4. Of the following, which would be the MOST informative step to be performed next?

- A. Test a routine antibody identification panel using polyethylene glycol (PEG).
- B. Repeat the antibody detection test using a three-cell screen.
- C. Test a routine antibody identification panel using a low-ionic-strength saline indirect antiglobulin test (LISS IAT).
- D. Repeat the antibody detection test using LISS IAT.

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient’s serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient’s serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

5. Based on the combined results of the antibody detection and identification (Panel 1) tests, which of the following appears to be present?

- A. One or more alloantibodies to common antigens.
- B. Antibody to a low-prevalence antigen.
- C. Antibody to a high-prevalence antigen.
- D. Autoantibody.

**Antibody Identification Panel 1:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	0	<b>3+</b>
<b>2</b>	0	0	0	+	+	+	+	+	+	0	0	+	0	0	0	+	+	+	+	+	+	<b>3+</b>
<b>3</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	0	0	+	0	+	0	0	+	<b>3+</b>
<b>4</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	0	+	0	+	0	+	0	+	<b>1+</b>
<b>5</b>	+	0	+	+	0	0	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	<b>0<sup>√</sup></b>
<b>6</b>	0	0	0	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	<b>3+</b>
<b>7</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	<b>3+</b>
<b>8</b>	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	<b>3+</b>
<b>9</b>	+	+	0	+	+	+	+	0	+	0	0	+	+	+	0	0	+	0	+	+	+	<b>3+</b>
<b>10</b>	+	0	+	+	0	0	0	+	+	+	0	+	+	0	+	0	+	+	0	0	+	<b>3+</b>
<b>11</b>	+	0	0	+	+	+	+	0	0	+	0	+	0	0	0	0	+	0	0	+	0	<b>1+</b>
<b>AC</b>																						<b>0<sup>√</sup></b>

6. What antibody specificity(ies) can be ruled out?

- A. Anti-D, -Le<sup>a</sup>, -Fy<sup>a</sup>, and -Jk<sup>a</sup>.
- B. Anti-D, -Le<sup>a</sup>, -Fy<sup>a</sup>, and -S.
- C. Anti-Le<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -s.
- D. Anti-Le<sup>a</sup>, -Fy<sup>b</sup>, and -Jk<sup>b</sup>.

7. What testing should be performed next?

- A. Panel tested using LISS IAT.
- B. Selected cells tested using PEG IAT.
- C. Panel of ficin-treated cells.
- D. Panel tested using gel.

8. What additional antibody specificity(ies) can be ruled out using the results from Panel 2?

- A. Anti-e, -C, -f, and -S.
- B. Anti-e, -C, -Le<sup>b</sup>, and -Jk<sup>b</sup>.
- C. Anti-e, -C, -Le<sup>b</sup>, and -Fy<sup>b</sup>.
- D. Anti-e, -C, -K, and -Jk<sup>b</sup>.

Antibody Identification Panel 2—Ficin-Treated:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Ficin	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	37 C	IAT
1	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	0	NH	0√
2	0	0	0	+	+	+	+	+	+	0	0	+	0	0	0	+	+	+	+	+	+	NH	3+
3	+	0	+	+	0	0	0	+	0	+	0	+	0	0	0	+	0	+	0	0	+	NH	3+
4	0	0	0	+	+	+	+	+	0	+	0	+	+	0	+	0	+	0	+	0	+	NH	2+
5	+	0	+	+	0	0	+	+	0	+	0	+	+	0	0	+	+	+	0	+	0	NH	0√
6	0	0	0	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	NH	2+
7	0	0	0	+	+	+	+	+	0	+	0	+	+	0	+	+	+	0	+	0	+	NH	3+
8	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	NH	2+
9	+	+	0	+	+	+	+	0	+	0	0	+	+	0	0	+	0	+	+	+	+	NH	2+
10	+	0	+	+	0	0	0	+	+	+	0	+	+	0	+	0	+	+	0	0	+	NH	0√
11	+	0	0	+	+	+	+	0	0	+	0	+	0	0	0	+	0	0	+	0	+	NH	2+
AC																						NH	0√

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9. What additional antibodies have NOT been eliminated?

- A. Anti-f, -M, -N, -S, -K, and -Fy<sup>b</sup>.
- B. Anti-S and -K.
- C. Anti-f, -S, and -K.
- D. Anti-K, -s, and -f.

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10. Given the results of the two panels and the antibody detection test, which of the following antibodies or antibody combinations would you consider to be the MOST likely hypothesis?

- A. Anti-e.
- B. Anti-f and -K.
- C. Anti-e and -Jk<sup>b</sup>.
- D. Anti-f, -S, and -K.

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11. What testing should be chosen next?

- A. Panel tested using LISS IAT.
- B. Selected cells tested using PEG IAT.
- C. Panel of ficin-treated cells.
- D. Panel tested using gel.

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

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12. Given the data from Panel 3 combined with the results in Panel 1, Panel 2, and the antibody screen, what antibody specificity(ies) is(are) MOST likely responsible for the reactivity noted?

- A. Anti-K.
- B. Anti-S and -K.
- C. Anti-c and -E.
- D. Anti-f, -K, and -S.



## Antibody Identification Selected Cell Panel 3:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	0	0	+	+	0	+	0	+	0	+	+	+	0	<b>3+</b>
<b>2</b>	+	+	0	0	+	0	+	+	0	+	0	+	0	+	0	+	+	+	+	+	+	+	<b>3+</b>
<b>3</b>	+	0	+	+	0	0	0	+	0	+	0	+	+	0	+	+	+	+	+	+	+	0	<b>3+</b>
<b>4</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	0	0	0	+	0	+	0	+	0	<b>0<sup>v</sup></b>

13. Given the combined serologic data, what antibody has NOT been ruled out?

- A. Anti-M.
- B. Anti-Fy<sup>b</sup>.
- C. Anti-N.
- D. Anti-Jk<sup>b</sup>.

14. The medical laboratory scientist phenotyped the patient's red cells to provide confirmatory evidence to support the hypothesized specificities. Given the results of the antigen typing (Table 1), what can be concluded?

- A. Anti-f is not supported by the data.
- B. Anti-K is not supported by the data.
- C. Anti-S is not supported by the data.
- D. The hypothesis is fully supported by the data.

**Table 1. Phenotype Results**

	Anti-C	Anti-E	Anti-c	Anti-e	Anti-S	Anti-K
CP	3+	3+	3+	3+	0	0
Positive control	3+	3+	3+	3+	3+	3+
Negative control	0	0	0	0	0	0

15. The medical laboratory scientist must antigen type donor units to identify units for transfusion to the patient. Which antigens should be tested for?

