



**Global Influenza
Hospital Surveillance
Network**

GIHSN Annual Report

SEASON 2021-22



**Foundation for
Influenza
Epidemiology**

www.gihsn.org

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Foreword

In 10 years of existence, the Global Influenza Hospital Surveillance Network (GIHSN) has reached an unprecedented size and notoriety. It is the largest global hospital network recruiting severe acute respiratory virus illness (SARI) patients through active case finding. It collects clinical and virological data using a standardized protocol across sites. Data collection has progressively been extended from influenza to other respiratory viruses and surveillance is now conducted year-round. Whole genome sequencing (WGS) from viruses is routinely performed and linked to epidemiologic and clinical information. Currently, the network consists of 81 hospitals in 18 countries. Over the 2021-22 year-round surveillance, data from more than 23,600 patients were collected.

This network is now a solid and active empowered community of researchers and public health professionals who are working together to close knowledge gaps on respiratory virus circulation worldwide. Most importantly, the GIHSN demonstrated its resilience by continuing to monitor SARI patients throughout the COVID-19 pandemic, despite the disruptions associated with mitigation measures in each of the countries. More than ever, the pandemic has shown the importance of a global platform that shows resilience and sustainability. The GIHSN was highlighted in a report from the Milken Institute, based on pandemic preparedness working group think tank¹ and it was featured in a commentary from Science² as an example of multi-stakeholders' collaboration to improve our understanding of epidemic prone respiratory viruses. For the GIHSN, collaboration with the World Health Organization (WHO) is of paramount importance as is connection with existing National Influenza Programs and the Global Influenza Surveillance and Response System (GISRS) -the WHO laboratory-based influenza surveillance system.

The GIHSN relies heavily on existing national capacity and infrastructure. The Foundation for Influenza Epidemiology (FIE), which operates the network, provides catalytic funding to sites under the format of grants to enhance research capacity. The Foundation budget consists of unrestricted grants from the private sector. To date, funders include Sanofi, Seqirus, Illumina and Abbott Diagnostics.

The scientific oversight of the activity of the GIHSN is managed by an independent group of experts. To date, more than 20 papers have been published, and the database, with more than 130,000 SARI hospitalized patients, is a strong research asset.

The GIHSN is now undergoing a new phase toward strategic expansion to achieve greater geographic representativeness across WHO transmission zones. Regional laboratory capacity is also being increasingly used for WGS. In February 2023, the GIHSN shared with WHO a report on WGS results, prior to the WHO consultation on the Composition of Influenza Virus Vaccines for use in the 2023-2024 Northern Hemisphere Influenza Season. Collaboration with WHO is being enhanced notably with regards to burden of disease assessment and influenza strain identification for vaccine candidates.



The pandemic has shown that a good understanding of respiratory viruses' circulation and genetic evolution is key public health priority. It is also crucial to shape future Research & Development efforts to facilitate control measures. For these reasons, pandemic preparedness needs to be a joint effort from both public and private sectors. The GIHSN offers the opportunity to the private sector to play a role in advancing this research and public health agenda working collaboratively and transparently with academic and public sector partners.



Dr Cedric Mahe

President, Foundation for Influenza Epidemiology

1 [A Global Early Warning System for Pandemics: A Blueprint for Coordination. \(milkeninstitute.org\)](https://www.milkeninstitute.org)

2 Uncertain effects of the pandemic on respiratory viruses. Gabriela B. Gomez, Cedric Mahé and Sandra S. Chaves. Science - 03 June 2021.

Abbreviations and definitions

APDC (Abbott Pandemic Defense Coalition): a global industry-led scientific and public health partnership dedicated to the early detection of, and rapid response to, future pandemic threats.

eCRF: electronic Case Report Form.

FIE: Foundation for Influenza Epidemiology.

FluNet: an online tool used for virological surveillance of influenza. FluNet is operated by GISRS (see below) <https://www.who.int/tools/fluNet>

GDPR (General Data Protection regulation): the Regulation in European law on data protection and privacy.

GIHSN (Global Influenza Hospital Surveillance Network): a global network of clinical centers/hospitals, connected with laboratories, established in 2012 to generate clinical and virological data on severe influenza. The GIHSN is operated by a dedicated fund, the Foundation for Influenza Epidemiology, under the auspices of Fondation de France. <https://www.gihsn.org/>

GISAID (Global Initiative on Sharing Avian Influenza Data): a global science initiative established in 2008 that provides open access to genomic data of influenza viruses and the coronavirus responsible for the COVID-19 pandemic. <https://gisaid.org/>

GISRS (Global Influenza Surveillance and Response System): a global network of laboratories which was established in 1952 to conduct global influenza surveillance. GISRS is coordinated by WHO and endorsed by national governments. GISRS operates FluNet, an online tool used for virological surveillance of influenza. <https://www.who.int/initiatives/global-influenza-surveillance-and-response-system>

ICU: Intensive Care Unit.

ICD: International Classification of Diseases

ISC: Independent Scientific Committee.

IVI (International Vaccine Institute): a nonprofit international organization established in 1997 as an initiative of the United Nations Development Program (UNDP). IVI is dedicated to vaccines and vaccination for global health. <https://www.ivi.int/>

NICs: National Influenza Centers are national institutions designated by national Ministries of Health which collect virus specimens in their country and ship representative clinical specimens and isolated viruses to WHO Collaborating Centers for advanced antigenic and genetic analysis. The results form the basis for WHO recommendations on the composition of seasonal influenza vaccine each year. Several NICs participate in the GIHSN.

R&D: Research and Development.

RSV: Respiratory syncytial virus.

RT-PCR: Reverse Transcription - Polymerase Chain Reaction

SARI: Severe Acute Respiratory Infection.

SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2.

WGS: Whole Genome Sequencing.

WHO: World Health Organization.



PART I.

