Dosage Calculations Based on Body Surface Area

**LEARNING OBJECTIVES**

After completing this chapter, the student will be able to:

1. Identify which types of drugs are dosed according to body surface area
2. Use a nomogram to calculate body surface area
3. Perform dosing calculations for drugs based on body surface area

Body surface area (BSA) is used to accurately calculate doses for patients receiving chemotherapy agents. BSA is expressed as square meters (m²). Body surface area is calculated using patient body weight and height, and can be determined by referring to a standard nomogram.

A nomogram has three columns:
- Height (expressed in centimeters and in inches)
- Body surface area (expressed in square meters)
- Weight (expressed in kilograms and in pounds)

The height and weight of the patient are found on the nomogram and then a straight line is drawn connecting the two values. The BSA for that patient is found where the line intersects the BSA column. Many manufacturers of chemotherapy drugs supply BSA calculators with sliding scales. The principle of finding the BSA is similar to the nomogram.

**EXAMPLE**

A physician orders a chemotherapy drug in a dose of 5 mg/m². If the patient has a BSA of 2.1 m², what will be the dose in mg?

Set up a ratio and proportion:

\[
\frac{5 \text{ mg}}{1 \text{ m}^2} = \frac{X}{2.1 \text{ m}^2} \rightarrow X \times \frac{1 \text{ m}^2}{2.1 \text{ m}^2} = \frac{5 \text{ mg} \times 2.1 \text{ m}^2}{1 \text{ m}^2} \rightarrow X = 10.5 \text{ mg answer}
\]
EXAMPLE
The physician orders a drug for a child with a BSA of 0.95 m\(^2\). The drug dose is 750 mcg/m\(^2\). What will be the dose in milligrams for this child?

Set up a ratio and proportion:

\[
\frac{750 \text{ mcg}}{1 \text{ m}^2} = \frac{X}{0.95 \text{ m}^2} \rightarrow \frac{X \times \frac{1}{0.95} \text{ m}^2}{1 \text{ m}^2} = \frac{750 \text{ mcg} \times 0.95 \text{ m}^2}{1 \text{ m}^2} \rightarrow X = 712.5 \text{ mcg}
\]

The dose is in mg \(1 \text{ mg} = 1,000 \text{ mcg}\)

To find the number of milligrams, divide the micrograms by 1,000.

\[
712.5 \text{ mcg} = 0.713 \text{ mg answer}
\]

EXAMPLE
Using the nomogram: A patient’s weight is 80 kg and height is 6’6”. The physician orders his chemotherapy treatment as 6.5 mg/m\(^2\) once daily for five days. How many mg of drug will the patient receive in one day?

From the nomogram \(\text{BSA} = 2.30 \text{ m}^2\)

Set up a ratio and proportion:

\[
\frac{6.5 \text{ mg}}{1 \text{ m}^2} = \frac{X}{2.30 \text{ m}^2} \rightarrow \frac{X \times \frac{1}{2.30} \text{ m}^2}{1 \text{ m}^2} = \frac{6.5 \text{ mg} \times 2.30 \text{ m}^2}{1 \text{ m}^2} \rightarrow X = 14.95 \text{ mg answer}
\]

EXAMPLE
Using the nomogram provided, find the BSA for the following patient.

<table>
<thead>
<tr>
<th>Patient 1</th>
<th>weight 50 kg; height 55 inches</th>
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Using a straight edge (a ruler is good), find the patient weight and height and place the ruler on each. Where the ruler intersects with the BSA (the middle line) is the BSA for the patient.

\[
\rightarrow \text{BSA} = 1.40 \text{ m}^2
\]

Patient 2 \(\rightarrow\) weight 84 lbs.; height 119 cm; \(\text{BSA} = 1.10 \text{ m}^2\)

Patient 3 \(\rightarrow\) weight 60 kg; height 150 cm; \(\text{BSA} = 1.59 \text{ m}^2\)

Practice using the nomogram accurately.
Students and teachers should use this nomogram for calculations in this textbook. To use another nomogram may give different answers.

From the formula of Du Bois and Du Bois, *Arch. int. mèd.*, 17, 863 (1916): \( S = W^{0.425} \times H^{0.725} \times 71.84 \), or \( \log S = \log W \times 0.425 + \log H \times 0.725 + 1.8564 \) (\( S \) = body surface in \( \text{cm}^2 \), \( W \) = weight in kg, \( H \) = height in cm). From *Scientific Tables*, 7th ed. Basel, J. R. Geigy, p. 537.
Examples of chemotherapy medications that are dosed using Body Surface Area
1. A physician orders a bolus dose of doxorubicin for a patient with a BSA of 0.96 m². The drug dose is 75 mg/m². What is the bolus dose in mg?

2. A patient weighs 98 pounds and is 5'1" tall. Using the nomogram, find the patient's BSA. The dose of vincristine ordered by the physician is 10 mg/m² per day. What will be the dose in mg?