- A. e<sup>-</sup>, K<sup>-</sup>, and S<sup>-</sup>.
- B. f<sup>-</sup>, K<sup>-</sup>, and S<sup>-</sup>.
- C. e<sup>-</sup>, K<sup>-</sup>, and S<sup>-</sup>.
- D. None of the above.

## **Case Study 17**

**Initial Data:**

RR is a 53-year-old female of European ancestry who is undergoing induction chemotherapy for breast cancer. She has had three children but no significant medical problems until the discovery of the cancer. Her hemoglobin level has decreased to 7.1 g/dL and 2 units of Red Blood Cells have been ordered for transfusion. The following results were obtained during routine pretransfusion testing.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	0	3+	4+	4+

**Antibody Detection Test (Screen):**

							MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	<b>2+</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	+	+	+	0	<b>2+</b>

1. What is RR's ABO type?

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

2. What is RR's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. How would you interpret the antibody detection test?

- A. Alloantibody(ies) to common antigens.
- B. Autoantibodies.
- C. Antibody to high-prevalence antigen.
- D. Unable to differentiate between A, B, and C.

4. Which of the following tests would be MOST informative in excluding the presence of autoantibodies?

- A. A complete red cell phenotype.
- B. A direct antiglobulin test (DAT).
- C. An autologous control.
- D. An eluate.

**Antibody Identification Panel:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
1	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	2+
2	+	+	0	0	+	0	+	+	+	0	0	+	0	0	0	0	+	+	+	+	+	+	2+
3	+	0	+	+	0	0	0	+	+	+	0	+	0	0	0	0	+	+	+	+	0	+	2+
4	+	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	0	0	0	0	0	+	2+
5	0	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	+	2+
6	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	2+
7	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	+	2+
8	0	0	0	+	+	+	+	+	+	+	0	+	0	+	+	0	+	+	0	+	0	+	2+
9	0	0	0	+	+	+	+	0	+	0	0	+	+	+	0	0	+	0	+	+	+	+	2+
10	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	0	+	2+
11	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	+	+	0	+	+	+	+	2+
AC																							0√

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

5. Of the following, what is the MOST LIKELY interpretation for the combined results obtained in the antibody detection test and the panel?

- A. Alloantibody to high-prevalence antigen.
- B. Anti-e and anti-Jk<sup>b</sup>.
- C. Alloantibody to low-prevalence antigen.
- D. Anti-Fy<sup>a</sup> and anti-Fy<sup>b</sup>.

6. Which of the following is a suitable approach to differentiate common alloantibodies from an antibody to high-prevalence antigen?

- A. Perform autologous adsorption of plasma.
- B. Neutralize one alloantibody.
- C. Treat the plasma with dithiothreitol.
- D. Test one or more phenotypically similar red cells.

7. When investigating antibodies to high-prevalence antigens, it is useful to first eliminate some high-prevalence antigens limiting the number of possible specificities and thereby easing problem solving. Which of the following procedures would be MOST useful for this purpose?

- A. Phenotype the patient's red cells for selected high-prevalence antigens.
- B. Test the patient's serum with ficin and/or papain and DTT-treated cells.
- C. Perform alloadsorptions with selected cells.
- D. Test additional antibody identification panels until a negative cell is found.

8. Based on the results of extended testing with chemically modified cells, in which of the following blood groups is the target antigen likely found?

- A. RH or JK systems.
- B. KEL or DO systems.
- C. JHM or YT.
- D. FY or MNS systems.

**Results of Testing With DTT- and Ficin-Treated Red Cells:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		DTT Treated		Ficin Treated		
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	Saline IAT	Saline IAT	Saline IAT	Saline IAT	
<b>1</b>	+	+	0	0	+	0	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	0	+	0	√	2+
<b>2</b>	+	+	0	0	+	0	0	+	0	+	0	+	+	0	0	0	+	0	0	0	+	0	+	0	√	2+
<b>3</b>	+	+	0	0	+	0	+	0	0	+	0	+	0	+	0	0	+	0	+	0	+	0	+	0	√	2+

9. Given the results of the antibody detection, panel, DAT, testing with phenotypically similar cells, and testing with chemically treated cells, which antibody to a high-prevalence antigen is MOST likely to be present?

- A. Anti-k.
- B. Anti-Kp<sup>b</sup>.
- C. Anti-LW.
- D. Anti-Gy<sup>a</sup>.

DAT	
Polyspecific AHG IS/RT	Saline control IS
0/0√	0

Testing the Patient's Cells Against Selected Phenotypically Similar Red Cells:

	RH						MNS				Lu		P	Lewis		Kell	Duffy		Kidd		PEG	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT	
Patient cells		+	0	0	+	0	+	+	0	+	0	+	+	+	0	+	0	+	0	+		
1	+	+	0	0	+	0	0	+	0	+	0	+	+	0	0	0	0	0	0	0	+	2+
2	+	+	0	0	+	0	+	0	0	+	0	+	0	+	0	0	0	+	0	+		2+

10. Given the results of the mini-panel of cells that were negative for selected high-prevalence antigens, what antibody specificity is likely present?

- A. Anti-LW<sup>a</sup>.
- B. Anti-Hy.
- C. Anti-Gy<sup>a</sup>.
- D. Anti-Kp<sup>b</sup>.

Testing Selected High-Prevalence Antigen Negative Cells

Cell Type	PEG IAT
k-	2+
Kp(b-)	0√
LW(a-)	2+
Gy(a-)	2+
Hy-	2+

---

11. **There are additional antigens in the KEL and DO blood group systems. Why were only the selected cells tested?**

- A. Only these rare cells were available.
- B. Other Kell (KEL) and Dombrock (DO) antigens are not destroyed by DTT.
- C. There are no other antigens of high prevalence in KEL or DO systems.
- D. The antibody-maker is of European ancestry.

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12. **What is the EASIEST way to exclude most other alloantibodies required by laboratory policy?**

- A. Test additional Kp(b-) red cells that carry the appropriate antigens.
- B. Remove the anti-Kp<sup>b</sup> by adsorption and test appropriate cells.
- C. Test additional DTT-treated red cells that carry the appropriate antigens.
- D. Do not exclude these antibodies. Give antigen-negative units instead.