The GIHSN: 10 years of global, patient-level data on severe, influenza-like illness

The Global Influenza Hospital Surveillance Network is a platform that collects standardized data from hospitalized patients with severe acute respiratory illnesses across countries, including low-, middle-, and high-income countries from both hemispheres. The GIHSN has evolved over the last 10 years to focus on linking

epidemiologic and clinical data with WGS information to facilitate exploring viral phenotypes as they relate to severity or vaccine-breakthrough cases. This information is shared with local public health authorities, WHO and the scientific community at large.

Objectives of the GIHSN

1. Generate strong epidemiological and medical evidence on hospitalized patient with respiratory virus infection to better understand virus circulation, related severity, and risk factors.
2. Support vaccine strain selection improvement through timely sharing of clinical and laboratory data (including whole genome sequencing data) from patients hospitalized with influenza from both northern and southern hemispheres.
3. Contribute as an alert system in case of emerging of novel influenza viruses and other pandemic-prone respiratory viruses that may trigger the need for public health response and/or R&D initiatives.

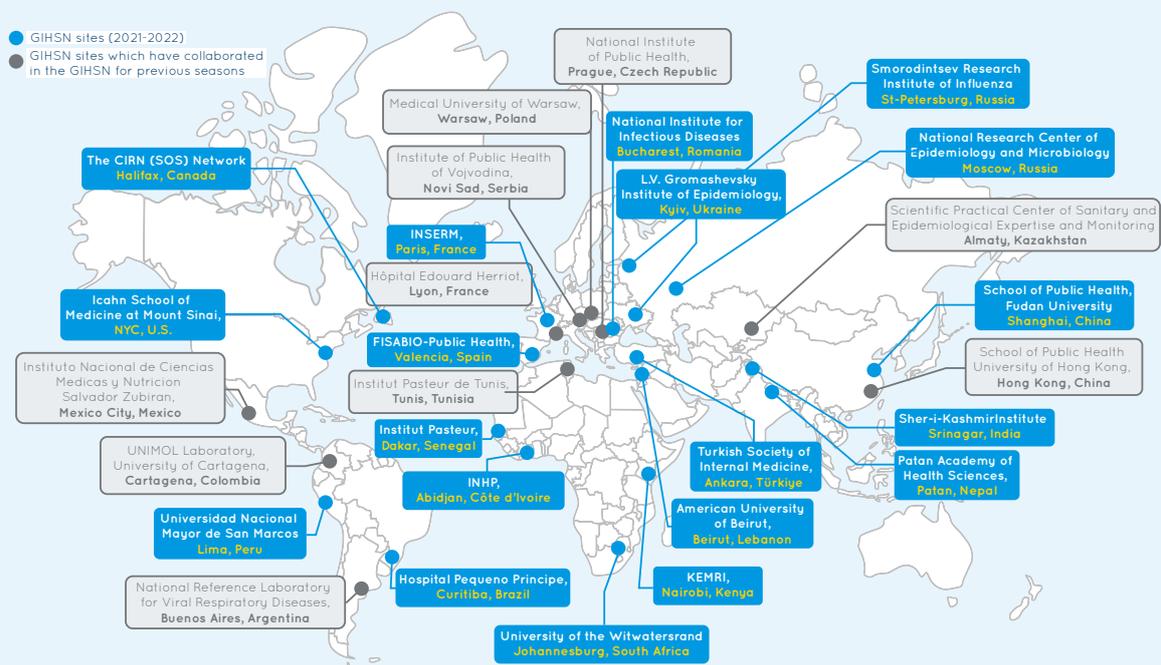
1. A 10-year-old community of experienced investigators worldwide



The GIHSN started its activity in 2012-2013 and has been collecting data over the seasons. It has contributed to global surveillance of influenza and other respiratory viruses for 10 years now, with

over 100 hospitals involved in 26 countries worldwide. **Figure 1** shows the geographic distribution of sites which have collaborated in the GIHSN over the seasons (2012-2013 to 2021-2022).

Figure 1: Geographic distribution of sites which contributed data in the GIHSN over the seasons (2012-2013 to 2021-2022)



Length of contribution in the GIHSN vary from one site to another: some sites have been participating in the GIHSN for several years, even from the first season; others have been recently involved, some were added in 2021-2022.

The list of sites which contributed over the years is shown in [Annex 1](#).

All GIHSN investigating sites are not-for-profit institutions, with experience in hospital-based surveillance for influenza and other respiratory viruses. Some of them are involved in the national surveillance in their country; some are National Influenza Centres (NICs).

Data is collected at hospital level, with one to several hospitals being included in the surveillance.

All sites have an excellent connection between a hospital surveillance platform and a virology laboratory in their country, allowing for influenza testing by RT-PCR³ and subsequent sequencing (subtype/lineage) of the positive specimens. Sites connected to national influenza centers have subtype and lineage results available within seven days from receiving the samples.

All sites must have the capacity to submit WGS at a minimum consensus data of the HA and NA⁴ segments to the GISAID EpiFlu™ database. If a site has no capacity to generate WGS, the site is offered the possibility to ship its specimens to the GIHSN sequencing platform at the National Influenza Centre in Lyon, France.

2. A common protocol

All GIHSN sites use a common protocol⁵: demographic and clinical information are collected from patients admitted with respiratory illnesses. Respiratory specimens are collected to test for influenza and other respiratory viruses, including SARS-CoV-2 and RSV.

RT-PCR tests and whole genome sequencing are performed to provide virological information.

Key features of the GIHSN protocol:

- Screening and inclusion of hospitalized patients with respiratory illness meeting protocol case definition year-round (November, 1st 2021, to October, 31, 2022).
- Collection of epidemiologic and clinical data for all participating patients (i.e., those who meet case definition and consent to participate), with a standardized questionnaire administered at enrolment and a chart abstraction at patient discharge/death.
- Enrolled patients would have respiratory specimen collected shortly after hospital admission (within first 72 hours) and sent for testing at the local and/or reference laboratory or National Influenza Centre.
- All specimens are tested by RT-PCR for influenza. When possible (e.g. available multiplex PCR), specimens are also tested for SARS-CoV-2, RSV and other respiratory viruses.
- Respiratory samples (swabs) from all swabbed patients are stored (-20C or -70C) for a minimum of one year. This can facilitate retrospective investigations on pathogen discovery, or evaluation of new diagnostic tools.
- WGS -see GIHSN WGS lab guidelines⁶- is done for a minimum of 50 to 100 influenza viruses per season. If the number of influenza positive cases is low, sites are encouraged to complete WGS of SARS-COV-2.
- WGS data are uploaded to GISAID by site in a reasonable timeframe, so results are available for the WHO Vaccine Composition Meeting.
- Link between WGS data uploaded in GISAID and clinical data in GIHSN is enabled through a specific tag.

