Intake and Output: A Mathematics Application in Health Care

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Objectives

- Describe the process of charting intake and output in clinical situations
- Emphasize the underlying mathematics in the I/O process
- Illustrate how I/O calculations can be used as a context for developing sound quantitative reasoning skills
- Provide examples of I/O activities that can be utilized in a Quantitative Reasoning course

Intake and Output

- Monitoring fluid intake and output
  - **Intake:** intravenous fluids, blood products, oral fluids, tube feedings, irrigations
  - **Output:** urine, vomit, fluid from drains or wounds, liquid bowel movements

- Why is it necessary?
  - Prevent dehydration or fluid overload
  - Medical conditions (e.g. renal, gastrointestinal or cardiac)
  - Pre-, intra- & post-surgical procedures
  - Medications (e.g. diuretics)

I/O Example - Intake

Before . . .

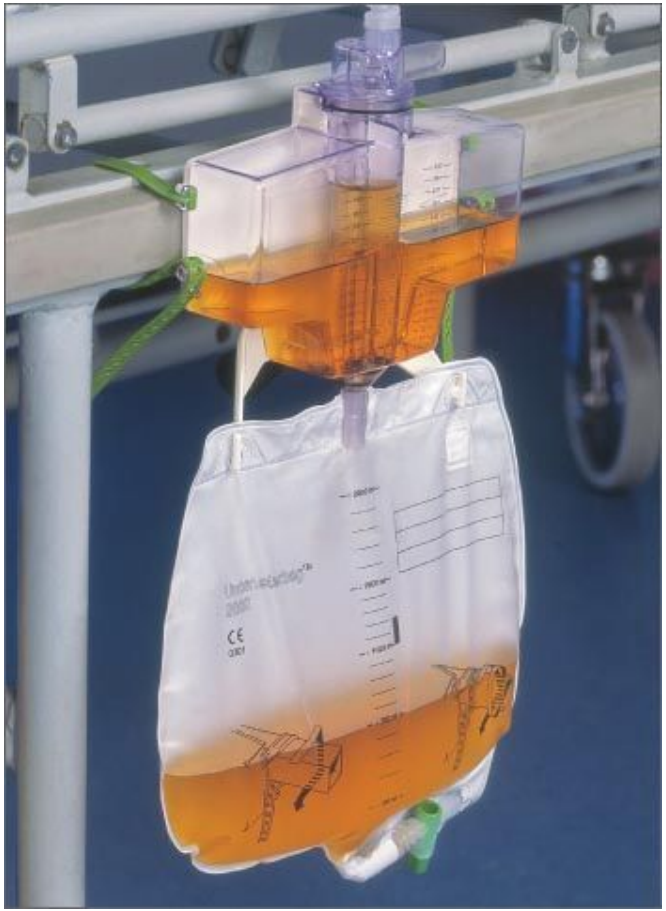
I/O Example - Intake

Before . . .

After . . .

I/O Example - Output

https://www.ndsu.edu/pubweb/bismarcknursing/basic/skill/F003.html

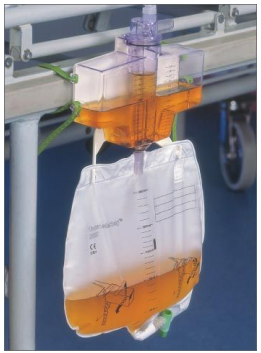


http://milmed.ru/product/tonometry-devices-for-monitoring-urine-output-and-intra-abdominal-pressure/

Charting I/O

Before . . .

After . . .



Intake/Output Sheet

Juice glass – 180 mL	Milk carton – 180 mL
Water glass – 200 mL	Gelatin cup – 100 mL
Coffee cup – 240 mL	Juice cup – 120 mL
Soup bowl – 180 mL	Creamer – 30 mL

Date: _____

Client Information

INTAKE			OUTPUT			
Time	**Type**	**Amount**	**Time**	**Urine**	**Stool**	**Other**
1630	Ice cream	120 mL	1330	225 mL		
1630	Coffee	240 mL	1600	100 mL		
1630	Water	50 mL				
Shift Total:		410 mL				