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13. **When testing rule-out cells that have been treated with DTT, which of the following antibodies CANNOT be ruled out?**

- A. Anti-C.
- B. Anti-M.
- C. Anti-Jk<sup>b</sup>.
- D. Anti-K.

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14. **What additional testing must be performed to complete this case?**

- A. Confirm that patient's red cells are Kp(b-).
- B. Exclude other common red cells alloantibodies.
- C. Test additional Kp(b-) cells to confirm specificity.
- D. All of the above.

## **Case Study 18**



**Initial Data:**

RS is a 32-year-old female of European ancestry who has just visited her obstetrician for the first prenatal visit of her second pregnancy. Her first pregnancy was 3 years ago, and the prenatal and postnatal periods were uneventful. She delivered a healthy male infant at 39.5 weeks of gestation.

The obstetrician ordered a type and screen as part of the routine prenatal blood work. The following results were obtained.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
4+	0	4+	0	4+

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		LISS			
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IS	37 C	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	0	0	0	1+
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	+	+	+	0	0	0	0	1+
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	0	0	+	0	+	0	+	+	+	0	0	0	1+

1. What is RS's ABO type?

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

2. What is RS's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the antibody detection test, what hypothesis can be generated?

- A. One or more alloantibodies are present.
- B. One or more autoantibodies are present.
- C. Both A and B are potential solutions.
- D. Neither A nor B is supported by the evidence.

## Antibody Identification Panel 1:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		LISS	PEG
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	IAT
1	+	+	0	0	+	0	+	+	+	0	0	+	+	0	+	0	+	0	+	+	+	1+	2+
2	0	+	0	+	+	0	+	+	0	+	0	+	0	0	0	0	+	+	+	+	+	1+	NT
3	+	0	+	+	0	0	0	+	+	+	0	+	0	0	0	0	+	+	+	+	0	1+	2+
4	+	0	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	0	0	+	1+	NT
5	0	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	1+	2+
6	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	1+	NT
7	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	1+	2+
8	0	0	0	+	+	+	+	+	+	+	0	+	0	+	0	+	+	+	0	+	0	1+	NT
9	0	0	0	+	+	+	+	0	+	0	0	+	+	+	0	0	+	0	+	+	+	1+	NT
10	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	+	1+	NT
11	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	+	+	0	+	+	+	1+	2+
AC																						0√	0√

## Laboratory Protocol:

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

- 
4. Given the initial serologic findings, the technologist decided to perform an antibody identification procedure using a tube LISS IAT procedure (Panel 1). What can be concluded from the LISS IAT results?
- LISS IAT is the optimal medium for further testing.
  - A single antibody against a high-prevalence antigen is likely.
  - A single autoantibody is most consistent with the data presented.
  - Multiple alloantibodies to common antigens are the most likely solution.
- 
5. Testing several representative panel cells with PEG was valuable for which of the following reasons?
- To determine if the reactivity of the antibody(ies) was enhanced.
  - To look for variations in strength from cell to cell that were not evident in LISS.
  - To determine if reactivity of one or more cells was diminished.
  - All of the above.

6. Combining the data from the LISS and PEG reactivity, what can be concluded?

- A. The hypothesis of a single antibody against a high-prevalence antigen is strengthened.
- B. There is more evidence to suggest that multiple alloantibodies are present.
- C. PEG would not be a suitable medium for further testing.
- D. No additional testing needs to be performed.

7. Of the following options, which would be the MOST logical next step that could be quickly performed?

- A. Test k-, Lu(b-), and Yt(a-) cells from panels currently available in the laboratory.
- B. Test U- and Js(b-) cells from panels currently available in the laboratory.
- C. Type the patient's cells for high-prevalence antigens.
- D. Call the hospital where the first infant was delivered and inquire about the antibody history.

Antibody Identification Panel 2:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Additional Typing	PEG
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>		IAT
1	+	+	+	+	+	+	+	+	+	+	+	0	+	+	0	0	+	+	0	+	0	Lu(b-)	2+
2	+	+	0	0	+	+	+	0	0	+	0	+	+	0	+	+	0	+	+	0	+	k-	2+
3	0	0	0	+	+	+	0	+	+	+	0	+	+	0	0	0	+	+	+	+	0	Yt(a-)	2+

8. Given the results of the antibody identification panel 2, what would be a logical next step in the resolution of this antibody problem?

- A. Suspend testing and report as unidentified antibody against high-prevalence antigen.
- B. Test the serum with dithiothreitol (DTT)-treated cells.
- C. Test the serum with ficin-treated cells.
- D. Both B and C.

Panel 3 — Ficin- and DTT-Treated Red Cells:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Saline	Ficin	DTT
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT	IAT	IAT
1	+	+	0	0	+	0	+	+	+	0	0	+	+	0	+	0	+	0	+	+	+	1+	1+	1+
3	+	0	+	+	0	0	0	+	+	+	0	+	0	0	0	0	+	+	+	+	0	1+	1+	1+
7	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	1+	1+	1+

## **Case Study 19**

**Initial Data:**

PJ, a 79-year-old female of European ancestry, was diagnosed with myelodysplastic syndrome 6 months ago. After a course of erythropoietin her hemoglobin remains low at 7.5 g/dL. Two units of Red Blood Cells Leukocytes Reduced are ordered to be transfused in infusion clinic tomorrow. You have no record of PJ having been in your transfusion service.

**ABO and RH Typing – First Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	0	3+	4+	4+

**ABO and RH Typing – Repeat Typing on Second Sample:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	0	3+	4+	4+

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	E	c	e	f	M	N	S	S	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	+	+	<b>2+</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	0	+	+	0	<b>2+</b>

1. What is PJ's ABO type?

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

2. Did the second sample ABO type confirm the results of the first sample drawn?

- A. Yes.
- B. No.

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3. **What is PJ's RH type?**

- A. D+.
  - B. D-.
  - C. Weak D+.
  - D. Cannot determine with the data provided.
- 

4. **Given the results of the antibody detection test, what hypothesis can be generated?**

- A. One or more alloantibodies are present.
  - B. One or more autoantibodies are present.
  - C. Both A and B are potential solutions.
  - D. Neither A nor B is supported by the evidence.
- 

5. **Of the following, which would be the MOST informative step to be performed next?**

- A. Test a routine antibody identification panel using Gel IAT.
- B. Repeat the antibody detection test using a three-cell screen.
- C. Test a routine antibody identification panel using LISS IAT.
- D. Repeat the antibody detection test using LISS IAT.