3. A global database of more than 130,000 SARI hospitalized patients

During the last 10 years, a total of 132,053 patients hospitalized with respiratory illness have been enrolled, including laboratory-confirmation of 23,910 Influenza cases and 42,608 patients with other respiratory viruses. The annual positivity rate for influenza has ranged from 29% in 2019 to 2% in 2020-2021 (COVID-19 pandemic period).

Figure 2 shows the distribution by season (2012-13 to 2021-22) of patients hospitalized with respiratory illness, overall and by pathogen detected, and the count of documented cases in the database, overall and by pathogen.

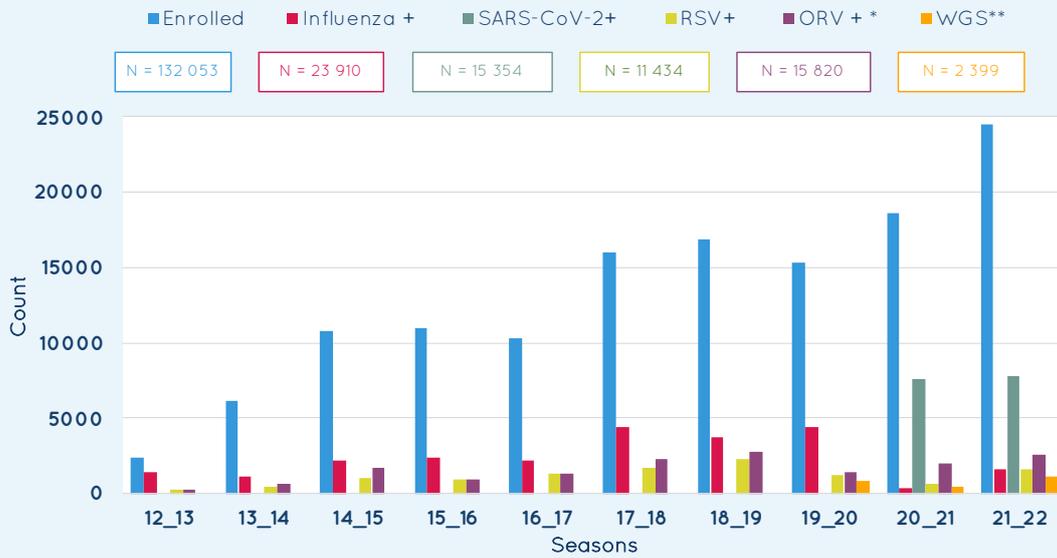
3 RT-PCR = Reverse Transcription - Polymerase Chain Reaction.

4 HA = Hemagglutinin NA = Neuraminidase

5 The GIHSN protocol is available here: <https://www.gihsn.org/the-network/protocol-and-questionnaires/2021-2022-season>

6 <https://www.gihsn.org/the-network/wgs-lab-guidelines>

Fig. 2: Distribution of patients hospitalized with respiratory illness, overall and by pathogen detected, by season (2012-2013 to 2021-2022)



* Other respiratory viruses.
 ** Whole Genome Sequencing.

4. Sharing of results and communication

A Global Annual Meeting of the GIHSN is organised once a year in October, with all site investigators and stakeholders of the network, to share results of the year-round surveillance and

discuss protocol and analyses.

In 2022, more than 70 experts and investigators attended (remotely) the GIHSN 10-year anniversary Meeting.



Seasonal results are shared publicly on the GIHSN website⁷.

In 10 years, the network has contributed to more than 20 published manuscripts⁸ and numerous local and international meetings and conferences.

More recently, the Foundation for Influenza Epidemiology (FIE) is also supporting research activities that leverage the community of scientists to use data gathered through the GIHSN and expanding collaborations to better understand the burden of influenza and other respiratory viruses.

⁷ <https://www.gihsn.org/results-by-season/results-2021-2022>

⁸ <https://www.gihsn.org/publications/scientific-papers>



PART II.

