Designing Safer Doses

Use test results to improve a blood treatment plan.

HAP.9.4 "Enrichment: Use an engineering design process to develop effective treatments for blood disorders (e.g., methods to regulate blood cell counts or blood doping tests).*"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the design goal and safety constraints, circle the measurements used to make decisions, and number the test results that could guide a redesign.

A Decision Aid for Anemia Care

1. At a kidney clinic, a patient with chronic kidney disease feels tired because their red blood cell count is low. Damaged kidneys may release too little erythropoietin, a hormone that signals the bone marrow to make red blood cells. A clinician may prescribe an erythropoiesis-stimulating medicine, but raising hemoglobin too much can increase the risk of blood clots and other harms. For this imaginary case, the care team chooses a hemoglobin goal of 10 to 11 grams per deciliter. Any useful plan must also account for iron availability and blood pressure, not just a single hemoglobin number.

2. An engineering team builds two decision aids for the clinician to review, not machines that prescribe medicine. Protocol A suggests the same medicine dose at every visit, two weeks apart. Protocol B uses the latest hemoglobin result, an iron test, and a blood pressure reading to suggest whether the clinician should review the dose or pause treatment for assessment. Both aids record each suggestion so the team can inspect it later. Because new red blood cells take time to develop, the team tests changes over eight weeks rather than judging success the day after a dose. Neither aid replaces clinical judgment.

3. The team first tests both protocols on the same simulated patient record, which starts at 9.2 grams of hemoglobin per deciliter. At week eight, Protocol A reaches 12.1, while Protocol B reaches 10.6. Across four follow-up visits, A stays in the goal range once and B stays in it three times. The simulated iron result drops at week four, and blood pressure rises at week six. B flags both changes for clinician review; A continues to suggest its scheduled dose. These results can guide a redesign, but simulated records cannot prove that a protocol is safe for real patients.

2 ANSWER WITH EVIDENCE

Use the passage

1. Which two measurements besides hemoglobin should a safe decision aid consider? Why is hemoglobin alone not enough?

2. To avoid suggestions that ignore new warning signs, which feature of Protocol B should the team keep? Use the week-four or week-six event to explain.

3. Which protocol better meets the hemoglobin goal in this test? Cite its week-eight result and its number of follow-up visits in the goal range.

4. Suggest one specific change to Protocol A for its next version. Which test result makes that change necessary?

3 YOUR TURN

Your own words

Oral iron can treat iron-deficiency anemia but may cause stomach pain. Design a reminder and follow-up plan: give a measurable eight-week goal, one safety limit, a test using fictional patient records, and a change you would make if stomach pain is common.

Designing Safer Doses

PART 1 · READ AND MARK

Underline the design goal and safety constraints, circle the measurements used to make decisions, and number the test results that could guide a redesign. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Which two measurements besides hemoglobin should a safe decision aid consider? Why is hemoglobin alone not enough?	**It should consider iron availability and blood pressure. Hemoglobin alone would miss changes in these safety-related measurements.**
2	To avoid suggestions that ignore new warning signs, which feature of Protocol B should the team keep? Use the week-four or week-six event to explain.	**Keep its flag for clinician review when a measurement changes. It flagged the drop in iron at week four or the rise in blood pressure at week six.**
3	Which protocol better meets the hemoglobin goal in this test? Cite its week-eight result and its number of follow-up visits in the goal range.	**Protocol B. Its week-eight result was 10.6 grams per deciliter, within the 10 to 11 goal, and it was in range at three of four follow-up visits.**
4	Suggest one specific change to Protocol A for its next version. Which test result makes that change necessary?	**Add a blood pressure check that flags a rise for clinician review. At week six, blood pressure rose, but A continued to suggest its scheduled dose.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

My goal is for at least 8 of 10 simulated patients to gain at least 1 gram of hemoglobin per deciliter in eight weeks. The system will never suggest changing a prescribed dose without a clinician's review. I would test it on ten fictional records that track reminder use, hemoglobin, and reported stomach pain. If many report pain, I would add an alert asking them to contact the clinic to discuss treatment options.

Accept other specific redesigns supported by the passage. For the open task, look for a measurable goal, a safety limit, a test using fictional records, and a response to reported stomach pain that leaves treatment decisions to a clinician.