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

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6. **Based on the combined results of the antibody detection and identification (Panel 1) tests, which of the following appears to be present?**

- A. One or more alloantibodies to common antigens.
- B. Antibody to a low-prevalence antigen.
- C. Antibody to a high-prevalence antigen.
- D. Autoantibody.

## Antibody Identification Panel 1:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>i</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	0	0	<b>2+</b>
<b>2</b>	0	0	0	+	+	+	+	+	0	0	+	0	0	0	+	+	+	+	+	+	+	+	<b>2+</b>
<b>3</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	0	0	+	0	+	0	0	0	+	<b>2+</b>
<b>4</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	0	+	0	+	0	+	0	0	+	<b>2+</b>
<b>5</b>	+	0	+	+	0	0	+	+	0	+	0	+	+	0	0	+	+	0	+	0	0	+	<b>2+</b>
<b>6</b>	0	0	0	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	<b>2+</b>
<b>7</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	0	+	+	+	0	+	0	0	+	<b>2+</b>
<b>8</b>	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	+	<b>2+</b>
<b>9</b>	+	+	0	+	+	+	+	0	+	0	0	+	+	0	0	+	0	+	0	+	+	+	<b>2+</b>
<b>10</b>	+	0	+	+	0	0	0	+	0	+	0	+	+	0	+	0	+	+	0	0	0	+	<b>2+</b>
<b>11</b>	+	0	0	+	+	+	+	0	0	+	0	+	0	0	0	+	0	0	0	+	0	+	<b>2+</b>
<b>AC</b>																							<b>0</b>

7. Which of the following would be the MOST efficient way to begin an investigation of a possible antibody directed against an antigen of high prevalence?
- Perform an antibody identification test with a selected panel of cells missing known antigens of high prevalence.
  - Phenotype the patient's cells for antigens of high prevalence until one is found that is negative.
  - Test the patient's serum with three sets of red cells; one untreated, one ficin-treated, and one dithiothreitol (DTT)-treated.
  - Test an antibody identification panel using a LISS or saline test tube method.

## Extended Testing:

The medical laboratory scientist tested the antibody with ficin- and DTT-treated red cells.

## Ficin- and DTT-Treated Red Cells:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Saline	Ficin	DTT
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>i</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	IAT	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	0	+	0	+	+	0	<b>1+</b>	<b>0√</b>	<b>1+</b>
<b>2</b>	0	0	0	+	+	+	+	+	0	0	+	0	0	+	+	+	+	+	+	+	+	<b>2+</b>	<b>0√</b>	<b>2+</b>
<b>3</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	0	0	+	0	+	0	0	+	<b>1+</b>	<b>0√</b>	<b>1+</b>

8. Given the data from Panel 2 as compared to the results in Panel 1, what type of antibody is MOST likely responsible for the reactivity noted?

- A. One or more alloantibodies to common antigens.
- B. Antibody to a high-prevalence antigen of questionable significance.
- C. Antibody to a high-prevalence antigen known to cause shortened red cell survival.
- D. Autoantibody.

9. Given the information obtained from the chemically treated red cells, which of the following cell sets would be the MOST logical selection to test with the patient's serum?

- A. Kn(a<sup>-</sup>) cell, Yk(a<sup>-</sup>) cell, and McC(a<sup>-</sup>) cell.
- B. Ch<sup>-</sup> cell and Rg<sup>-</sup> cell.
- C. Ch<sup>-</sup> cell and Cs(a<sup>-</sup>) cell.
- D. Cs(a<sup>-</sup>) cell and Yk(a<sup>-</sup>) cell.

**Antibody Identification Panel 2:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Saline			
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37 C	IAT	
1	+	+	0	0	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	0	0	0	0	1+
2	0	0	0	+	+	+	+	+	0	0	+	0	0	0	0	+	+	+	+	+	+	0	0	0	2+
3	+	0	+	+	0	0	0	+	0	+	0	+	0	0	0	+	0	+	0	0	+	0	0	0	W+
4	0	0	0	+	+	+	+	+	0	+	0	+	+	0	+	0	+	0	+	0	+	0	0	0	1+
5	+	0	+	+	0	0	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	0	0	0	1+
6	0	0	0	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	0	0	W+
7	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	0	0	0	W+
8	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	0	0	0	1+
9	+	+	0	+	+	+	+	0	+	0	0	+	+	+	0	0	+	0	+	+	+	0	0	0	2+
10	+	0	+	+	0	0	0	+	0	+	0	+	+	0	+	0	+	+	0	0	+	0	0	0	1+
11	+	0	0	+	+	+	+	0	0	+	0	+	0	0	0	+	0	0	0	+	0	0	0	0	W+
AC																						0	0	0√	

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**



10. What additional testing will help confirm specificity of the antibody?

- A. Urine neutralization.
- B. Human milk neutralization.
- C. Soluble A substance.
- D. Plasma neutralization.

**Plasma Neutralization Antibody Identification Panel 3:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Neutralized Plasma	Saline Control
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	Saline IAT	Saline IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	0	+	0	+	+	0	0√	1+
<b>2</b>	0	0	0	+	+	+	+	+	+	0	0	+	0	0	+	+	+	+	+	+	+	0√	2+
<b>3</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	0	0	+	0	+	0	0	+	0√	W+

The laboratory's policies for antibody exclusion remain as previously stated.

11. What do these results suggest?

- A. Anti-Ch or -Rg.
- B. Anti-JMH.
- C. Anti-Sd<sup>a</sup>.
- D. Anti-Kn<sup>a</sup>.

12. Given the results of the plasma neutralization testing, which of the following clinically significant antibodies CAN be ruled out?

- A. Anti-D.
- B. Anti-C.
- C. Anti-Fy<sup>a</sup>.
- D. All of the above.

13. What additional testing can be performed to identify the exact specificity of the antibody?

- A. Test a second antibody identification panel.
- B. A selected cell panel of Ch<sup>-</sup> and Rg<sup>-</sup> cells.
- C. A selected panel of JMH<sup>-</sup> cells.
- D. A selected panel of Kn(a<sup>-</sup>) cells.

14. Given the results of Panel 4, what can be concluded?

- A. Anti-Ch is present in the serum.
- B. Anti-Rg is present in the serum.
- C. Both A and B.
- D. Neither A nor B.

