SPSP | SWISS PATHOGEN SURVEILLANCE PLATFORM

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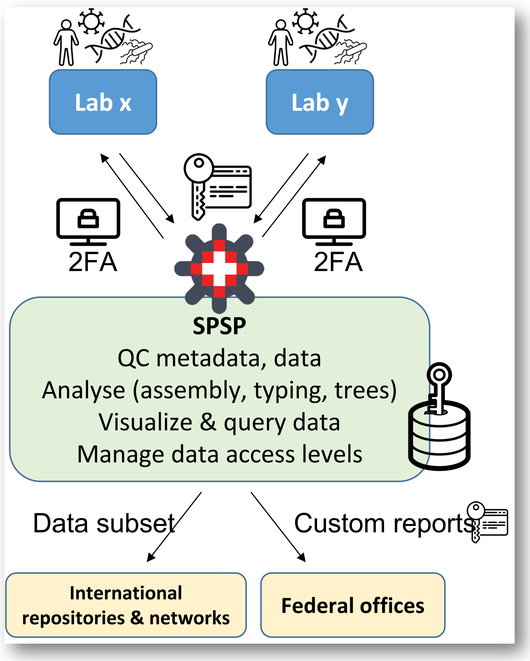
Abstract

Currently, the BA.2 variant of SARS-CoV-2 dominates in Switzerland as it does in places around the globe. In recent months, circulating virus lineages have been widely monitored by sequencing the genomes of thousands of SARS-CoV-2 isolates. These efforts were coordinated by the National Reference Centre for Emerging Viral Infections (CRIVE) in Geneva. A total of 15 laboratories from diagnostics and research supported this and thus contributed significantly to the surveillance and risk assessment of viral evolution in Switzerland. The large quantities of sequencing data and associated metadata were centralized at the **"Swiss Pathogen Surveillance Platform" (SPSP)**, where quality was checked, the sequences annotated, and finally transmitted to other databases. Data was visualized for example in the dashboard of the Federal Office of Public Health (FOPH) or using international comparisons via GISAID on platforms such as nextstrain.org. SPSP was developed together with the SIB Swiss Institute of Bioinformatics as a "One Health" focused platform to share genomes and associated metadata between institutions for surveillance and research. The project was initially funded by the National Research Programme (NRP72) of the Swiss National Science Foundation and has since been further developed.

Today, SPSP represents a key platform for the future molecular monitoring of human, animal, and environmental pathogens (viruses, bacteria, fungi) in Switzerland and clearly passed the maturity test during the COVID-19 pandemic. A key challenge now is to secure sustainable funding for SPSP and to motivate diagnostic and research laboratories to share sequence data via SPSP as an essential step in comprehensive “One Health” surveillance and outbreak monitoring of infectious diseases beyond COVID-19.

Overview



SPSP Overview. SPSP is a secure online platform hosted on BioMedIT (SENSA).

Clinical laboratories submit pathogen sample data including **genomic data** and associated **clinical/epidemiological metadata**. As much as possible, controlled vocabularies and ontologies are used.

The transfer is performed with the SPSP Transfer tool (**encrypted**, IP-white listed, ssh authentication). The data on SPSP is quality controlled (metadata and data) and then loaded into the SPSP database.

Dedicated **analysis workflows**, standardized, are run on the data (e.g. typing).

The data is then **shared to international databases** (anonymized) or with **federal offices** (secured transfers).

