SARS-CoV-2 Sequencing and Variants in Washington State

Washington State Department of Health

January 31, 2024

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Next Generation Sequencing (NGS) is a set of laboratory methods that scientists use to scan a viral genome to determine the genome sequence of a virus. A genome sequence of a virus is referred to as its "genomic fingerprint," and can reveal mutations in a virus that make it unique. Mutations are changes in a genome sequence and occur naturally over time.

Scientists compare viral genomes to better understand how viruses can spread from person to person. NGS technology allows public health officials to detect clusters of cases and monitor new variant viruses. Groups of same-species viruses that share a set of genome mutations are referred to as a lineage. Some variants belonging to specific lineages may have characteristics such as the ability to spread more quickly, cause more severe disease, or impact clinical therapy such as treatment with monoclonal antibodies. These variants may be classified as variants of interest, variants being monitored, variants of concern or variants of high concern.

Throughout this report, we refer to the scientific name of the virus SARS-CoV-2 that causes COVID-19. Sequencing can only be performed on samples that are processed in laboratories and where swabs are stored in liquid that is compatible with sequencing, which means only samples used for molecular tests (such as PCR) can be included. For this reason, this report is limited to confirmed cases only. The genomes that are sequenced and compared are those of the virus, not of humans.

At a glance (data through January 30, 2024)

- During the month of December 2023, **2.2%** of all confirmed molecular COVID-19 cases were sequenced. This number is preliminary and will change over time as additional specimens are received from the previous month.

- **144,009 (9.7%)** COVID-19 cases in Washington state have sequencing information available since January 2021.

CDC currently categorizes variants as Variants of High Consequence (VOHC), Variants of Concern (VOC), Variants of Interest (VOI) and Variants Being Monitored (VBM). There are currently no VOHC or VOI so only VOC and VBM are detailed in this report.

Variants of Concern

Variant	Area first detected	Background	Cumulative Washington cases detected	First detection in Washington*	Most recent detection in Washington*
Omicron (B.1.1.529 and descendant lineages)	South Africa	Early research indicates evidence for increased transmissibility, immune evasion, and lower risk of hospitalization and death, relative to Delta. Approved vaccines are effective at preventing severe disease and death against Omicron variants	77,284	Nov 29, 21	Jan 16, 24

*Detection dates are based on the date a sample is collected, it can take several weeks before a variant result is completed and added to the report

Note: Omicron lineages in this report are defined as below:

Omicron grouping	Inclusion
BA.2	Includes BA.2.X except BA.2.12.1 and BA.2.75.X
CH.1.1	Includes CH.1.1.X
BQ.1	Includes BQ.1 (Alias of BA.5.3.1.1.1.1.1) except BQ.1.1
XBB	Includes XBB.X except XBB.1.5, XBB.1.9.1, XBB.1.9.2, XBB.1.16, XBB.2.3, FE.1.1
XBB.1.5	Includes XBB.1.5.X except XBB.1.5.1, XBB.1.5.10, XBB.1.5.59, XBB.1.5.68, XBB.1.5.72, EU.1.1
XBB.1.5.10	Includes XBB.1.5.11.X
XBB.1.5.59	Includes XBB.1.5.59.X
XBB.1.5.68	Includes XBB.1.5.68.X
XBB.1.5.72	Includes XBB.1.5.72.X
EU.1.1	Includes EU.1.1.X
XBB.1.9.1	Includes XBB.1.9.1.X
XBB.1.9.2	Includes XBB.1.9.2.X
EG.5	Includes EG.5.X