**Antibody Identification Panel 4:**

	Extended Phenotype	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Saline
		D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
1	Ch-	+	+	0	+	+	+	+	0	0	+	0	+	+	0	+	0	+	+	0	+	+	0√
2	Rg-	0	0	0	+	+	+	0	+	+	+	0	+	+	0	0	0	+	0	0	+	0	1+
3	Ch-	0	0	0	+	+	+	+	0	+	+	0	+	0	+	+	+	+	0	+	0	+	0√

## **Case Study 20**

**Initial Data:**

SP, a 42-year-old female of African ancestry, is scheduled to undergo a heart valve replacement. She has had cardiac problems for much of her adult life and received 4 units of Red Blood Cells (RBCs) in previous years. In addition, SP has been managed as a high-risk obstetrical patient through five pregnancies because of her cardiac problems and because she produced anti-D after her first pregnancy 23 years ago.

In preparation for her upcoming surgery, orders have been received in the blood bank for type and crossmatch of 4 RBC units.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
4+	0	0	0	4+

**Antibody Detection Test (Screen):**

							MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test
	D	C	E	c	e	f	M	N	S	S	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	+	+	<b>3+</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	0	+	+	0	+	0	+	0	+	+	0	<b>3+</b>

1. What is SP's ABO type?

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

2. What is SP's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the antibody detection test, what hypothesis can be generated?

- A. One or more alloantibodies are present.
- B. One or more autoantibodies are present.
- C. Both A and B are potential solutions.
- D. Neither A nor B is supported by the evidence.

4. Which of the following would be the MOST informative step to be performed next?

- A. Test a routine antibody identification panel.
- B. Repeat the antibody detection test using a three-cell screen.
- C. Test a selected panel of D- cells.
- D. Repeat the antibody detection test using LISS IAT.

Antibody Identification Panel 1:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Gel Test	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	0	+	0	+	+	0	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	2+
<b>2</b>	0	+	0	+	+	0	+	+	+	0	0	+	0	0	0	0	+	+	+	+	+	+	2+
<b>3</b>	0	0	+	+	+	0	0	+	+	+	0	+	0	0	0	0	+	+	+	+	0	+	2+
<b>4</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	0	0	0	+	2+
<b>5</b>	0	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	0	2+
<b>6</b>	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	+	2+
<b>7</b>	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	0	2+
<b>8</b>	0	0	0	+	+	+	+	+	+	+	0	+	0	0	+	0	+	+	0	+	0	0	2+
<b>9</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	0	0	+	0	+	+	+	+	2+
<b>10</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	+	0	+	+	0	0	0	+	2+
<b>11</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	+	+	0	+	+	+	+	3+
<b>AC</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Laboratory Protocol:

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

5. Based on the combined results of the antibody detection and identification (Panel 1) tests, which of the following appears to be present?

- A. One or more alloantibodies to common antigens.
- B. Anti-D and an antibody to a high-prevalence antigen.
- C. An antibody to a high-prevalence antigen.
- D. Anti-D plus an autoantibody.

6. Which of the following would be an efficient way to begin an investigation of a possible antibody directed against an antigen of high prevalence?

- A. Test a selected panel of cells missing known antigens of high prevalence.
- B. Phenotype the patient's cells for antigens of high prevalence until a negative is found.
- C. Test the patient's serum with three sets of cells (all D-) one untreated, one that has been treated with ficin, and one treated with DTT.
- D. Select additional D- cells until a nonreactive cell is found and follow up by typing this cell for antigens of high prevalence.

**Extended Testing:**

Ficin- and DTT-treated cells were tested. In this case, the D- cells treated with DTT and with ficin continued to be positive, indicating that the target antigen is resistant to both DTT and ficin. The untreated cells are tested as a comparison because the original testing was performed in gel and DTT and ficin cells are most frequently tested in tubes.

**Ficin- and DTT-Treated RBCs:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Sal	Ficin	DTT
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	IAT	IAT
1	0	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	+	0	+	0	2+	2+	2+
2	0	0	+	+	+	+	+	+	+	0	+	+	0	+	0	+	+	0	+	+	+	2+	2+	2+
3	0	0	0	+	+	+	+	+	0	+	0	+	+	+	0	+	+	0	+	0	+	2+	2+	2+

7. Given the information provided in the testing above, which of the following cell sets would be the MOST logical selection to test with the patient's serum?

- A. k- cell and Kp(b-) cell.
- B. Js(b-) cell and U- cell.
- C. U- cell and Lu(b-) cell.
- D. At(a-) cell and Jk:-3 cell.

**Antibody Identification Panel 2:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		U	Saline	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	U	IAT	
1	0	+	0	+	+	+	+	+	0	0	0	+	+	+	0	0	+	+	0	+	0	0	0	0√
2	0	0	0	+	+	+	0	+	+	+	+	0	+	+	0	+	+	0	+	0	+	+	+	2+

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

8. Given the data from the antibody detection test and antibody identification Panels 1 and 2, what antibody specificity is **MOST LIKELY** responsible for the reactivity noted with D– red cells?

- A. Anti-U.
- B. Anti-Lu<sup>b</sup>.
- C. Both.
- D. Neither.

9. What additional testing will **NOT** be required to confirm the anti-U specificity?

- A. Additional D–U– red cell samples.
- B. Additional antibody identification panel with DTT-treated cells.
- C. Exclusion of remaining alloantibodies.
- D. Typing the patient's cells for the U antigen.

**Antibody Identification Panel 3:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		U	IAT
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>		
<b>1</b>	0	0	0	+	+	+	+	0	0	0	0	+	+	0	+	0	+	0	0	+	+	0	0√
<b>2</b>	0	0	0	+	+	+	0	+	0	0	0	+	+	0	0	0	+	0	0	+	0	0	0√

**Laboratory Protocol:**

The laboratory's policies for antibody exclusion remain as previously stated.

**Extended Testing:**

The patient's red cell S/s/U phenotype was performed with the following results:

	<b>S</b>	<b>s</b>	<b>U</b>
<b>SP</b>	0√	0√	0√
<b>Pos Control</b>	3+	4+	3+
<b>Neg Control</b>	0√	0√	0√

Note that the patient is S–s–. This is associated with the U– phenotype.

When managing a patient with an antibody to an antigen of high prevalence, it is good practice to obtain a complete red cell phenotype. This testing was performed with the following results.

	<b>RH</b>					<b>MNS</b>		<b>P</b>	<b>Lewis</b>		<b>Kell</b>		<b>Duffy</b>		<b>Kidd</b>	
	D	C	E	c	e	M	N	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>
<b>SP</b>	0	4+	0	4+	3+	4+	4+	3+	0	4+	0√	4+	3+	0√	2+	0√
<b>Pos Control</b>	4+	4+	4+	4+	3+	4+	4+	3+	3+	4+	4+	4+	3+	2+	2+	3+
<b>Neg Control</b>	0	0	0	0	0	0	0	0	0	0	0√	0√	0√	0√	0√	0√

10. Given all serologic data presented, which of the following alloantibodies have yet to be excluded in this case?

- A. Anti-C.
- B. Anti-K.
- C. Anti-M.
- D. All of the above.