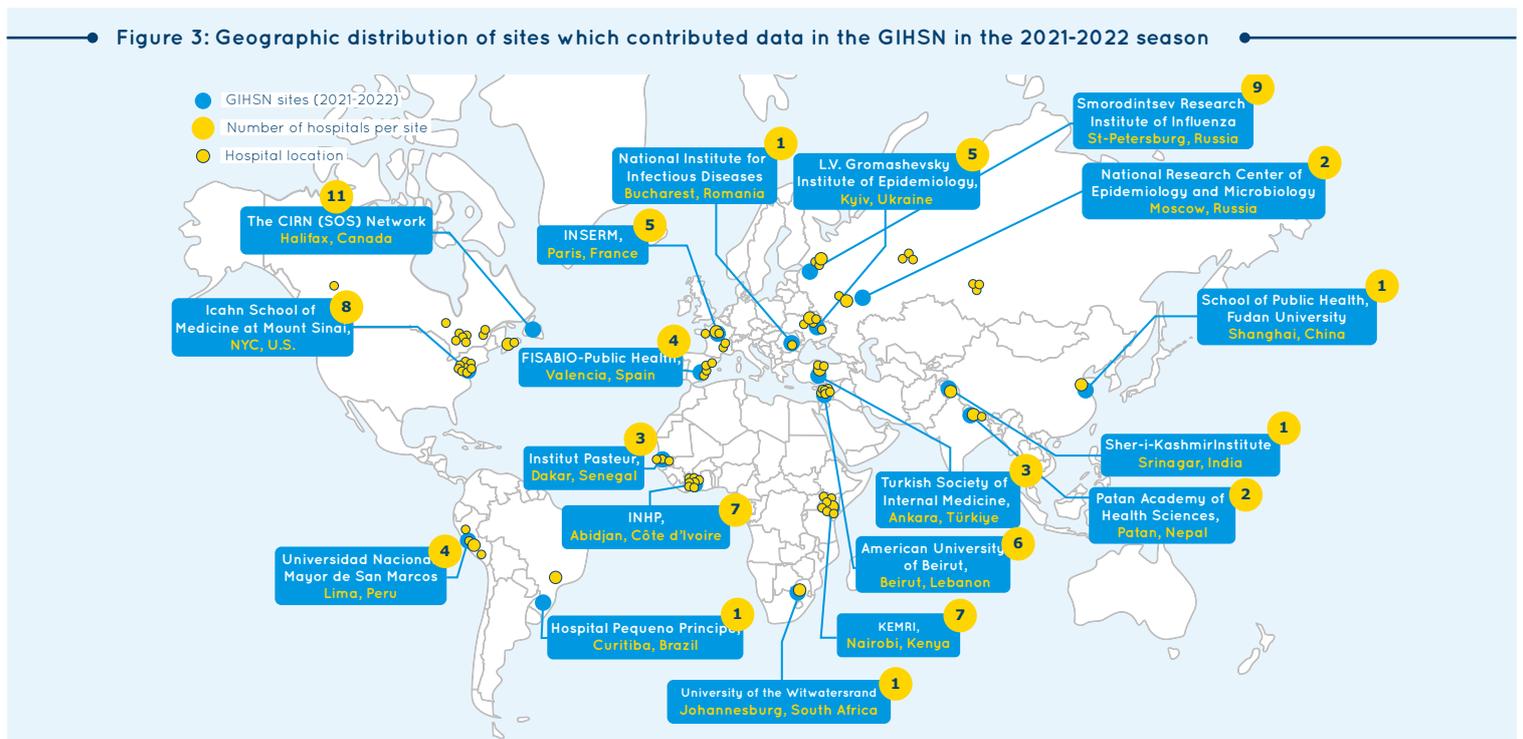
GIHSN 2021-2022 season

1. Participating sites

In the 2021-2022 season, the GIHSN sentinel platform included 81 hospitals from 18 countries, doing surveillance from November through October the following year. The network included 23 698 hospitalized patients, of which 1 612 were tested positive for influenza. The GIHSN supported local laboratory capacities, having 88 % of its influenza whole genome sequencing activity done by sites (representing a total of 446 influenza sequenced results uploaded on GISAID for 2021-22).

Beyond influenza, 11 888 respiratory viruses were detected by the network (respectively 7 716 SARS-CoV-2, 1 625 RSV and 2 547 patients with other respiratory viruses). In addition, 841 SARS-CoV-2 whole genome sequencing results were uploaded on GISAID, contributing to COVID-19 pandemic surveillance.

Figure 3 presents the sites which contributed data in the GIHSN in the 2021-2022 season.



Surveillance population and settings by site can vary significantly from one site to another, depending notably on the number and type of hospitals involved, site case finding approach, laboratory and WGS capacities, site experience in influenza surveillance and within the GIHSN. These specificities by site must be carefully considered when analysing the data. Characteristics and features of each site are collected in a dedicated form and consolidated in a table, which is available on the GIHSN website⁹. A summary description of site key features is proposed in [Annex 2](#).

Range of viruses tested beyond influenza can also vary from one site to another. Although influenza virus surveillance is a key priority for the GIHSN, the network indeed encourages sites to include other respiratory viruses as part of their surveillance, if laboratory capacity exists locally. In 2021-2022, almost all sites tested and shared data on SARS-CoV-2. 17 sites also shared data on RSV. Other respiratory viruses were also tested, including human coronaviruses, metapneumovirus, adenovirus, bocavirus, parainfluenza viruses, rhinovirus. Viruses tested by sites are presented in **Table 1** below.

⁹ <https://www.gihsn.org/the-network/contributing-sites>

Table 1: Viruses tested by sites (2021-2022)

Country	Site/Institution	Influenza	SARS-CoV-2	RSV*	HCoV*	HMPV*	AdV*	HBoV*	HPIV*	RhV*	others
Africa											
Kenya	Kenya Medical Research Institute (KEMRI), Nairobi	█	█								
Côte d'Ivoire	Institut National d'Hygiène Publique (INHP), Abidjan	█	█	█	█	█	█	█	█	█	
Senegal	Institut Pasteur of Dakar (IPD), Dakar	█	█	█	█	█	█	█	█	█	█
South Africa	University of the Witwatersrand, Johannesburg	█	█	█		█					
Asia/Pacific											
China	School of Public Health, Fudan University, Shanghai	█		█	█	█	█	█	█	█	
India	Sher-i-Kashmir Institute, Srinagar	█		█							
Nepal	Patan Academy of Health Sciences	█	█								
Middle East											
Türkiye	Turkish Society of Internal Medicine, Ankara	█	█	█	█	█	█	█	█	█	█
Lebanon	American University of Beirut, Beirut	█	█	█	█		█		█	█	█
Eurasia											
Russia - St Petersburg	Smorodintsev Research Institute of Influenza, St Petersburg, Russia	█	█	█	█	█	█	█	█	█	
Russia - Moscow	FSBI "N.F. Gamaleya NRCEM" Ministry of Health, Moscow	█	█	█	█	█	█	█	█	█	█
Ukraine	L.V.Gromashevsky Institute of Epidemiology & Infectious Diseases, Kyiv	█	█	█		█		█	█	█	
Spain	FISABIO, Valencia	█	█	█	█	█	█	█	█	█	
Romania	National Institute for Infectious Diseases "Prof. Dr. Matei Bals", Bucharest	█	█	█	█	█	█	█	█	█	
France	INSERM, Paris	█	█	█	█	█	█	█	█	█	█
North America											
Canada	The CIRN Serious Outcomes Surveillance (SOS) Network, Halifax	█	█	█	█	█	█		█	█	█
USA	Icahn School of Medicine at Mount Sinai, NYC	█	█	█		█		█	█	█	█
South America											
Brazil	Hospital Pequeno Principe, Curitiba	█	█	█	█	█	█	█	█	█	█
Peru	Instituto de Medicina Tropical, Lima	█	█	█		█					█

*RSV: Respiratory Syncytial Virus; HCoV: Human Coronaviruses; HMPV: Metapneumovirus; AdV: Adenovirus; HBoV: Bocavirus; HPIV: Parainfluenza viruses; RhV: Rhinovirus; ORV : Other Respiratory Viruses.