Math Skills and Concepts Needed for I/O

- Basic operations
- Fractions/Decimals/Percents
- Reasoning with ratios
- Estimation of measurements
- Conversions between measurements
- Compare order of magnitudes

Additional Skills Incorporated in I/O Problems

- “[Students] express numerical answers with a degree of precision appropriate for the problem context.”[1]
- Multiple ways to approach and complete the task
- Students may arrive at different numerical values

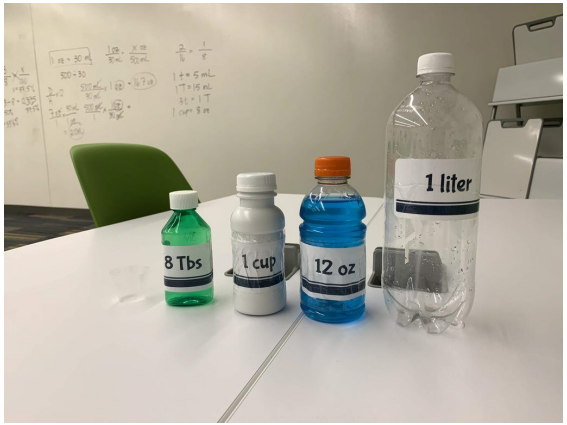
[1]See the Common Core State Standards -- Standards for Mathematical Practice
Also described in MAA Instructional Practices Guide and AMATYC IMPACT Document

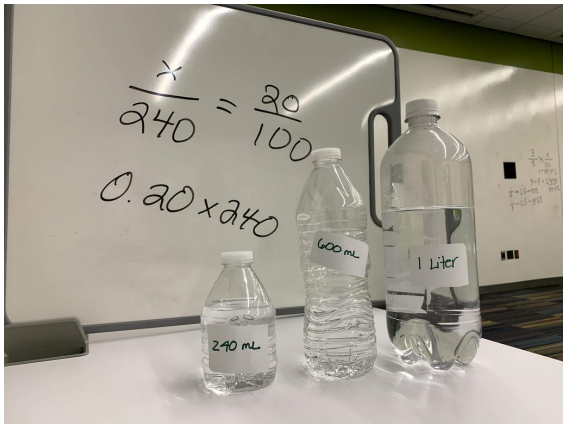
Intake / Output Activity in an In-Class Lab

In-Class Lab Activity

Students worked in groups to...

- Review fractions, percents, and volume conversions
- Estimate the amount of fluid consumed from various sizes of bottles
- Estimate the amount of volume eliminated by a patient.
- Calculate intake from a patient's tray.






BARD
APPROXIMATE VOLUME
350
300
250
200
150
100
2500
2300
2100
1900
1700
1500
1300
900
700
500
400
300
200


Intake/Output Sheet
Client Information
INTAKE
OUTPUT
JELL-O

Intake / Output Activity in an Online Format

Welcome to

Calculating Intake Activity

Enter your name(s) to begin:

Go!

Not Daniel? Sign out

https://student.desmos.com/join/aqezw5

Intake / Output Activity in an Online Format

STUDENT SCREEN PREVIEW

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Equivalent Fractions and Percents

Calculating intake and output requires a good understanding of fractions and percents.

If a patient consumes 1 1/2 glasses of water, how many mL is this?

What percent of the food tray did the patient consume?

These are questions that need to be answered and a solid foundation of fractions and percents will be beneficial to answering these types of questions.

percentage	fraction	decimal
30%	$\frac{3}{10}$	0.3

to go from a fraction to a percentage we can convert to a decimal first

3/5 → 0.6 → 60%

Intake / Output Activity in an Online Format

STUDENT SCREEN PREVIEW

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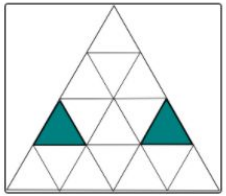
Your Turn: Gather the equivalent fractions and percentages -- click and drag the cards together to group them.