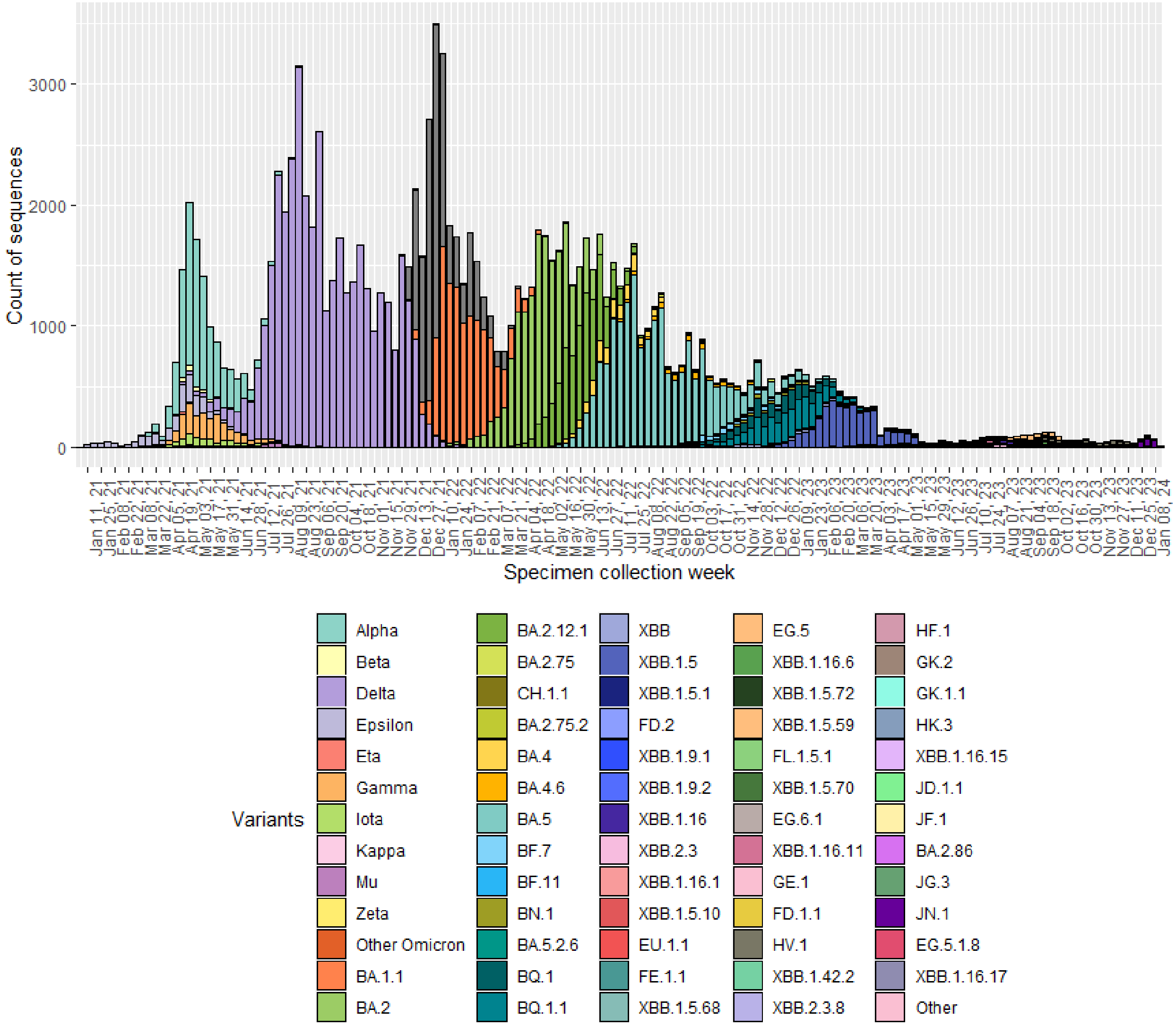
Omicron grouping	Inclusion
XBB.2.3	Includes XBB.2.3.X except XBB.2.3.8
XBB.1.16	Includes XBB.1.16.X except XBB.1.16.1, XBB.1.16.6, XBB.1.16.15
XBB.1.16.1	Includes XBB.1.16.1.X
XBB.1.16.6	Includes XBB.1.16.6.X
XBB.1.5.72	Includes XBB.1.5.72.X
XBB.1.5.59	Includes XBB.1.5.59.X
FL.1.5.1	Includes FL.1.5.1.X
XBB.1.5.70	Includes XBB.1.5.70.X
EG.6.1	Includes EG.6.1.X
XBB.1.16.11	Includes XBB.1.16.11.X
GE.1	Includes GE.1.X
XBB.2.3.8	Includes XBB.2.3.8.X
XBB.1.42.2	Includes XBB.1.42.2.X
XBB.1.16.15	Includes XBB.1.16.15.X
HV.1	Includes HV.1.X
GK.2	Includes GK.2.X
GK.1.1	Includes GK.1.1.X
HK.3	Includes HK.3.X
JG.3	Includes JG.3.X
BA.2.86	Include BA.2.86.X
JD.1.1	Includes JD.1.1.X
JF.1	Includes JF.1.X
JN.1	Includes JN.1.X
EG.5.1.8	Includes EG.5.1.8.X
XBB.1.16.17	Includes XBB.1.16.17.X