11. What is the MOST efficient method for excluding the remaining alloantibodies?

- A. Test D–U– cells with the appropriate antigen-positive cells.
- B. Adsorb the anti-D and anti-U on D+U+E–K–Fy(b–)Jk(b–) cells. Test adsorbed plasma with appropriate antigen-positive cells.
- C. Adsorb the anti-D and anti-U on D+U+E+K+Fy(b+)Jk(b+) cells. Test adsorbed plasma with appropriate antigen-positive cells.
- D. None of the above.

12. Which of the following could be used to confirm the previously identified anti-D is still reactive?

- A. Test the patient's plasma with D+U– cells.
- B. Adsorb anti-U onto D–U+ cell. Test adsorbed plasma with D+ cells.
- C. Test the patient's plasma with ficin treated D+U+ cells.
- D. Both A and B.



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**13. What is the most likely source of sufficient antigen-negative units for transfusion?**

- A. Test units in the D- inventory for U antigen.
- B. Test donations from RH- individuals of African ancestry for U antigen.
- C. Test the patient's siblings.
- D. Request units from a rare donor registry.

## **Case Study 21**

**Initial Data:**

DB, a 34-year-old female of European ancestry, is G2P1.\* She is presenting to her obstetrician for her initial prenatal visit. To the best of her recollection, she has no history of surgical procedures or transfusions. She is confirmed by ultrasound to be at approximately 27 weeks' gestation.

\*NOTE: G, P, and A are abbreviations for terms that describe a woman's history of pregnancy (gravida or G), delivery of viable offspring (para or P), and abortion (abortus or A). The "A" is generally not included if there is no history of abortion. In this case, DB has had two pregnancies (G2), one live birth (P1), and no abortions; this represents her current status.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
4+	0	0	0	4+

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Solid Phase
	D	C	E	c	e	f	M	N	S	S	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	+	+	0	+	+	+	0	0	+	<b>3+</b>
<b>2</b>	+	0	+	+	0	0	+	0	+	0	+	+	0	+	0	+	+	+	+	+	0	<b>2+</b>
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	0	0	+	0	+	0	+	+	+	<b>0</b>

1. What is DB's ABO type?

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

2. What is DB's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Is a test for detecting weak expression of D antigen indicated in this patient?

- A. Yes.
- B. No.
- C. Optional.
- D. Cannot be determined from the data provided.

4. Given the results of the initial antibody detection test, which of the following antibodies CANNOT be ruled out?

- A. Anti-Le<sup>b</sup>.
- B. Anti-Jk<sup>a</sup>.
- C. Anti-Fy<sup>b</sup>.
- D. Anti-c.

5. Which of the following would be the MOST informative step to perform next?

- A. Direct antiglobulin test (DAT).
- B. Eluate.
- C. Antibody identification panel.
- D. Red cell phenotyping.

**Antibody Identification Panel 1—Solid Phase:**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		SP
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	0	+	0	+	0	+	0	+	<b>3+</b>
<b>2</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	+	0	+	+	+	+	+	0	<b>0</b>
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	+	0	0	+	<b>0</b>
<b>4</b>	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	+	+	+	<b>3+</b>
<b>5</b>	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	<b>0</b>
<b>6</b>	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	<b>3+</b>
<b>7</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	0	<b>2+</b>
<b>8</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	<b>0</b>
<b>9</b>	+	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	+	+	0	<b>3+</b>
<b>10</b>	+	0	+	+	0	0	0	+	+	+	0	+	+	+	0	0	+	+	0	+	0	<b>2+</b>
<b>11</b>	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	<b>2+</b>

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

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6. **Based on the results of the antibody detection and identification tests, which of the following appears to be present?**

- A. More than one alloantibody to common antigens.
- B. One or more autoantibodies.
- C. An antibody to a high-prevalence antigen.
- D. Antibodies to multiple low-prevalence antigens.

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7. **The reactivity in the antibody detection test and the antibody identification panel are consistent with which of the following possible antibody combinations?**

- A. Anti-D and anti-C.
- B. Anti-D and anti-E.
- C. Anti-c and anti-E.
- D. Anti-e and anti-C.

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8. **Besides the anti-D and anti-C, what other combinations of antibodies could account for the reactivity seen in Panel 1?**

- A. Anti-D, anti-C, and anti-G.
- B. Anti-C and anti-G.
- C. Anti-C and anti-LW<sup>a</sup>.
- D. All of the above.

## Selected Cell Panel 2—Polyethylene Glycol:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG		
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IS	37 C	IAT
1	+	0	0	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	0	NH	2+
2	0	+	0	+	+	+	+	+	+	0	0	+	0	0	+	0	+	+	+	+	+	0	NH	3+
3	0	+	0	+	+	+	0	+	+	+	0	+	0	+	0	+	+	+	+	0	+	0	NH	3+
4	0	0	+	+	+	+	+	+	0	+	0	+	+	0	+	0	+	0	0	0	+	0	NH	0 <sup>v</sup>
5	0	0	+	+	+	+	+	+	+	+	0	+	+	0	0	0	+	+	0	+	0	0	NH	0 <sup>v</sup>
AC																						0	NH	0 <sup>v</sup>

9. The medical laboratory scientist decided to test a selected cell panel using a polyethylene glycol (PEG) test tube method to confirm the original hypothesis that the antibodies in this case are anti-D plus anti-C. What can be concluded from the results of Panel 2?

- A. Anti-D and anti-C is confirmed.
- B. Anti-D and anti-G is confirmed.
- C. Anti-G is confirmed.
- D. The panel does not provide sufficient data to confirm antibody specificity.

10. Given the results of the serologic testing to this point, which of the following would provide additional data useful for case resolution?

- A. Testing DTT/AET-treated D+ and C+ red cells.
- B. A history of RHIG administration.
- C. The RH type of the previous infant.
- D. All of the above.

11. The MOST effective method to differentiate anti-D plus anti-C from anti-G alone or anti-G plus anti-C would be:

- A. Test D+C–G– (r<sup>G</sup>) cells.
- B. Adsorb the patient's serum on D+C– cells. Test adsorbed plasma with appropriate antigen-positive cells.
- C. Adsorb patient's serum on D–C+ cells. Test adsorbed plasma with appropriate antigen-positive cells.
- D. Adsorb patient's serum on D+C+ cells. Test adsorbed plasma with appropriate antigen-positive cells.