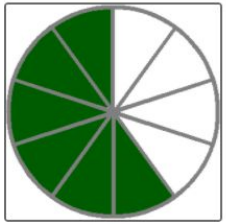
$1\frac{1}{3}$

12.5%

$\frac{3}{8}$

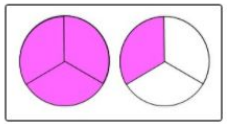


37.5%

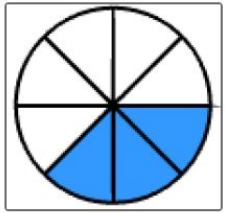


$\frac{3}{5}$

$\frac{2}{16}$



60%

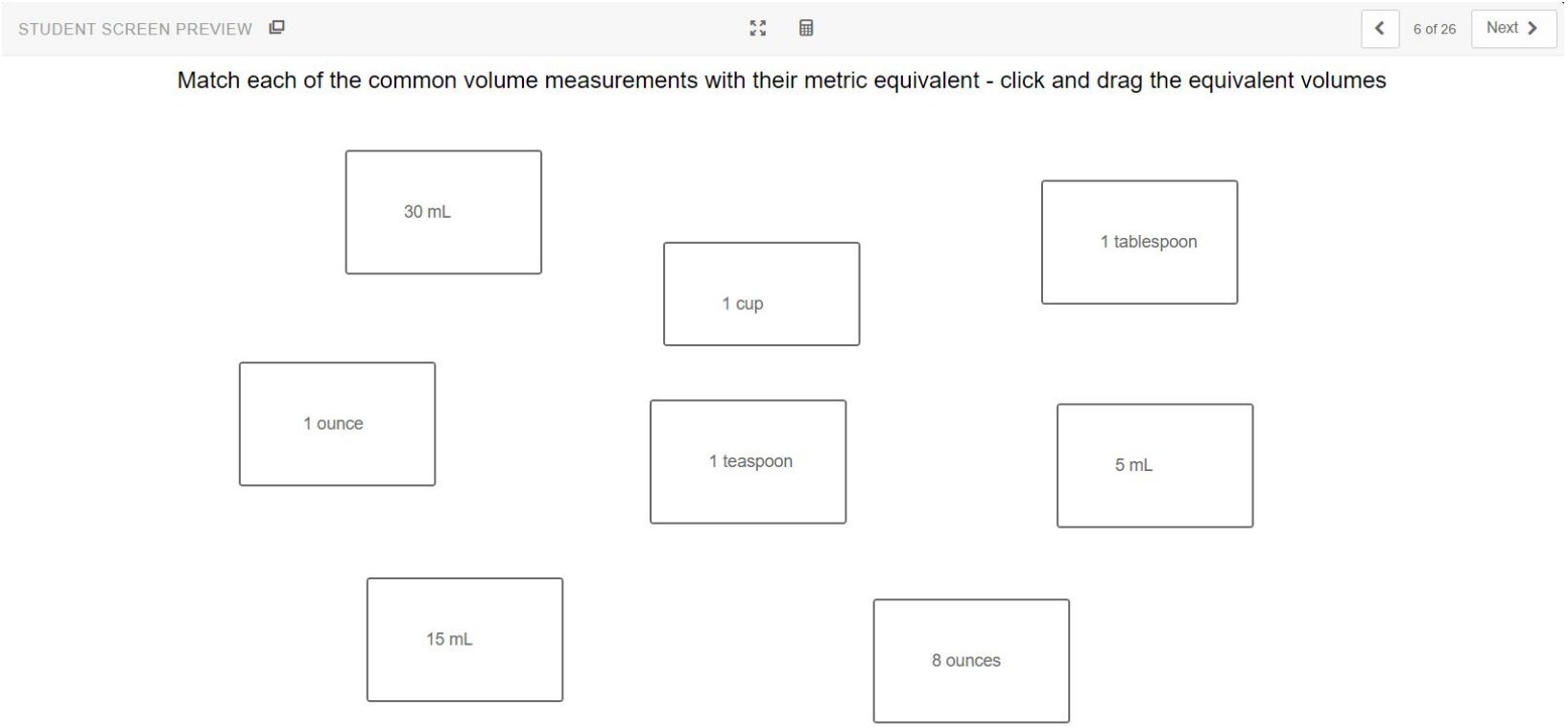


$\frac{6}{10}$

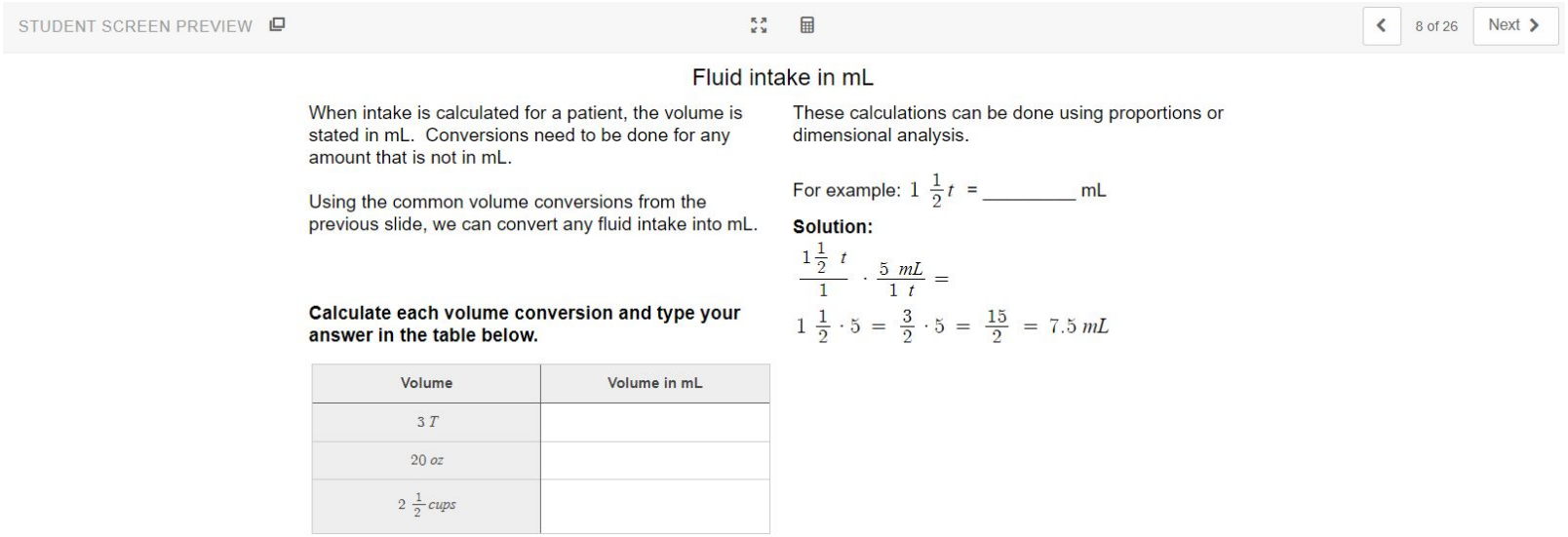
$\frac{4}{3}$

$\frac{1}{8}$

Intake / Output Activity in an Online Format



Intake / Output Activity in an Online Format



Intake / Output Activity in an Online Format

STUDENT SCREEN PREVIEW

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Calculate the volume for each bottle in mL. Then state the total volume for all 5 bottles combined.

Water Bottle 1 Liter

Juice 12 oz

Ensure 8 oz


Medicine Bottle 8 T


Medicine Cup 30 mL

The total volume for all 5 bottles together in mL is:

Explain how you calculated your answer:

Intake / Output Activity in an Online Format

STUDENT SCREEN PREVIEW

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Calculating the mL Consumed -- Fill in the Table

Water Bottle 1 Liter Juice 12 oz Ensure 8 oz

Our patient did not finish drinking the liquid in these bottles, but we can still estimate how many milliliters they have consumed based on the markings in the picture.

For each of the bottles, first consider ***what percent*** of the volume ***still remains*** and what percent has been ***consumed*** by the patient. Complete these in the table provided.

Then use your percentages and previous volume conversions to calculate the number of ***milliliters (mL) that remain*** and the ***milliliters (mL) consumed***. Once you have the tables completed, determine the ***total milliliters (mL)*** consumed by this patient.

Item	% Remaining	% Consumed
Water Bottle		
Juice Bottle		
Ensure		

Item	mL Remaining	mL Consumed
Water Bottle		
Juice Bottle		
Ensure		

Intake / Output Activity in an Online Format

STUDENT SCREEN PREVIEW

14 of 26 Next

Which items count towards fluid intake?