Variants Being Monitored

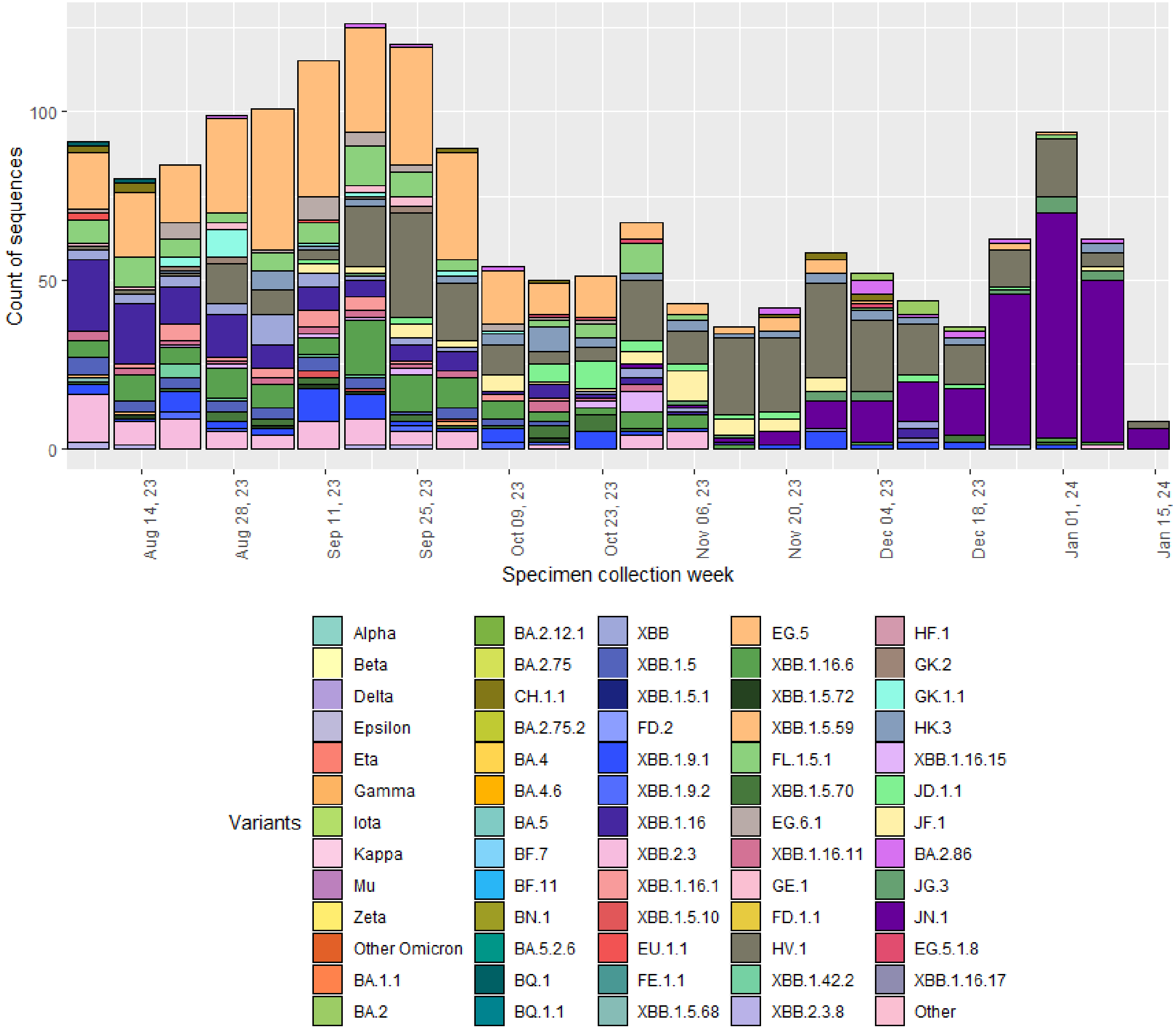
Variant	Area first detected	Cumulative Washington cases detected	First detection in Washington*	Most recent detection in Washington*
Alpha (B.1.1.7)	United Kingdom	10,337	Jan 07, 21	Sep 08, 21
Beta (B.1.351)	South Africa	282	Jan 29, 21	Jun 29, 21
Delta (B.1.617.2 and AY lineages)	India	38,826	Apr 03, 21	Sep 02, 22
Epsilon (B.1.427 / B.1.429)	California	4,191	Dec 11, 20	Jun 24, 21
Eta (B.1.525)	New York	92	Feb 02, 21	Jun 08, 21
Gamma (P.1)	Brazil	2,498	Feb 06, 21	Dec 02, 21
Iota (B.1.526)	New York	933	Jan 21, 21	Aug 20, 21
Kappa (B.1.617.1)	India	46	Mar 22, 21	Jun 14, 21
Mu (B.1.621)	Colombia	219	Apr 09, 21	Dec 20, 21
Zeta (P.2)	Brazil	45	Jan 18, 21	Apr 20, 21

*Detection dates are based on the date a sample is collected, it can take several weeks before a variant result is completed and added to the report

Epidemiologic curve of variants being monitored and variants of concern by week of specimen collection date from January 01, 2021 to January 19, 2024