3. A patient with a BSA of 1.95 m² is ordered a dose of doxorubicin of 40 mg/m² two times daily. What will be the daily dose, in mg, for this patient?

4. Using the nomogram, find the BSA for the following patient: Weight is 64 kg, height is 5'6". The physician orders a dose of vinblastine of 1.6 mg/m² daily for four days. Calculate the number of milligrams received by the patient over the four days.

5. A patient's weight is 70 kg and height is 155 centimeters. Calculate the dose of fluorouracil, in mg, for the patient if the oncologist orders 400 mg/m² daily.

6. A patient has a BSA of 1.54 m². The physician orders a daily dose of 900 mg/m² of methotrexate for this patient. What is the daily dose, in ml, if the concentration of methotrexate available is 25 mg/ml?
7. A physician order is for Adriamycin 25 mg/m² daily for four days. The patient has a 2.5 m² BSA. What is the total amount, in mg, that the patient will receive over the four days?

8. A patient with 1.8 m² BSA is to receive mesna 4,500 mg/m² IV in 1,000 ml D5W over 18 hours on day one of treatment. Mesna is available as 1,000 mg/ml vials. Calculate how many ml are required for the IV bag.

9. The physician for a patient, BSA 1.9 m², orders cisplatin 15 mg/m² continuous infusion. Cisplatin is available in 50 ml vials with a concentration of 1 mg/ml. How many ml will be required for this order?

10. Taxotere is ordered 55 mg per m² over one hour. The patient has a BSA of 1.93 m². Taxotere is available in a concentration of 20 mg/ml. Calculate how many ml are needed for this patient’s dose.

11. A patient weighs 184 pounds and is 72 inches in height. The physician orders doxorubicin 25 mg/m² IV push. The doxorubicin is supplied as 50 mg vials reconstituted to 4 mg/ml. How many ml will this patient need for his IV push?

12. A patient with a BSA of 1.52 m² is ordered leukovorin 100 mg/m² IV in 100 ml 0.9% sodium chloride solution over one hour. Leukovorin is supplied as 200 mg dry powder that is reconstituted to 10 mg/ml. Calculate how many ml are to be added to the IV bag.
13. 5FU 400 mg/m² as IV push is ordered for a patient—whose height is 60.5 inches and weight is 123.4 pounds. 5FU is available as 50 mg/ml in 10 ml vials. How many ml will the patient require?

14. Topotecan 1 mg/m² IV over 30 minutes in 50 ml of normal saline is ordered for a patient with a BSA of 2.00 m². Topotecan is supplied as 4 mg/vial reconstituted to 1 mg/ml. How many ml will be added to the IV bag?

15. A patient with a BSA 1.8 m² is to receive Cytoxan 4,500 mg/m² IV in 1,000 ml of 0.9% sodium chloride injection over 12 hours. Cytoxan is supplied as 2 g vials 50 mg/ml after reconstitution. How many ml should the technician add to the IV bag?

16. A patient with a BSA of 1.52 m² is to receive etoposide 2,000 mg/m² via a syringe pump over two hours. Etoposide is supplied as 525 mg/25 ml vials. How many ml will be needed for this patient?

17. Bleomycin 10 units/m² IV push is ordered for a patient with a BSA 2.05 m². Bleomycin is available as 15 units/ml. Calculate how many ml are needed for this patient’s dose.

18. A patient, whose weight is 80.5 kg and height is 63 inches, is to receive dacarbazine 375 mg/m² in 250 ml 5% dextrose injection over 30 to 60 minutes. Dacarbazine is available as 200 mg/vial reconstituted to 10 mg/ml. How many ml will be needed to add to the IV bag?
19. Paclitaxel 45 mg/m² in 500 ml normal saline is to be given to a patient with BSA 2.1 m². Paclitaxel is supplied as 6 mg/ml. How many ml should the technician add to the IV bag?

20. A physician orders carboplatin, 360 mg/m² in 250 ml normal saline infused over one hour. The patient has a BSA of 2.6 m². How many ml must the technician add to the IV bag? Carboplatin is available after reconstitution in a concentration of 10 mg/ml.

21. A physician orders a 375 mg/m² dose of Rituxan in 500 ml NS for a patient with a BSA of 1.24 m². Rituxan is available in 10 ml vials in a concentration of 10 mg/ml. How many ml will be added to the IV bag?

22. Cyclophosphamide, after reconstitution, has a concentration of 20 mg/ml. The patient, who weighs 67 kg and is 155 cm tall, is ordered cyclophosphamide 600 mg/m² in 250 ml NS. How many ml will be added to the bag?

23. Doxorubicin, after reconstitution, is available as a 2 mg/ml solution. The physician orders a syringe for IV push at a dose of 35 mg/m². The patient has a BSA of 1.2 m². How many ml are drawn into the syringe?