12. Given the results of Panel 3, what can be concluded about the antibody specificity(ies) in the serum of the patient?

- A. Both anti-D and anti-C are present.
- B. Only anti-G is present.
- C. Anti-D is not present.
- D. Only anti-C is present.

Selected Cell Panel 3—DB's Plasma Adsorbed with D–C+G+ Red Cells:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
1	+	0	0	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	0√
2	0	+	0	+	+	+	+	+	+	0	0	+	0	0	+	0	+	+	+	+	+	0√
3	0	+	0	+	+	+	0	+	+	+	0	+	0	+	0	0	+	+	+	0	+	0√
4	+	0	+	+	0	0	+	+	0	+	0	+	+	0	+	0	+	0	0	0	+	0√
5	0	0	+	+	+	+	+	+	+	+	0	+	+	0	0	0	+	+	0	+	0	0√
AC																						0√

13. Given the results of Panel 4, what can be concluded about the antibody specificity(ies) in the serum of the patient?

- A. Both anti-D and anti-C are present.
- B. Only anti-G is present.
- C. Anti-D is not present.
- D. Anti-C is present.

Selected Cell Panel 4—DB's Plasma Adsorbed With D+C–G+ Red Cells:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT
1	+	0	0	+	+	+	+	+	+	+	0	+	+	0	+	0	+	0	+	+	+	0√
2	0	+	0	+	+	+	+	+	+	0	0	+	0	0	+	0	+	+	+	+	+	3+
3	0	+	0	+	+	+	0	+	+	+	0	+	0	+	0	0	+	+	+	0	+	3+
4	+	0	+	+	0	0	+	+	0	+	0	+	+	0	+	0	+	0	0	0	+	0√
5	0	0	+	+	+	+	+	+	+	+	0	+	+	0	0	0	+	+	0	+	0	0√
AC																						0√

14. The eluate tested in Panel 5 was prepared from the D+C-G+ adsorbing cells (refer to Panel 4). What antibody was removed during the adsorption and has now been recovered in this eluate?

- A. Anti-D and anti-C.
- B. Anti-C.
- C. Anti-G.
- D. Anti-G and anti-D.

**Selected Cell Panel 5—Eluate Prepared from D+C-G+ Red Cells After Adsorption with DB’s Plasma**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		Eluate		Last Wash
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	Saline IAT	Saline IAT	
<b>1</b>	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	<b>2+</b>		
<b>2</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	<b>0√</b>		
<b>3</b>	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	+	0	0	+	<b>0√</b>		
<b>4</b>	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	+	+	+	<b>2+</b>		
<b>5</b>	0	0	+	+	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	0	+	<b>0√</b>		
<b>6</b>	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	<b>2+</b>		
<b>7</b>	+	0	+	+	0	0	0	+	0	+	0	+	0	0	+	0	+	0	+	+	0	<b>2+</b>		
<b>8</b>	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	<b>0√</b>		
<b>9</b>	+	+	0	+	+	+	+	+	0	+	0	+	+	0	0	+	+	0	+	+	0	<b>2+</b>		
<b>10</b>	+	0	+	+	0	0	0	+	+	+	0	+	+	0	0	+	+	+	0	+	0	<b>2+</b>		
<b>11</b>	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	<b>2+</b>		
<b>SC I</b>	+	+	0	0	+	0	+	+	0	+	0	+	+	0	+	+	+	0	+	+	0		<b>0√</b>	
<b>SC II</b>	+	0	+	+	0	0	+	0	+	+	0	+	0	0	+	0	+	+	0	+	+		<b>0√</b>	

15. Given the results of all of the serologic testing, what antibody(ies) are present in the patient’s serum?

- A. Anti-D and anti-C.
- B. Anti-C.
- C. Anti-G.
- D. Anti-G and anti-C.

16. Is this patient a candidate for RHIG?

- A. Yes.
- B. No.
- C. Optional.
- D. Only if fetal testing is done and the fetus is D+.



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17. **Given that the first infant was D–, where could the woman have become sensitized and produce anti-C and anti-G?**

- A. The antibodies do not require stimulation and are most likely naturally occurring.
- B. The first infant could have been C+.
- C. The mother may have had an unreported abortion.
- D. Both B and C.

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18. **Anti-G is implicated in which of the following:**

- A. Hemolytic transfusion reactions (HTRs).
- B. HDFN.
- C. Both of the above.
- D. Neither of the above.

## **Case Study 22**

**Initial Data:**

PR, a 14-year-old male of African ancestry, is a patient at the sickle cell anemia clinic at the local Children's Hospital. He receives periodic Red Blood Cell (RBC) transfusions for the management of his condition and was recently admitted to the hospital in a severe pain crisis. With a current hemoglobin level of 4.1 g/dL, a transfusion has been ordered. The blood bank records show that PR has a history of anti-K. His last transfusion was 6 months ago.

**ABO and RH Typing:**

Forward (Cell) Typing			Reverse (Serum) Typing	
Anti-A	Anti-B	Anti-D	A <sub>1</sub> Cells	B Cells
0	4+	4+	4+	0

**Antibody Detection Test (Screen):**

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG		
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IS	37 C	IAT
<b>1</b>	+	+	0	0	+	0	+	+	0	+	0	+	+	+	0	+	+	+	0	+	+	0	NH	4+
<b>2</b>	+	0	+	+	0	0	+	0	+	0	+	+	+	0	+	0	+	+	+	+	0	0	NH	0√
<b>3</b>	0	0	+	+	+	+	0	+	0	+	0	+	0	+	0	+	+	0	+	0	+	0	NH	1+

1. What is PR's ABO type?

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

2. What is PR's RH type?

- A. D+.
- B. D-.
- C. Weak D+.
- D. Cannot determine with the data provided.

3. Given the results of the antibody detection test, what is the MOST likely hypothesis?

- A. One or more alloantibodies are present.
- B. One or more autoantibodies are present.
- C. Both A and B are likely solutions.
- D. Neither A nor B is supported by the evidence.

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-C, -c, -E, -e, -M, -N, -S, -s, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, and -Jk<sup>b</sup>.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

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4. Given the results of the antibody detection test, which of the following antibodies **CANNOT** be ruled out?

- A. Anti-E.
- B. Anti-S.
- C. Anti-Fy<sup>b</sup>.
- D. All of the above can be ruled out.