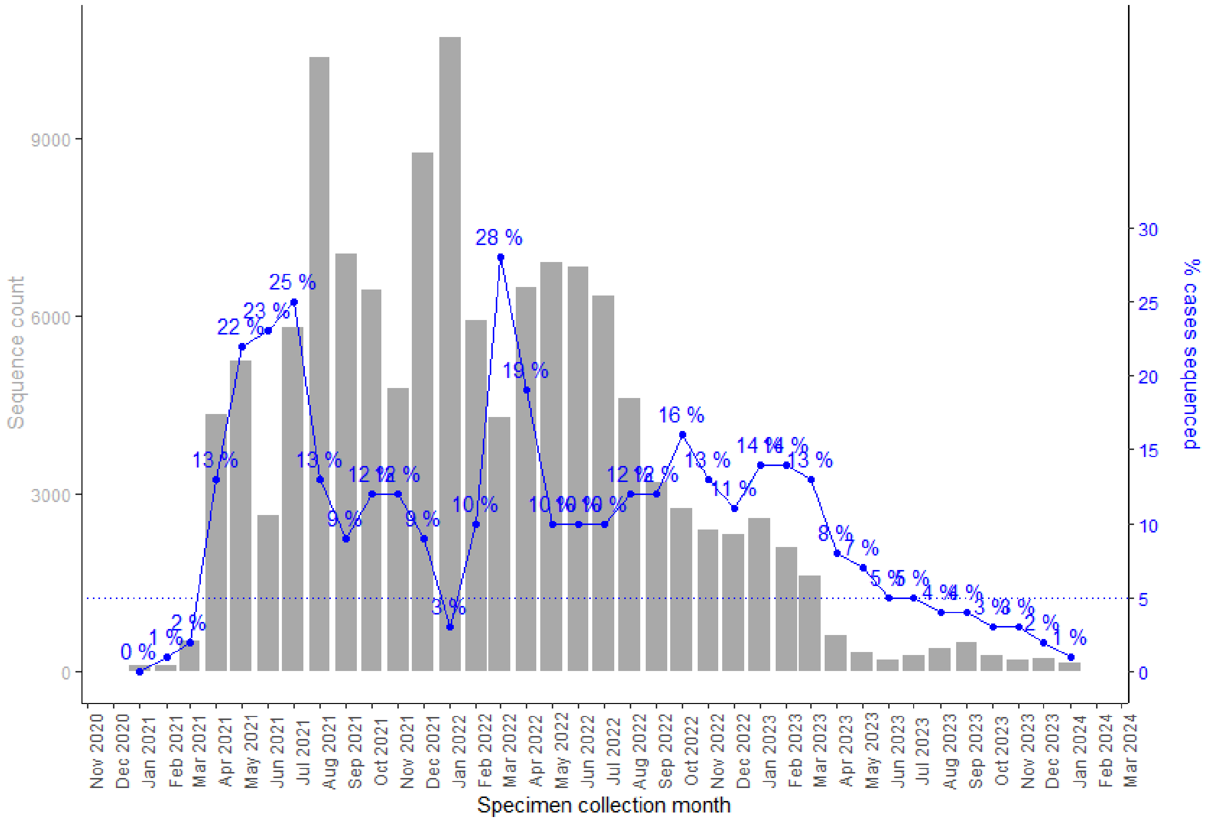


Epidemiologic curve of variants being monitored and variants of concern by week of specimen collection date from August 06, 2023 to January 19, 2024



- The above graphs show the total number of variants detected by the week the specimen was collected from a patient.
- Sequencing can be performed on stored patient specimens at any time, so these numbers may change as additional specimens are sequenced.
- This graph shows all specimens sequenced, including specimens sequenced during outbreaks and other targeted sequencing efforts.
- “Other Omicron “ includes B.1.1.529, BA.1.X and BA.3.X sublineages

Number of specimens sequenced, and percent of Washington State confirmed COVID-19 cases that have been sequenced by specimen collection date from January 2021 through December 2023.