2. Descriptive analysis

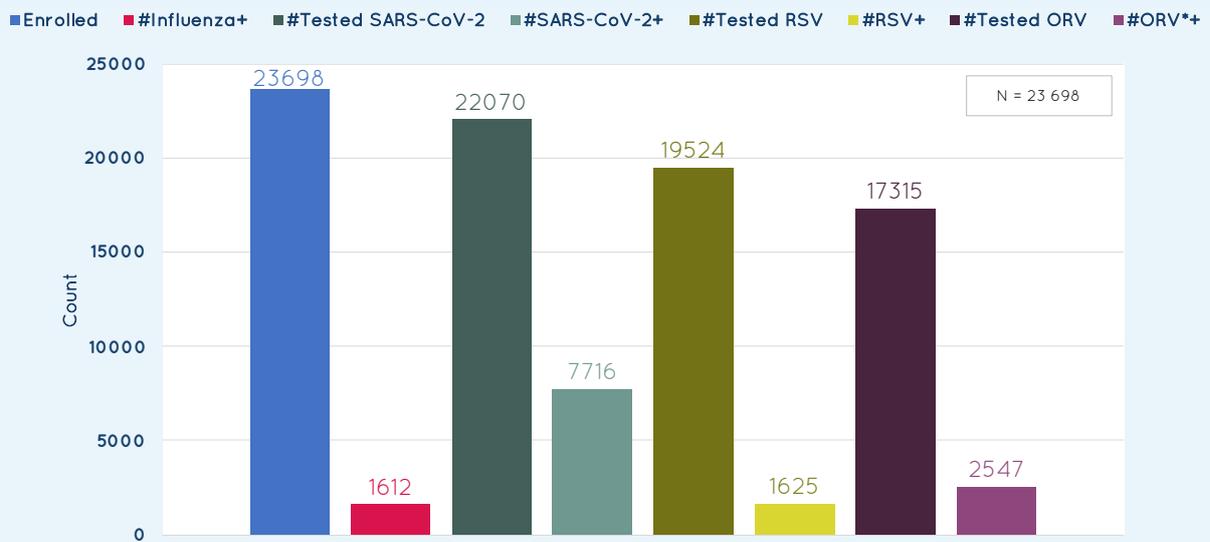
2.a. Overview of the GIHSN cohort

Overall, 23 698 patients were enrolled in the 2021-2022 season. All 23 698 cases were documented following the GIHSN questionnaire¹⁰.

As per the GIHSN protocol, all patients enrolled are to be tested by RT-PCR for influenza¹¹. In all, 1 612 influenza positives were detected during the 2021-2022 season.

When possible (e.g., available multiplex PCR), specimens collected were also tested for SARS-CoV-2, RSV and other respiratory viruses (see **Figure 4**).

Figure 4: Overall number of patients enrolled and positive cases for influenza, SARS-CoV-2, RSV and other respiratory viruses (2021-2022)

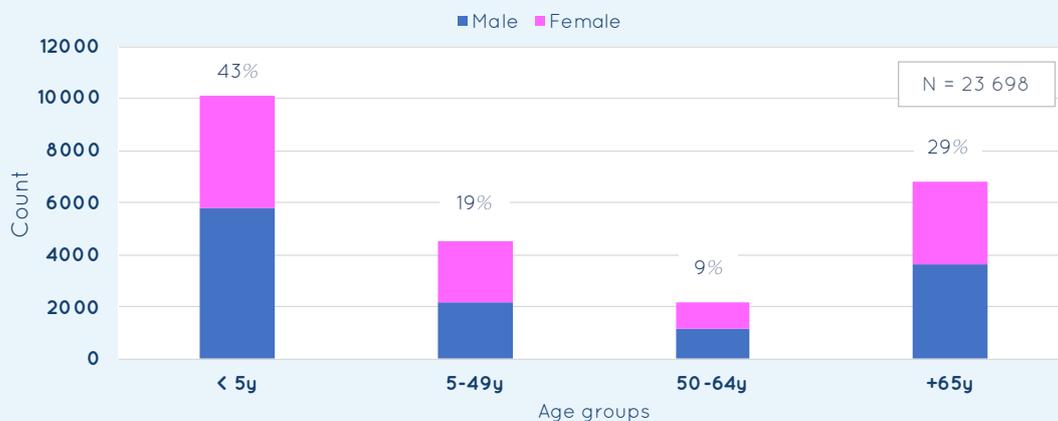


*ORV: Other Respiratory Viruses

2.b. Patient distribution by age group

The GIHSN patient-cohort population of 2021-2022 comprises 43% of children <5 years old, as shown on **Figure 5**. The paediatric population mainly comes from the following sites: Kenya, Côte d'Ivoire, Senegal, South Africa, China, Lebanon, Russia-St Petersburg, Brazil and Peru (see **Figure 6**). Some of these sites enrol patients in paediatric hospitals (see details in **Annex 2**).

Figure 5: Distribution of enrolled patients by age group and sex - All sites (2021-2022)



¹⁰ The GIHSN questionnaire is available here: <https://www.gihsn.org/the-network/protocol-and-questionnaires/2021-2022-season>

¹¹ In rare known circumstances, systematic testing was not possible because of unavailability of reagents.

