

Study Guide — MI Unit 4: When Organs Fail (End-of-Unit Cumulative Test)

Medical Interventions (Genetics of Disease) · Unit 4 — When Organs Fail · Modeled on the PLTW Guided Review format

Vocabulary to know cold

Term	Definition
Nephron / GFR	Nephron = kidney's filtering unit; GFR = volume of blood filtered per minute, the key measure of kidney function
Dialysis	Artificial filtering of blood (hemodialysis = external dialyzer; peritoneal = abdominal lining) when kidneys fail
Drug clearance	Removal of a substance from the blood; dialysis can clear certain drugs and wastes, lowering their blood levels
HLA (MHC) antigens	Human leukocyte antigens — self-markers on cells used to match donors and recipients and judged in rejection
Immune rejection	Immune attack on a graft recognized as non-self; minimized by HLA matching and immunosuppressants.
Immunosuppressant	Drug that lowers immune activity to prevent rejection; trade-off is higher infection risk.
ABO blood group	Blood typing system based on A and B antigens, controlled by co-dominant IA, IB and recessive i alleles.
Rh (D) antigen	A red-cell surface antigen; Rh-negative people can form anti-Rh antibodies, important in transfusion and pregnancy
Universal donor / recipient	O-negative red cells = universal donor (no A, B, Rh antigens); AB-positive = universal recipient of red cells.
Biomedical / bionic device	Engineered device that supports or replaces a body function (dialysis machine, LVAD, cochlear implant).
Organ donation shortage	The gap between patients on the transplant waiting list and the smaller number of organs available each year
Sensitivity	True-positive rate: how well a test or device detects/handles the target when it is actually present.

Worked examples (follow the reasoning)

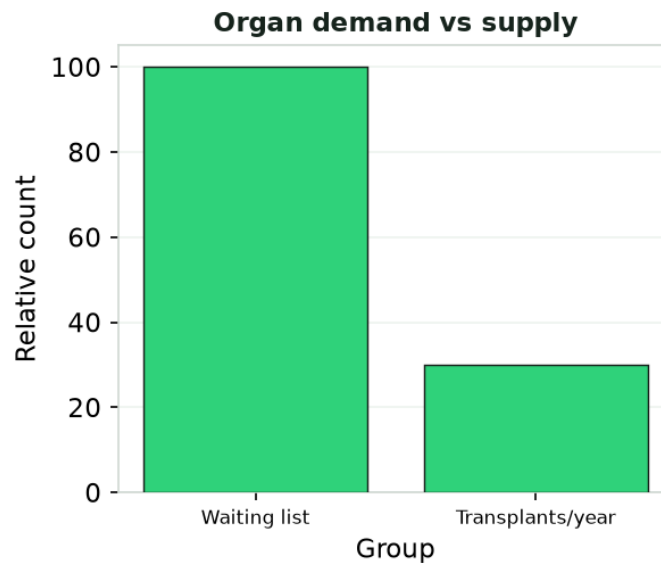
Example 1. Two parents are each blood type AB (genotype $I^A I^B$). Use a Punnett square to find the possible blood types of their children and the ratio.

	$I^A I^B \times I^A I^B$	
	A	B
A	AA	AB
B	AB	BB

- Each parent's gametes carry either I^A or I^B .
- Fill the square: $I^A I^A$, $I^A I^B$, $I^B I^A$, $I^B I^B$.
- $I^A I^A$ = type A; $I^B I^B$ = type B; $I^A I^B$ = type AB (I^A and I^B are co-dominant).
- Count outcomes: 1 type A : 2 type AB : 1 type B.

Answer: Children can be type A, AB, or B in a 1:2:1 ratio (no type O is possible).

Example 2. A bar chart shows about 100 patients on a waiting list but only ~30 transplants per year. Explain the problem this reveals and one ethical response society uses.



- Compare the bars: far more people wait than receive organs.
- This shows a chronic shortage of donor organs relative to need.
- With scarce organs, fair allocation systems (e.g., matching, medical urgency, time on list) are used.
- Encouraging registered organ donation and researching engineered organs are responses to the shortage.

Answer: It shows an organ shortage; society responds with fair allocation policies and by promoting donor registration and bioengineered-organ research.

Practice questions (with reasoning)

1. Which donor blood is safest when a patient's type is unknown in an emergency?

- A. AB-positive
- B. O-negative
- C. A-positive
- D. B-negative

Answer: B. O-negative red cells lack A, B, and Rh(D) antigens, minimizing reaction risk.

2. Closer HLA matching between donor and recipient mainly reduces the risk of:

- A. Surgical bleeding
- B. Immune rejection of the graft
- C. Anesthesia allergy
- D. Wound infection

Answer: B. Fewer foreign HLA markers means less for the immune system to attack.

3. The major trade-off of immunosuppressant therapy is:

- A. More rejection
- B. Greater susceptibility to infection
- C. Higher GFR
- D. Loss of blood type

Answer: B. Suppressing the immune system to stop rejection also weakens defense against infection.

4. SPIRAL (Unit 2): A DNA base change that swaps one amino acid for another is a:

- A. Silent mutation
- B. Missense mutation
- C. Nondisjunction
- D. Duplication

Answer: B. A single base change altering one amino acid is a missense mutation.

5. A new artificial-kidney membrane reports 95% sensitivity for urea removal. Sensitivity means it:

- A. Adds urea
- B. Correctly removes the target waste when present
- C. Ignores the waste
- D. Rejects clean samples

Answer: B. Sensitivity is the true-positive rate for handling the target when it is present.