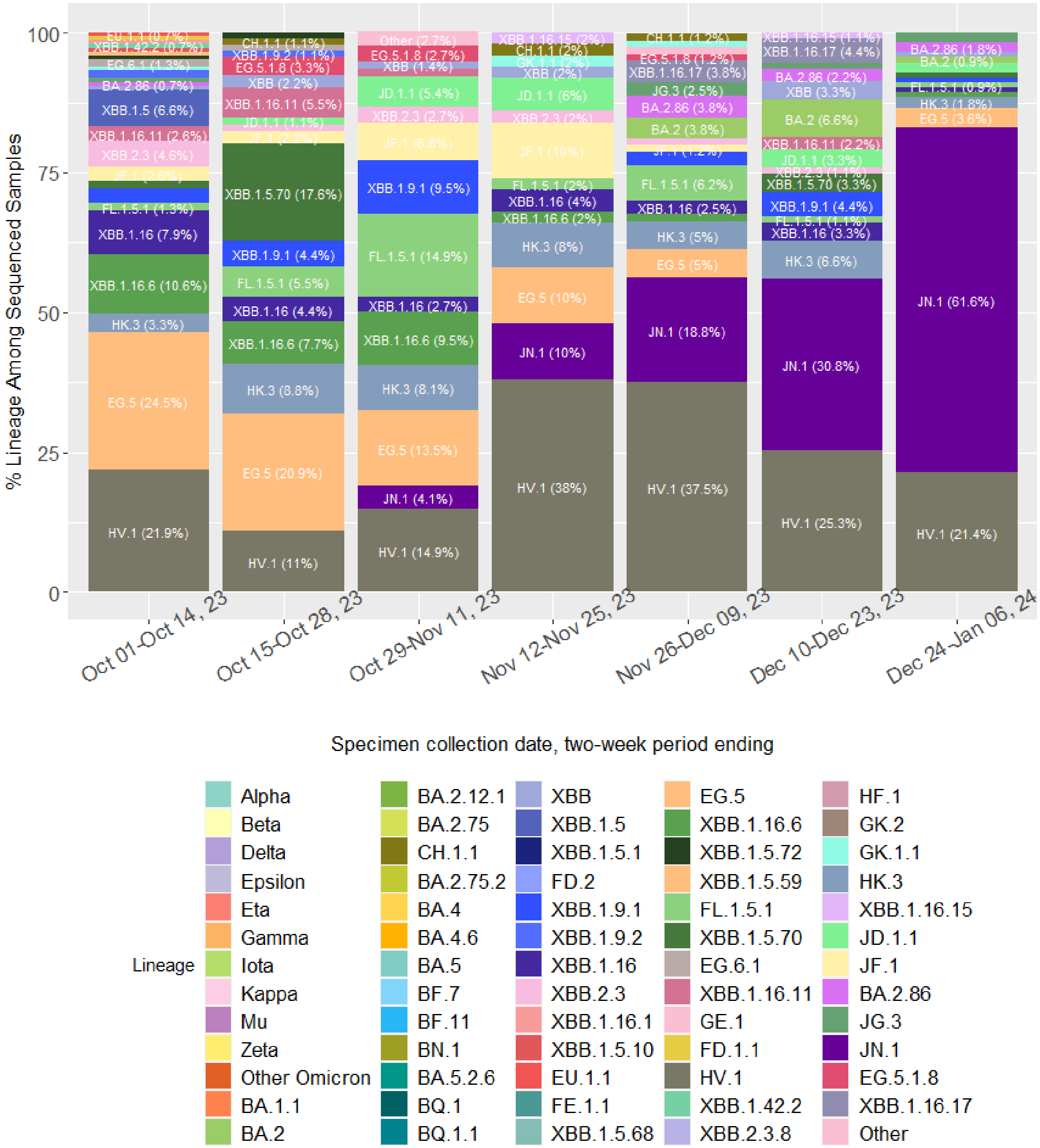


- Samples are not sequenced for every confirmed COVID-19 case. The above graph shows the total number of specimens sequenced (gray bars) and the percent of all confirmed cases (blue line) that have had sequencing performed each month. Data from the previous month may still be incomplete.
- Sequencing can be performed on stored specimens at any time, so numbers from past months may change if stored specimens are sequenced.

SARS-CoV-2 Lineages Circulating in Washington State

The graph below shows the change in proportion of select SARS-CoV-2 lineages by time period. A viral lineage is a group of viruses that descend from a common ancestor with shared genetic characteristics, allowing them to be grouped together. Since this figure represents the share of all sequences that a particular lineage represents, as the proportion of sequences assigned to one lineage increases, the proportion of sequences assigned to other lineages will decrease.

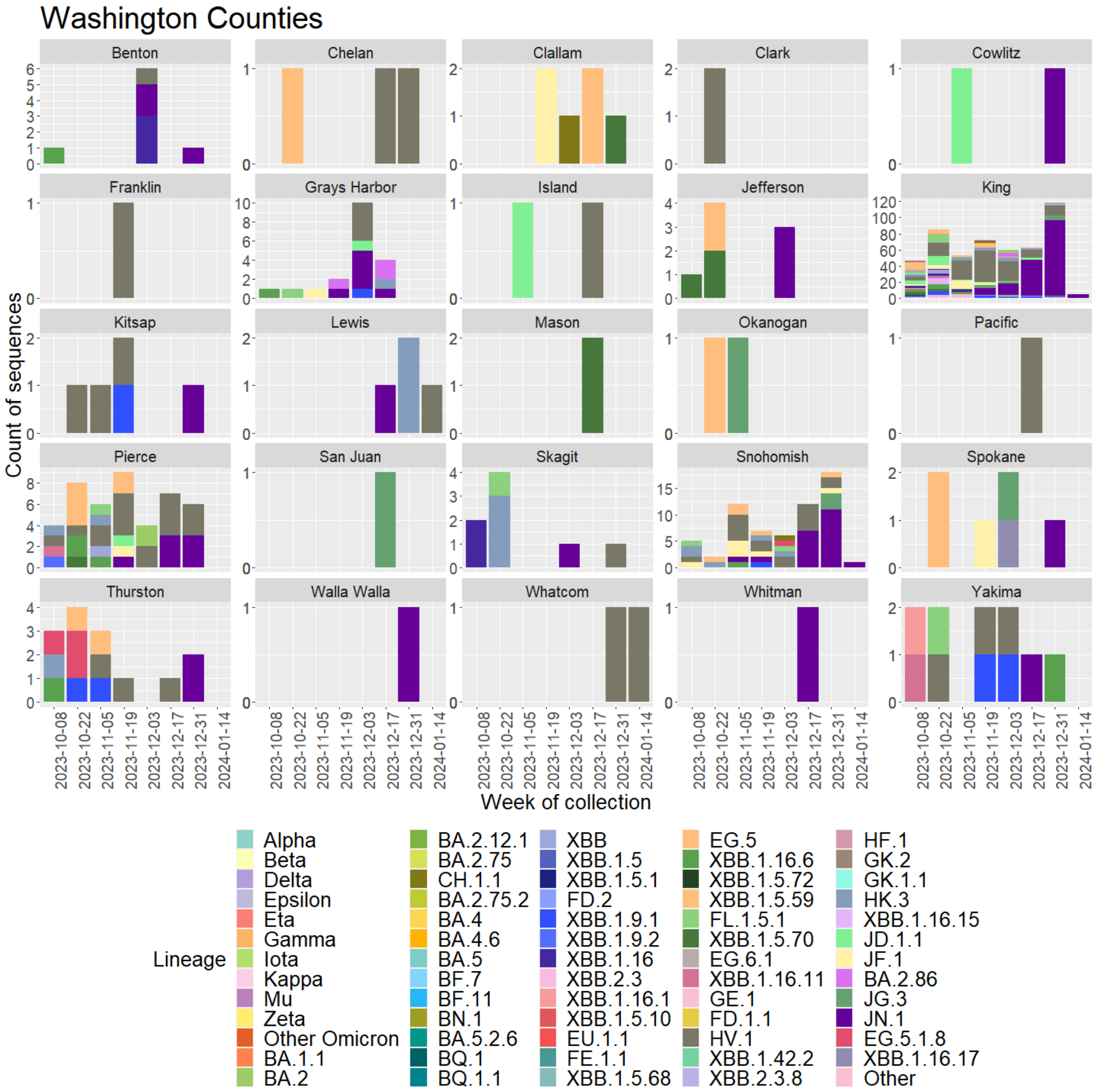
NOTE: The data on this graph come from cases that marked as “Baseline surveillance” in GISAID. Cases sequenced because they were part of an outbreak or were otherwise manually selected for sequencing are excluded, as this could cause a lineage to appear over represented.