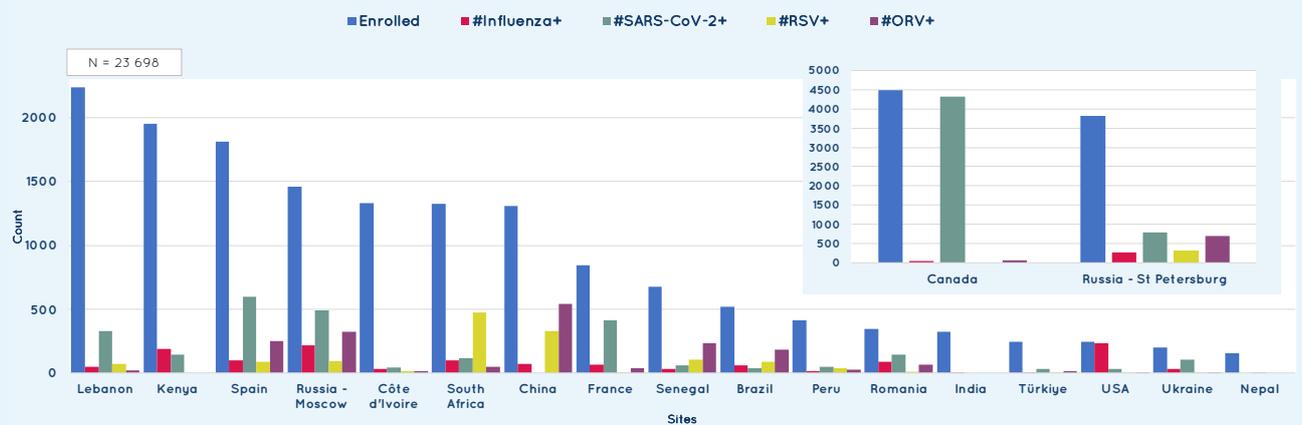
Figure 6: Distribution of enrolled patients by age group - By site (2021-2022)



2.c. Patient distribution by site

Figure 7 shows the distribution of enrolled patients by site, and, for each site, the distribution of viruses detected. Detailed count of patients by site is provided in Annex 3.

Figure 7: Distribution of patients by site: number of enrolled patients and number of viruses detected by site (2021-2022)



3. Results overview: Influenza

3.a. Positivity

The influenza positivity rate vary substantially by site, from 1 or 2% in India, Côte d'Ivoire, and Lebanon, to 25% in Romania (this excludes Nepal, which could not test because of unavailability of reagents; this also excludes Canada and the USA because their enrolment strategy did not allow to calculate positivity rate).

Figure 8 shows, for each site, the number of enrolled patients, of which how many were tested positive to influenza, and, among these, how many influenza viruses were sequenced.

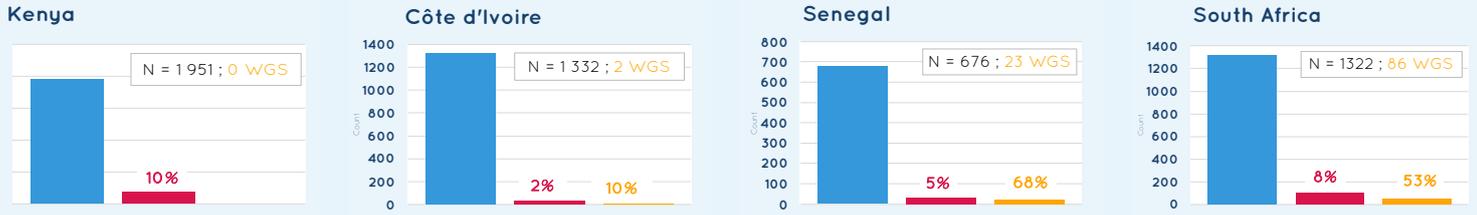
Positivity rate is derived by the number of laboratory-confirmed patients with influenza among all patients enrolled. Percentage of whole genome sequencing derived from the total number of influenza patients.

In all, as of end of 2022, 13 sites could provide influenza Whole Genome Sequencing results for the 2021-2022 season. Improvements are expected in 2022-2023 for the other sites.

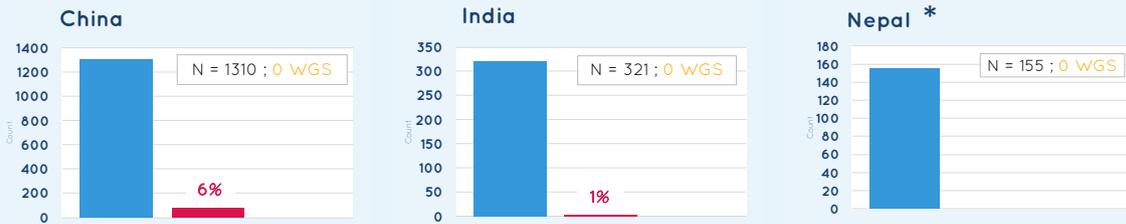
Figure 8: Number of enrolled patients, influenza positivity rate and percentage of influenza viruses with whole genome sequencing data available - By site (2021-2022)

