Laboratory Test Utilization Rate

Description: These instructions will demonstrate how to calculate the rate of use for a specific laboratory test. Utilization rates can be used for diagnostic stewardship initiatives, when the goal is to avoid unnecessary testing. Also, trending test utilization rates can help you understand if a change in testing practice might impact your ability to identify specific infectious outcomes or events. For example, antimicrobial stewards may want to track utilization of blood cultures, urine cultures, or *C. difficile* tests.

For this example, we'd like to track the utilization rate of blood cultures in an ICU on a monthly basis so we can evaluate the effects of a blood culture stewardship educational initiative.



Data Sources:

- Data from the local electronic health record (EHR) -- Calculating the test utilization rates will require laboratory data from the electronic health record (i.e., NOT from NSHN) for the numerator of the number of tests. Information on lab tests requires working with your local data and/or informatics analyst who has knowledge of the lab information system (LIS) tables in your EHR.
- NHSN Modules -- The denominator for test utilization rates can be obtained from NHSN modules (e.g. either patient days from the HAI modules or days present from the AU module). You may need to get access permissions from the infection prevention facility administrator to access HAI modules.

We expect that the proposed NHSN module for hospital-onset bacteremia (HOB) may provide structure to calculate blood culture utilization rates, but this module is not yet released (as of Summer 2023).

Manipulating the Data

Numerator

The numerator for the lab utilization rate is the number of laboratory tests, or in this example blood cultures, which is outside of data NHSN can currently provide.

Culture data can be particularly complex to work with because more than one pathogen can grow from the same culture specimen, and a single patient-encounter can have more than one culture event. Also, cultures can have no growth or minimal growth of an organism that the lab doesn't identify (e.g. <10,000 CFU of a gram-positive organism). Finally, LIS systems include interim or preliminary results from cultures that are updated over time.

Thus, you'll need to work with an analyst familiar with the LIS tables for culture results, and specify that you want "final" results rather than preliminary result information and date/time values that represent the time of specimen collection and the unit where the specimen was collected. The dataset structure that provides all the information needed will require unique accession number and date/time of sample collection (**Table**). Depending on how data is structured in the LIS tables, there may be multiple rows for accession numbers associated with growth of more than one pathogen (e.g. *E. coli* and *B. fragilis* growing in the same blood culture set). In that situation, your analyst might need to remove duplicate rows prior to aggregating the counts of unique accession numbers by month. The table structure below is one way to collapse to a single row per accession number.

You also might want to explore if the counts of tests already exist in support of other quality improvement projects. For example, your hospital may already be tracking blood culture contaminants and have monthly test count data available.

Inclusion or filtering criteria for this example is as follows:

- 1. Time period = 2021-2022
- 2. Location of specimen collection = limited to ICU
- 3. Specimen type = limited to blood
- 4. Component (Order or procedure type) = blood culture
- 5. Result type = limited to Final results (excludes preliminary results)

Field	Description	Format	Examples of values
PatientID (or	Patient identifier	Character	
MRN)			
Encounter (or	Encounter identifier	Numeric	
admission)			
Accession	Unique accession number for	Numeric	14AF-100466
Number	the culture specimen		
Date/Time of	Date and time when specimen	Date time	31MAR2023 15:32
Specimen	was collected		
Collection			
Location	Location or Unit where	Character	MICU; 6West
	specimen was collected		
Specimen	Body site where specimen was	Character	Percutaneous, venous; Central
source	collected		line; Dialysis catheter
Component	Order or procedure type	Character	Blood culture
Result	Abnormal or Normal flag for	Character	Normal; Abnormal
	test result		
Test Result	Test result, typically including	Character	No growth; Staphylococcus
	the name of pathogen or no		capitis
	growth.		

Table. Data Dictionary where 1 row is equal to one accession number

Figure: Screenshot of granular data (Identifiers have been removed)

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	5/5/2022 17:35 86	5/7/2022 3:03 22AF-126M945 Percuta	neous, venous Culture Blood A	Abnormal Streptococcus dysgalactiae (gro	up C)
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	9/30/2021 15:16 89	10/8/2021 3:25 21AF-281M001 Blood	Culture Blood N	Normal No growth detected.	
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	11/27/2021 10:14 65	11/30/2021 14:23 21AF-334M108: Blood	Culture Blood N	Normal No growth detected.	
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Then, your analyst would use the granular data to create monthly counts of tests/accession numbers. The abnormal test prevalence could also be counted using the result indicator, where the number of abnormal results is divided by the number of tests.

Figure: Screenshot of aggregated data table including month, year, location, specimen count, abnormal test percent.

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6	May-21 ICU	0.150538	93														
7	Jun-21 ICU	0.113402	97														
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Denominator

1. Finding the denominator for this calculation, or finding the total monthly patient days by location can be obtained through NHSN. Your analyst may also be able to provide these data easily from other quality improvement projects as this measure is used commonly for healthcare associated infection surveillance.

First, be sure that your facility administrator has given you access to the HAI modules, and not just the antibiotic use option, in order to get to the patient days denominators. After generating the datasets, go

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Next, select XLS for the output dataset.

Specify the Time period - 01/2021 through 12/2022 for our example.

Filter to locCDC = Medical-Surgical Critical Care and eventType = CLAB so we can get single row data for our unit of interest. Our example hospital only has one critical care unit, by the way.

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The column of interest is labeled "numpatdays" which gives the number of patient days for that location or unit and month. Copy the "numpatdays" column into the same workbook you had your counts of tests.

Then, you can calculate the rate using this formula: "=D2/(E2/100)". This represents a testing rate per 100 patient days.

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Data Visualization

Once the counts are available in tabled format above, doing the rate calculation and then visualizing trends over time are relatively easy to do in Excel using a line graph functions.

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Another way to prospectively evaluate an intervention is to create a control chart or "run" chart with limits to identify a significant change in rate.

We have an example workbook here for you, created by investigators at John's Hopkins Hospital who have published multiple manuscripts focused on blood culture diagnostic stewardship. Dr. Valeria Fabre and colleagues are currently leading a multicenter implementation project for blood culture stewardship, supported by the <u>CDC Prevention Epicenters Program</u> [https://www.cdc.gov/hai/epicenters/johns-hopkins_univ.html]. The pilot project at Hopkins outlining

the approach can be found in the <u>Journal of Clinical Microbiology</u> [https://pubmed.ncbi.nlm.nih.gov/32759354/].

To use this run chart, simply input the relevant data in columns for the number of tests and the number of patient days. Also, you can specify the baseline or intervention periods using a number (column F). In this example, we started our educational intervention in October 2021.

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The means are helpful for comparison to see if the rate has shifted from the baseline during the intervention period. Also, if a point goes above or below the control limits (dotted lines), then you know that point was significantly different based on the expected trend. In our example, the mean Blood culture utilization rate went from 17.9 per 100 patient days to 15.9 per 100 patient days during the intervention period. Looks like there is still some work to do!