The chart above shows the proportions of the most common SARS-CoV-2 lineages circulating in Washington grouped in two-week intervals. Proportions are calculated using data which are subject to change over time and will be updated as more data becomes available, including data from prior time periods. **Due to the time it takes to complete sequencing, the most recent time period is based on a very small number of sequences and likely to be adjusted over time.**

To see the national trends, visit the CDC's variant proportions page.

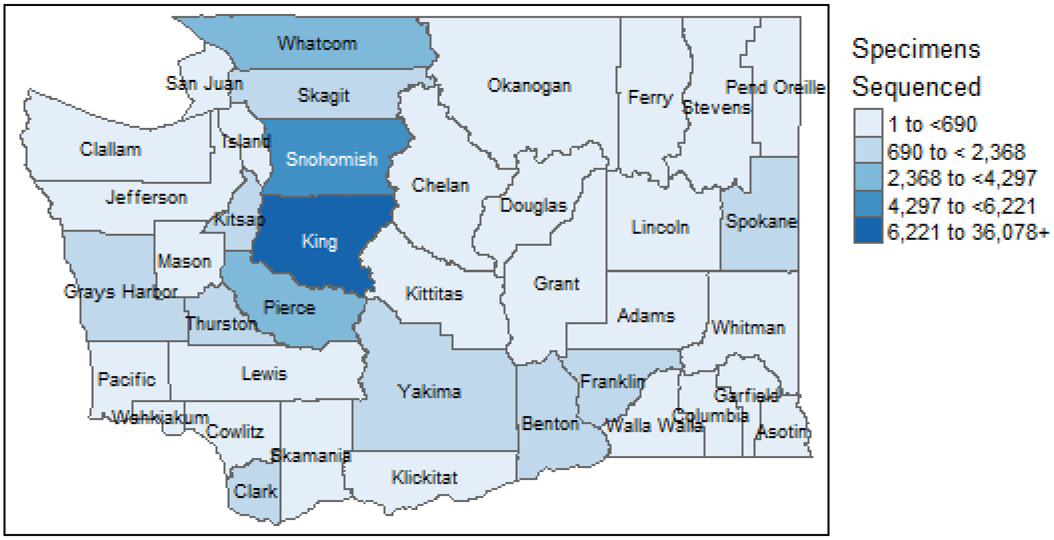
The figures below show the current number of variants of concern (VOC) detected by county of home address since four months prior; data is from the Washington Disease Reporting System (WDRS).