#Enrolled #Influenza #WGS Influenza

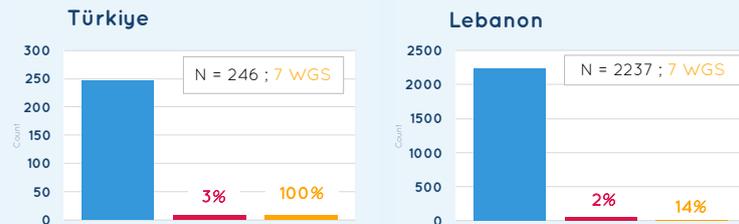
AFRICA



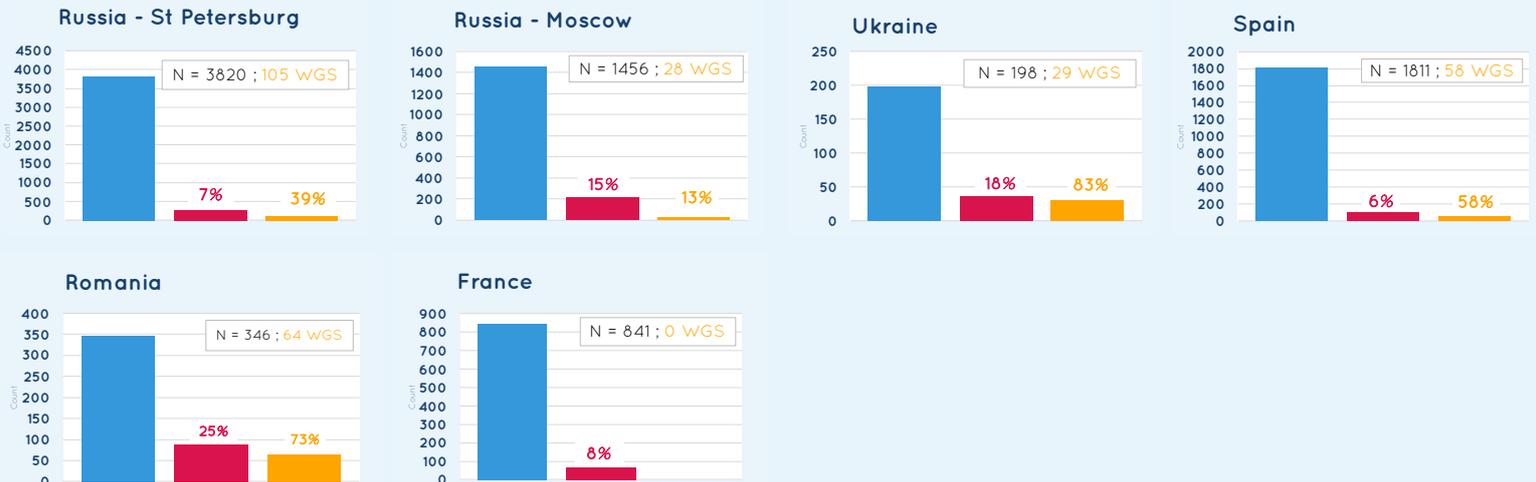
ASIA



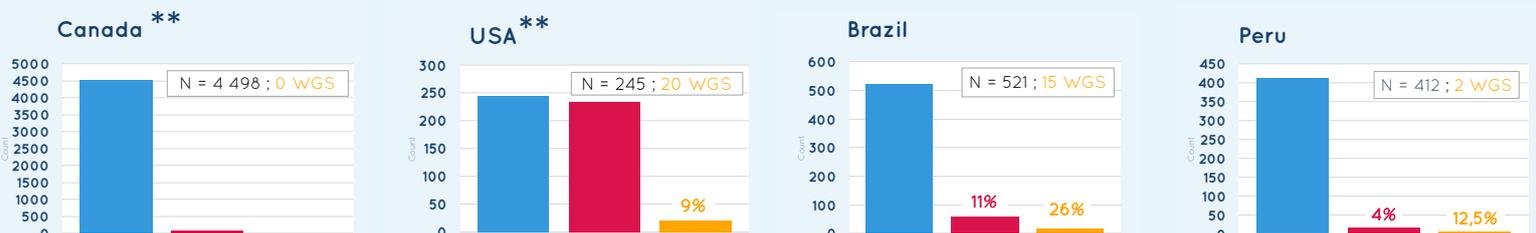
MIDDLE EAST



EURASIA



AMERICAS



Each site is represented with a different scale.

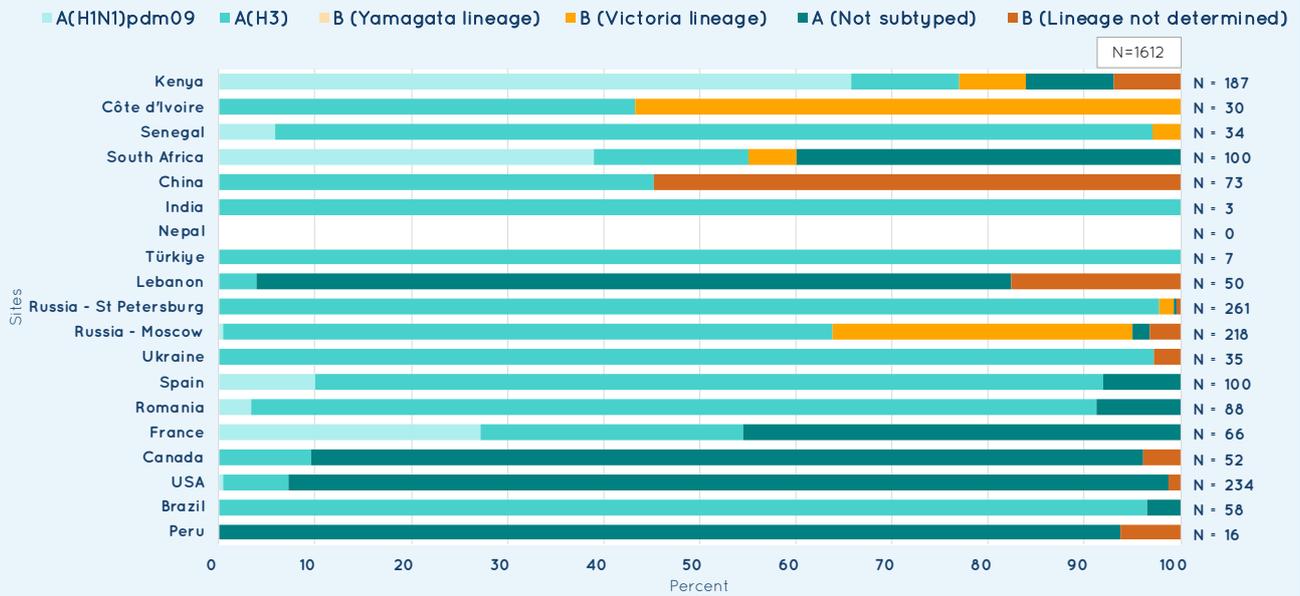
* Nepal was not able to report influenza positive cases due to unavailability of reagents over the 2021-22 period.