24. A patient is to receive Taxol 175 mg/m². She weighs 90 pounds and is 5'2" tall. The Taxol is available, after reconstitution, in a concentration of 6 mg/ml. How many ml will be added to a 500 ml bag of NS for IV infusion?
25. An order is received in the pharmacy for 5-FU IV for a patient with a BSA of 1.6 m². The 5-FU solution is available in a 50 mg/ml concentration. The dosage schedule is as follows:

Initial dose: 400 mg/m² for 5 days IV push

How many grams of 5-FU has the patient received for the initial dose?

26. 50 mg of a powdered drug is reconstituted with 10 ml of sterile water for injection (assume no powder volume). A patient is ordered an 85 mg/m² dose of the drug in 250 ml D5W. The patient’s BSA is 0.82 m². How many ml of the reconstituted drug will be added to the IV bag?

27. A patient weighs 180 pounds and is 6’2” tall. The dose of a drug ordered by his physician is 1.3 mg/m² IV push twice weekly for two weeks. The drug is available in a concentration of 1 mg/ml. How many ml of the ordered drug will the patient receive for each dose?

28. A patient, weight 125 pounds, height 5’6”, is to receive the following chemotherapy regime: 800 mcg/m² twice weekly for 2 weeks. The chemo drug when reconstituted has a concentration of 1 mg/ml. How many ml of the drug will the patient receive for the complete regime?

29. The initial loading dose of a chemo drug is 400 mg/m² infused over 120 minutes and the maintenance dose is 250 mg/m² infused over 60 minutes. The drug is available as 12 mg/ml. The patient, BSA 1.2 m², received a 25 ml dose. Is this an initial or maintenance dose?
30. A physician orders bleomycin in a dose of 20 units/m^2 twice weekly. The reconstituted bleomycin has a concentration of 30 units/5 ml. The patient has a BSA of 2.5 m^2. How many ml will the patient need for a single dose?

31. An order is received in the pharmacy for methotrexate 40 mg/m^2. Methotrexate is available in a concentration of 2.5 mg/ml. How many ml are needed for the dose for the patient (weight 80 kg, height 160 cm)?

32. A physician orders mesna 1.33 g/m^2/day. The pharmacy has on hand mesna 100 mg/ml. The patient has a BSA of 0.8 m^2. How many ml will the patient receive each day?

33. A 155-pound patient (height 5’9”) is ordered interferon Alfa-2b IM 2 million units/m^2 3 times a week. The drug is available 10 MU in 1 ml. How many ml will the patient need per week?

34. In the pharmacy, idarubicin is available as a 1 mg/ml solution for IV use. The patient, with a BSA of 1.5 m^2 is ordered 12 mg/m^2/day for 3 days by slow IV. How many ml will be administered for the total treatment?

35. 20 ml sterile water for injection is added to a 1 g vial of powdered ifosfamide (assume no powder volume). The order for the patient is 700 mg/m^2 IV push. How many ml of the reconstituted ifosfamide will be drawn into the syringe? The patient has a BSA of 1.1 m^2.
36. The patient is to receive a rapid bolus dose of Alkeran within the hour. The order is for 16 mg/m². Alkeran is reconstituted to 5 mg/ml. The patient has a BSA of 1.92 m². How many ml of the reconstituted solution will the patient need?

37. Robaxin injection is available in a 10 ml vial with a concentration of 100 mg/ml. An order is received in the pharmacy for Robaxin injection 500 mg/m²/dose that may be repeated in 6 hours. The patient weighs 68 pounds and is 4’10” tall. How many ml will the patient need for one dose?

38. A 1 g vial of methotrexate when reconstituted with normal saline has a concentration of 50 mg/ml. A patient with a BSA of 1.39 m² is ordered 6 g/m² by IV infusion every week. How many ml of the reconstituted solution will the patient receive?

39. A chemo drug is available in the pharmacy as 50 mg capsules. A patient with a BSA of 1.66 m² is ordered 60 mg/m²/day for 14 days. How many capsules will the patient require for this course of treatment?

40. Leukine is to be administered by IV at 250 mcg/m²/day for 21 days. The standard diluted dose in use is 250 mcg/25 ml NS. How many ml will a patient with a BSA of 2.1 m² require each day?
41. Cytarabine is available as a 20 mg/ml injection. A patient with a BSA of 1.4 m$^2$ is to receive 75 mg/m$^2$/day for 10 days. How many ml will be administered IV each day?

42. A high dose 3.38 g/m$^2$ of dacarbazine is ordered for a patient with a BSA of 1.5 m$^2$. The medication is available after reconstitution as 20 mg/ml. How many ml will be required for the IV infusion?

43. A chemo drug is available as 5 mg/ml. A patient with a BSA of 0.99 m$^2$ is ordered 25 mg/m$^2$. How many ml are needed?

44. A child with a BSA of 0.97 m$^2$ is ordered a one-time dose of 12 mg/m$^2$. The antineoplastic is available as 1 mg/ml in 10 ml vials. How many ml are required for the one dose?

45. A patient with a BSA of 2.1 m$^2$ is to receive 7.5 mg/m$^2$/week of methotrexate. MTX is available as 25 mg/ml. How many ml are needed for the weekly dose?