We are given a picture of a patient's lunch tray containing the following items:

- Sandwich
- Cream of potato soup
- Pudding
- Jello
- Peach
- Juice box
- Coffee and creamers

When calculating intake, we must first identify the items that count as "fluid". Of the items on this tray, which ones do you think we will need to consider for volume intake?

(Select all that apply.)

- [ ] Sandwich
- [ ] Coffee and creamers
- [ ] Peach
- [ ] Cream of potato soup
- [ ] Juice box
- [ ] Jello
- [ ] Pudding

Intake / Output Activity in an Online Format

STUDENT SCREEN PREVIEW

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Calculate the volume intake

Juice glass – 180 mL	Milk carton – 180 mL
Water glass – 200 mL	Gelatin cup – 100 mL
Coffee cup – 240 mL	Juice cup – 120 mL
Soup bowl – 180 mL	Creamer – 30 mL

Date: _____

Let's assume our patient consumed 100% of the items on this tray.

We now want to determine how many milliliters (mL) of fluid our patient will consume.

We see that the **juice box contains 6.75 ounces**.

Use this information as well as the common fluid conversions provided to calculate the fluid intake in mL.

Complete the chart below.

Item	Amount (mL)
Juice box	
Coffee	
Creamers	
Jello	
TOTAL	

Intake / Output Activity in an Online Format

STUDENT SCREEN PREVIEW

Calculating volume of each item, in mL, before consumption

Before . . .

Notice the amount of each item on the tray. Not all of the containers are full. Keep that in mind for when you calculate the amount or percent consumed.

Here's a copy of an Intake/Output Sheet:

Juice glass – 180 mL	Milk carton – 180 mL
Water glass – 200 mL	Gelatin cup – 100 mL
Coffee cup – 240 mL	Juice cup – 120 mL
Soup bowl – 180 mL	Creamer – 30 mL

Date: _____

Calculate the volume, in mL, of each fluid intake item that you identified on the previous slide.

Enter the item in the left column and the amount of mL for that item in the right column.

Note: Pay careful attention to the items that are not full to start. Only state the number of mL that are shown in the picture.

Use the conversions on the Intake/Output sheet as needed.

Item	Volume in mL

Intake / Output Activity in an Online Format

STUDENT SCREEN PREVIEW

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Here is the patient's food tray after they finished eating

After . . .

What do you notice about the items consumed?
Be specific.

Submit

Intake / Output Activity in an Online Format

STUDENT SCREEN PREVIEW

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Calculating volume consumed, in mL

Based on the items remaining on the food tray, **calculate the volume consumed,** in mL.

After . . .

Enter the item in the left column of the table.

Enter the **volume consumed (in mL)** for each item in the right column of the table.

Then calculate the total intake in mL.

Show the calculations in the space below:

Item	Volume Consumed in mL
Total in mL:	

Submit

Intake / Output Activity in an Online Format

STUDENT SCREEN PREVIEW

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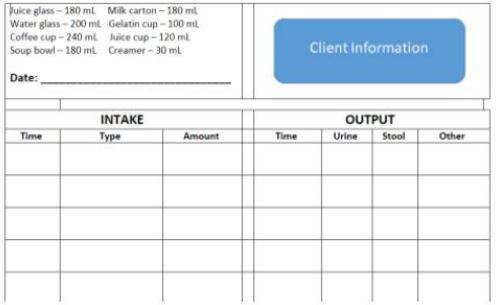
Wrap Up: What have you learned?



What have you learned from this activity?

Please list 3 specific concepts that you have learned OR that you still have questions with after completing this activity.

State these items in the box below:

Submit

This activity required you to first think about fractions and percents as they relate to volume.

Then, we looked at some common volume conversions to be able to estimate the volume of items consumed on a food tray.

Next, we estimated the percent consumed and the amount consumed by looking at some bottles that were not filled the entire way.

After that, we looked at determining which items are counted as intake and which items are not.

At that point, we could calculate the volume, in mL, that was on a food tray.

And finally, putting all of that information together, we could calculate the total intake for a patient based on their food tray.

This is a lot of information to put all together!

Questions and Feedback

Please feel free to reach out to us with questions, comments, and feedback. We are happy to share additional materials!

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