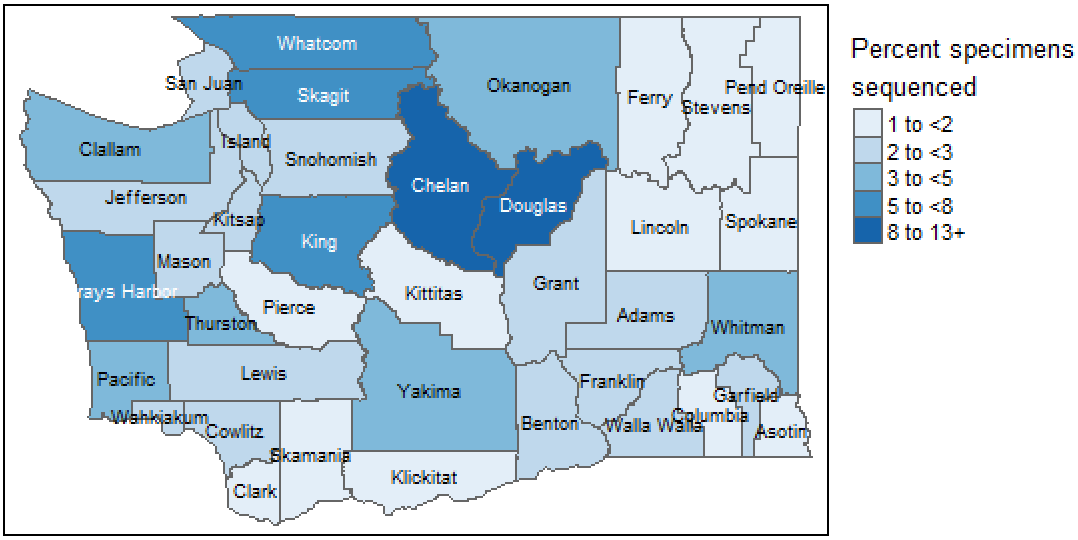
Geographic Coverage of Sequencing

Efforts are made to sequence specimens from all geographic areas of Washington State. The number of sequences and the percent of cases sequenced vary based on several factors including number of cases in that region and which laboratories conduct the majority of testing in each locality.

The map below shows the number of specimens sequenced by county of home address since January 1, 2021.



The map below shows the percent of COVID-19 cases with at least one specimen sequenced by county of home address since January 1, 2021.



The hospitalization table below includes sequencing data since January 1, 2021 sorted by total number of cases per variant and does not account for factors that can influence hospitalization rates such as age and vaccination status, which may be different across variants. This means that hospitalization rates are not necessarily comparable between variants.

Hospitalizations and deaths by variant, sorted by total case count

Variant	Percent cases who were hospitalized	Cases who were hospitalized per 100,000	Cases who died from COVID-19	Total cases	Percent of hospitalized cases who died from COVID-19
Delta	4.3%	4,271	1.3%	38,723	17.2%
BA.5	2.1%	2,101	0.4%	17,754	9.4%
BA.2	1.2%	1,167	0.2%	13,801	8.1%
BA.1	1.2%	1,159	0.3%	12,335	14.7%
BA.1.1	2.3%	2,349	0.8%	11,323	14.7%
Alpha	3.4%	3,443	0.6%	10,310	12.7%
BA.2.12.1	1.7%	1,733	0.3%	6,810	10.2%
Other	2.6%	2,586	0.8%	5,298	16.8%
Epsilon	2.6%	2,588	0.7%	4,134	16.8%
XBB.1.5	4%	4,016	0.4%	3,909	3.2%
BQ.1.1	2.7%	2,656	0.2%	3,012	6.2%
Gamma	6.8%	6,844	1.8%	2,484	17.6%
BQ.1	2%	2,015	0.2%	1,836	5.4%
BA.4	1.9%	1,874	0.3%	1,441	3.7%
Iota	3.2%	3,226	1.3%	930	30%
BA.4.6	2.9%	2,890	0.6%	692	5%
BF.7	3.2%	3,195	0.8%	532	23.5%
XBB	2.3%	2,283	0%	438	0%
EG.5	14.4%	14,441	0.8%	367	1.9%
BN.1	1.4%	1,351	0.3%	296	25%
HV.1	17.3%	17,314	0%	283	0%
Beta	7.1%	7,117	1.1%	281	15%

Variant	Percent cases who were hospitalized	Cases who were hospitalized per 100,000	Cases who died from COVID-19	Total cases	Percent of hospitalized cases who died from COVID-19
XBB.1.16	8.6%	8,633	0.4%	278	0%
JN.1	26%	26,027	1.8%	219	5.3%
Mu	2.8%	2,752	1.8%	218	33.3%
XBB.1.9.1	7.8%	7,767	0%	206	0%
BA.2.75	1.1%	1,070	0%	187	0%
XBB.2.3	5.7%	5,682	0%	176	0%
BA.5.2.6	2.4%	2,367	1.2%	169	50%
CH.1.1	7.5%	7,547	0%	159	0%
XBB.1.16.6	12.3%	12,264	0%	106	0%