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5. What could **BEST** explain the difference in reactivity strength between Cell 1 and Cell 3 of the antibody screen detection test?

- A. Anti-Jk<sup>b</sup> is present.
- B. The previously identified anti-K is a strong antibody.
- C. Cell 1 carries an antigen of low prevalence.
- D. Anti-N is present in the plasma.

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6. Which of the following tests would be the next **BEST** step in this case?

- A. Test a polyethylene glycol (PEG) panel with an autocontrol.
- B. Test a low-ionic-strength saline (LISS) indirect antiglobulin test (IAT) panel with an autocontrol.
- C. Test a ficin panel.
- D. Repeat the antibody detection using a GEL method.

**Laboratory Protocol:**

The following antibodies can be initially ruled out **ONLY** if the patient's serum is **NOT** reactive with the panel cells that have a double dose of the antigen: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, -Jk<sup>b</sup>, and -P1.**

Other antibodies listed on the antigen matrix can be initially ruled out if the patient's serum is **NOT** reactive with the panel cells that are positive for the corresponding antigen. Keep in mind that weakly reactive antibodies may not be reactive with all antigen-positive cells.

If any of the following antibodies are **NOT** ruled out using the initial screen and panel results, additional cells must be tested to provide data for rule-out decisions: **anti-D, -C, -c, -E, -e, -M, -N, -S, -s, -Le<sup>a</sup>, -Le<sup>b</sup>, -P1, -K, -k, -Fy<sup>a</sup>, -Fy<sup>b</sup>, -Jk<sup>a</sup>, -Jk<sup>b</sup>, and -P1.**

7. What alloantibody specificity is suggested by the results of Panel 1?

- A. Anti-D.
- B. Anti-D and anti-E.
- C. Anti-e.
- D. Anti-c and anti-e.

Antibody Identification Panel 1:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	JK <sup>a</sup>	JK <sup>b</sup>	IAT
1	+	+	0	0	+	0	+	+	+	+	0	+	0	+	0	0	+	0	+	0	+	1+
2	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+	+	0	4+
3	0	0	0	+	+	+	0	+	0	+	0	+	+	0	0	+	0	+	0	0	+	NT
4	+	+	0	0	+	0	+	0	+	+	0	+	0	0	0	0	+	+	+	+	+	1+
5	0	0	+	+	+	+	+	+	0	+	0	+	0	+	0	+	+	0	+	0	+	1+
6	0	+	0	0	+	0	+	+	0	+	0	+	+	0	0	+	+	+	+	+	+	NT
7	0	0	+	+	+	0	0	+	0	+	0	+	0	+	0	+	+	0	+	+	0	1+
8	0	0	0	+	+	+	+	0	+	0	0	+	+	0	+	0	+	+	0	0	+	1+
9	+	+	0	+	+	+	+	+	0	+	0	+	+	+	0	0	+	0	+	+	0	1+
10	+	0	+	+	0	0	0	+	+	+	0	+	+	+	0	0	+	+	0	+	0	0√
11	+	0	0	+	+	+	0	+	0	0	0	+	+	0	+	0	+	0	0	+	+	1+
AC																						0√

8. Given the combined results of the antibody detection test and Panel 1, which of the following alloantibodies can be excluded?

- A. Anti-C.
- B. Anti-s.
- C. Anti-K.
- D. Anti-Fy<sup>a</sup>.

9. Of the following, which is the next BEST step in the resolution of this antibody problem?

- A. Test an antibody identification panel from a different manufacturer using gel IAT.
- B. Select units that are negative for the e and K antigens and perform a full serologic crossmatch.
- C. Select units that are negative for the e and K antigens and perform a computer crossmatch to confirm ABO compatibility.
- D. Test a panel of selected e-K- negative cells.

## Antibody Identification Panel 2:

	RH						MNS				LU		P	Lewis		Kell		Duffy		Kidd		PEG	
	D	C	E	c	e	f	M	N	S	s	Lu <sup>a</sup>	Lu <sup>b</sup>	P <sub>1</sub>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>	Jk <sup>a</sup>	Jk <sup>b</sup>	IAT	
<b>1</b>	+	0	+	+	0	0	+	+	+	+	0	+	0	+	0	0	+	0	+	+	+	0	0√
<b>2</b>	+	0	+	+	0	0	+	0	0	+	0	+	+	0	+	0	+	+	+	+	0	+	0√
<b>3</b>	+	0	+	+	0	0	0	+	+	0	0	+	+	0	0	0	+	+	0	+	0	+	0√

10. Given the results of the antibody detection test and Panels 1 and 2, which of the following antibodies was/were ruled out?

- A. Anti-c.
- B. Anti-s.
- C. Anti-Jk<sup>b</sup>.
- D. All of the above.

11. The medical laboratory scientist phenotyped the patient's red cells using available antisera. Given the results of the phenotyping (Table 1), what can be concluded? (See result below.)

Table 1. PR's Phenotype Results

Red Cells Tested	Anti-C	Anti-e	Anti-c	Anti-E	Anti-K
PR	0	4+	4+	0	0√
Positive control	4+	4+	4+	4+	4+
Negative control	0	0	0	0	0√

- A. Anti-C has been ruled out.
- B. Typing is not consistent with the anti-e hypothesis.
- C. The anti-E and anti-e antisera were placed in the wrong tubes.
- D. Typing is not consistent with the previous anti-K identification.

12. Which of the following accounts for the discrepancy between the antibody identification results and the patient's red cell phenotype?

- A. Anti-e specificity is an autoantibody.
- B. Wrong patient's plasma was used in the antibody identification panels.
- C. Phenotyping results were incorrect.
- D. Patient's red cells have a variant e antigen.

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13. What is the next BEST course of action?

- A. Repeat the antibody detection testing.
- B. Refer PR's whole blood sample for *RHD/RHCE* genotyping.
- C. Test PR's red cells with another source of anti-e.
- D. Test PR's plasma against cells known to have various e variant antigens.

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14. Given the combined serologic findings, which of the following antibodies has not been excluded?

- A. Anti-C.
- B. Anti-M.
- C. Anti-Jk<sup>b</sup>.
- D. All of the above.

---

15. The physician has ordered two RBC units for the patient to be transfused STAT. What type of components would be the BEST choice for transfusion to PR at this point?

- A. e-C-K- RBCs.
- B. e+C-K- RBCs.
- C. K-C+ RBCs.
- D. *RHce* genotypically similar RBCs.