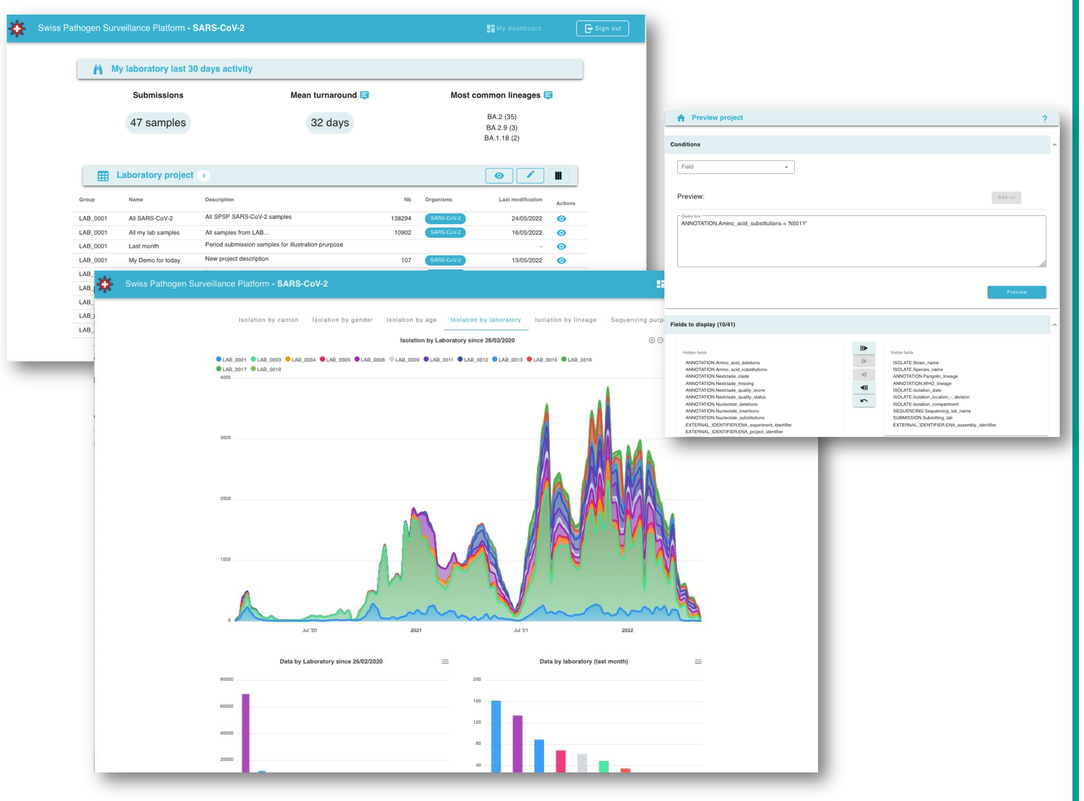
On the SPSP frontend, users can access the data, **query** it and visualize **dashboards** (two-factor authentication). Developments ongoing.

ESLI and Governance

- **Consortium Agreement** (dated 27 January 2021)
  - Deed of adherence for new parties
- **Data Transfer and Use Agreement**
  - Project-specific agreement for partners
- **Ethical approval** (Art. 34)

- Executive Board
- Scientific Board
- Advisory Board

Data management and visualization

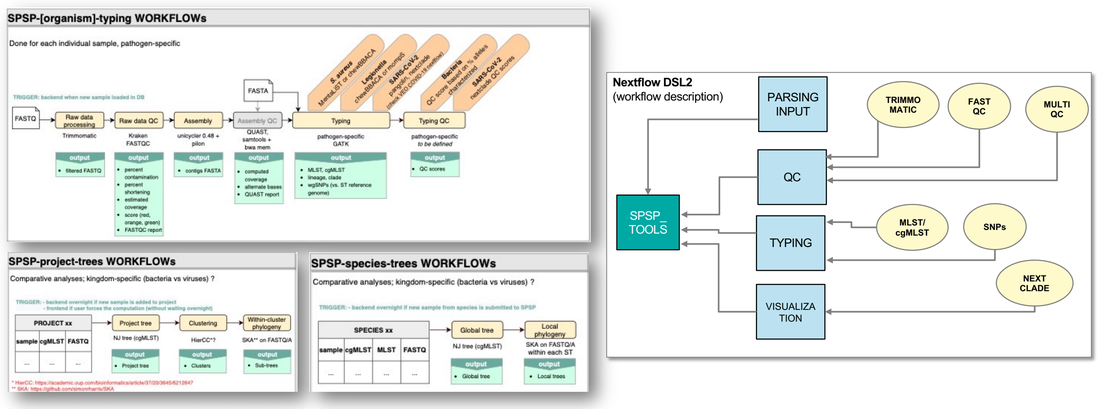


Three levels of **data access** for SPSP-registered users.

Data queries. User can **actively monitor data uploaded to SPSP (access to minimal metadata)** by creating queries that are saved. This can notably be used to monitor in near real-time isolates harboring a mutation of interest, as they are sequenced and uploaded to SPSP by any center.