Age distribution by variant, sorted by total case count

Variant	Age 0-19	Age 20-34	Age 35-49	Age 50-64	Age 65-79	Age 80+	Unknown	Total cases
Delta	23%	29%	23%	15%	8%	2%	0%	38,723
BA.5	12%	28%	26%	20%	12%	3%	0%	17,754
BA.2	19%	32%	24%	15%	8%	2%	0%	13,801
BA.1	24%	33%	23%	13%	5%	1%	0%	12,335
BA.1.1	24%	30%	22%	14%	7%	2%	0%	11,323
Alpha	27%	32%	23%	13%	3%	1%	0%	10,310
BA.2.12.1	15%	32%	24%	17%	10%	3%	0%	6,810
Other	24%	29%	24%	16%	5%	2%	0%	5,298
Epsilon	25%	31%	24%	14%	4%	1%	0%	4,134
XBB.1.5	13%	27%	26%	19%	12%	3%	0%	3,909
BQ.1.1	13%	26%	27%	19%	11%	3%	0%	3,012
Gamma	22%	35%	24%	12%	4%	3%	0%	2,484
BQ.1	12%	27%	26%	20%	12%	3%	0%	1,836
BA.4	17%	31%	26%	16%	8%	2%	0%	1,441
Iota	25%	33%	25%	12%	4%	1%	0%	930
BA.4.6	13%	31%	24%	16%	13%	2%	0%	692
BF.7	10%	27%	23%	23%	13%	5%	0%	532
XBB	12%	31%	25%	21%	8%	2%	0%	438
EG.5	14%	16%	26%	16%	19%	7%	0%	367
BN.1	11%	24%	30%	18%	13%	3%	0%	296
HV.1	12%	15%	18%	24%	23%	7%	0%	283
Beta	28%	34%	21%	12%	3%	0%	0%	281
XBB.1.16	11%	21%	28%	17%	18%	5%	0%	278
JN.1	1%	14%	20%	26%	23%	14%	0%	219
Mu	22%	37%	22%	11%	6%	1%	0%	218
XBB.1.9.1	16%	17%	26%	20%	15%	6%	0%	206
BA.2.75	10%	25%	32%	18%	14%	1%	0%	187

Variant	Age 0-19	Age 20-34	Age 35-49	Age 50-64	Age 65-79	Age 80+	Unknown	Total cases
XBB.2.3	16%	16%	25%	19%	19%	4%	0%	176
BA.5.2.6	11%	30%	26%	15%	15%	2%	0%	169
CH.1.1	9%	30%	24%	14%	17%	5%	0%	159
XBB.1.16.6	18%	14%	22%	20%	21%	6%	0%	106

*Other includes all variant viruses that are not categorized as VOC or VBM

The following clinical laboratories have contributed specimens for sequencing:

- Aegis Sciences Corporation
- Allenmore Hospital Laboratory
- Altius Institute for Biomedical Sciences
- Atlas Genomics
- Avero Diagnostics
- BioReference Laboratories Inc.
- Cascade Valley Hospital
- Central Washington Hospital
- Columbia Basin Hospital
- Curative Labs Inc.
- Dayton General Hospital
- Deaconess Hospital
- Diatherix Laboratories
- Dynacare Northwest Inc.
- East Adams Rural Hospital
- Everett Clinic Microbiology
- Evergreen Healthcare
- Ferry County Hospital
- FidaLab
- Forks Community Hospital
- Fulgent Genetics
- Gravity Diagnostics, LLC
- Harborview Medical Center
- Healthquest Esoterics
- Helix/Illumina
- Incyte Diagnostics Spokane
- Infinity Biologix

Interpath Laboratory

Jefferson Healthcare

Kaiser Permanente Washington Health Research Institute

Labcorp

Laboratories Northwest

Laboratory Corporation of America

Legacy Laboratory

Magnolia Diagnostics, LLC

Mann-Grandstaff VA Medical Center

Mason General Hospital Laboratory

Mid Valley Hospital

Molecular Testing Labs

MultiCare

Avero Diagnostics

OHSU Lab Services Molecular Microbiology Lab

Olympic Medical Center

Overlake Hospital

PeaceHealth

Polyclinic

Premier Medical Laboratory

Providence Medical Group

Public Health Seattle-King County Laboratory

Quest Diagnostics Incorporated

Samaritan Hospital Lab

Seattle & King County Public Health Lab

Seattle Children's Hospital

Seattle Flu Study

Skagit Valley Hospital Laboratory

St. Francis Hospital

St. Joseph Medical Center Microbiology
St. Michael Medical Center Laboratory
Swedish Medical Center
Tacoma General Hospital
The Vancouver Clinic
Tomorrow's Health, LLC
TridentCare Laboratory
TridentCare Laboratory
University of Washington Virology Lab
Virginia Mason Franciscan Health Microbiology
Washington State Department of Health Public Health Laboratories

The following labs have reported sequencing data that is included in this report:

Aegis Laboratory
Altius Institute for Biomedical Research
Atlas Genomics
Boise VA Medical Center
Centers for Disease Control and Prevention
Curative
Flow Diagnostics
Fulgent Genetics
Ginkgo Bioworks Clinical Laboratory
Gravity Diagnostics, LLC
Grittman Medical Center
Grubaugh Lab
Helix Laboratories
Idaho Bureau of Laboratories
Infinity Biologix
Institute for Systems Biology

Kaiser Permanente

Laboratory Corporation of America

Montana Public Health Laboratory

Naval Health Research Center

Oregon SARS-CoV-2 Genome Sequencing Center

Oregon State Public Health Laboratory

Providence St. Joseph Health Molecular Genomics Laboratory

Quest Diagnostics

Seattle Flu Study

The Jackson Laboratory

The Lauring Laboratory

United States Arm Medical Research Institute of Infectious Diseases

University of Washington Virology Lab

Washington State Department of Health Public Health Laboratories