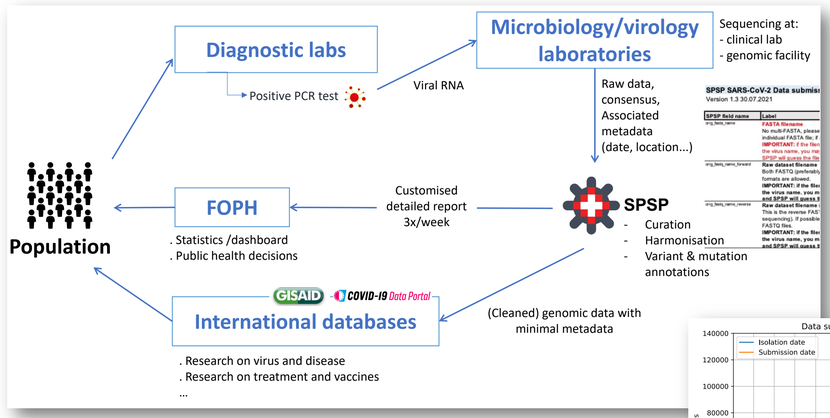
Data visualization and browsing: Data is visualized with a dashboard. An instance of nextstrain.org, will also be integrated within SPSP.

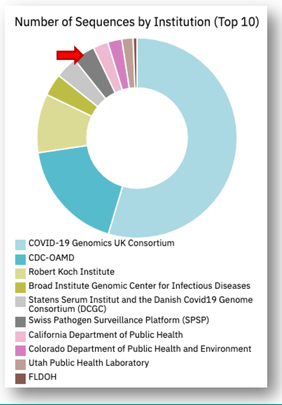
Bioinformatics behind the scenes



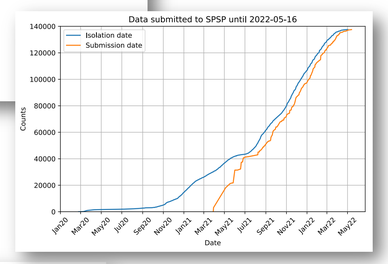
Pathogen/project-specific bioinformatics pipelines. Implemented dedicated pipelines for *S. aureus* analyses and SARS-CoV-2 typing. Refactoring ongoing within Nextflow DSL2. Future workflows may cover: Legionella, Influenza, food-borne pathogens, Enteroviruses. Run on a dedicated compute server.

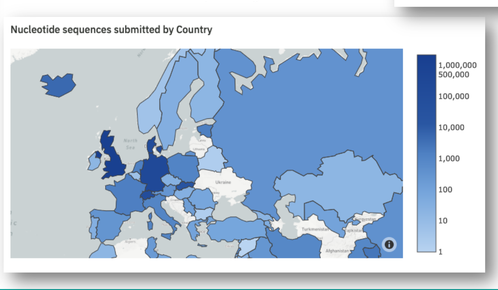
SPSP and SARS-CoV-2





Statistics from /www.covid19dataportal.org





Perspectives

Surveillance. Aim that SPSP is recognized as the Swiss infrastructure for molecular surveillance of pathogens, connected to international databases and networks (ENA, GISAID, BeONE…). Pathogens of interest include: Legionella, food-borne pathogens, Enteroviruses, Influenza…

Research. Build a research ecosystem around SPSP data, continue data sharing, connect with biobanks.

Publications

Egli A, Blanc DS, Greub G, Keller PM, Lazarevic V, Lebrand A, Leib S, Neher RA, Perreten V, Ramette A, Schrenzel J, Stephan R, Wagner K, Wuethrich D, Xenarios I. **Improving the quality and workflow of bacterial genome sequencing and analysis: paving the way for a Switzerland-wide molecular epidemiological surveillance platform.** *Swiss Med Wkly* 2018;148:w14693

Wüthrich D, Blanc D, Greub G, Perreten V, Schrenzel J, Stephan R, Lebrand A, Xenarios I, Neher R, Egli A. Modern Microbiological Surveillance for Antibiotic Drug Resistance. In Federal Office of Public Health and Federal Food Safety and Veterinary Office. **Swiss Antibiotic Resistance Report 2018. Usage of Antibiotics and Occurrence of Antibiotic Resistance in Bacteria from Humans and Animals in Switzerland**, November 2018, FOPH publication number: 2018-OEG-87, 93-95.

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