**In Canada and the USA, current patient enrolment process does not allow to show a positivity rate.

3.b. Virus distribution

Most of the influenza viruses were influenza type A viruses, with some rare influenza B viruses. No influenza B Yamagata lineage was detected (Figure 9).

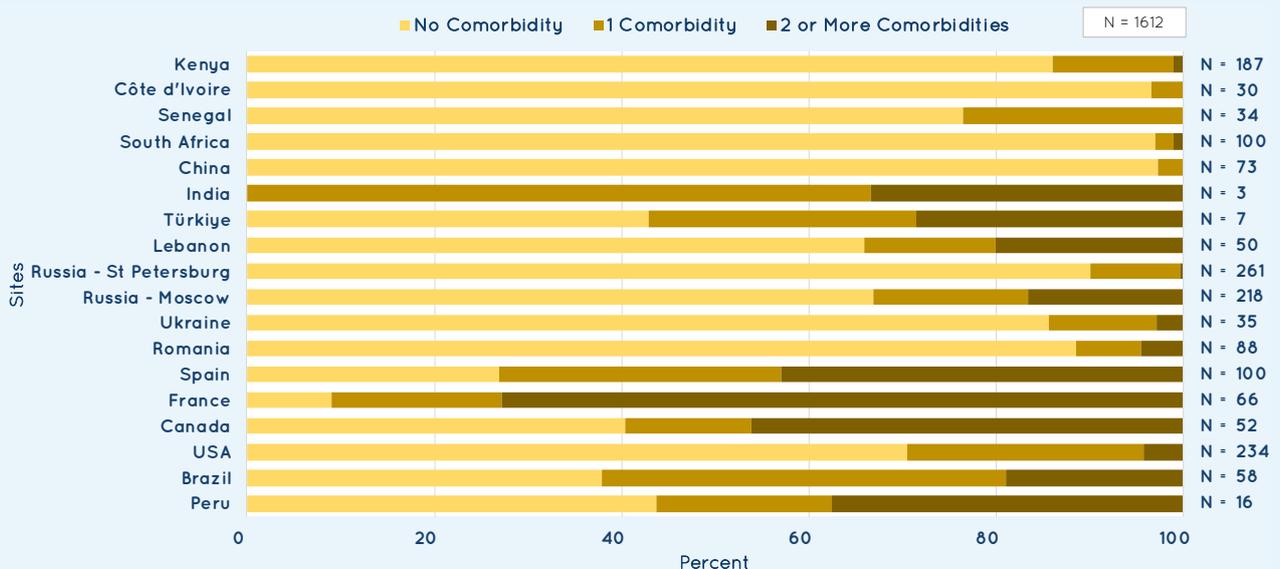
Figure 9: Distribution of laboratory-confirmed influenza cases by influenza virus subtype and lineage - By site (2021-2022)



3.c. Comorbidities

Comorbidities are captured in the clinical questionnaire. Figure 10 shows the number of comorbidities (none / 1 / 2 or more) among laboratory-confirmed influenza cases, by site. The list of comorbidities captured is provided in Annex 4.

Figure 10: Presence of comorbidities among laboratory-confirmed influenza cases - By site (2021-2022)



3.d. Severity

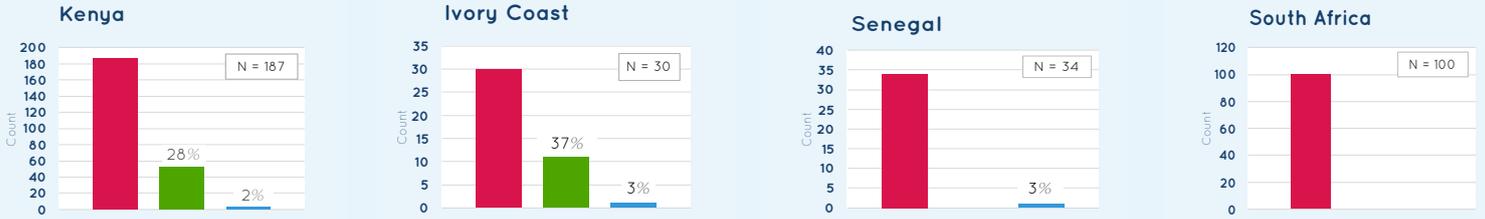
Severity is captured at admission (e.g., lethargy, oxygen saturation, need for supplement oxygen), during admission (e.g., ICU, mechanical ventilation) and at patient discharge/death. Figure 11 shows ICU admissions and deaths among laboratory-confirmed influenza cases, in each participating site.

The percentages on top of the bars represent the number of ICU admissions by total patients with influenza. Deaths represent total deaths by the total number of influenza cases (not within ICU).

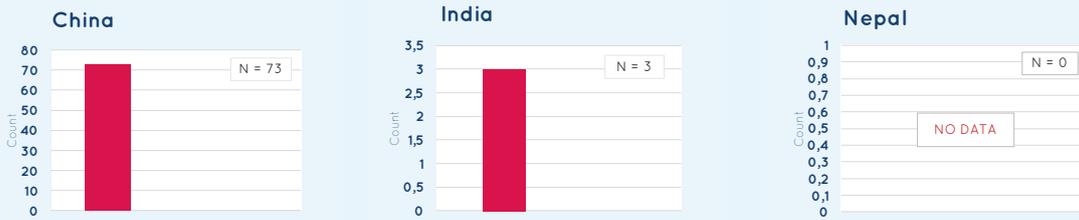
Figure 11: Intensive care unit (ICU) admissions and deaths among laboratory-confirmed influenza cases - By site (2021-2022)

#Influenza #ICU admissions #Deaths

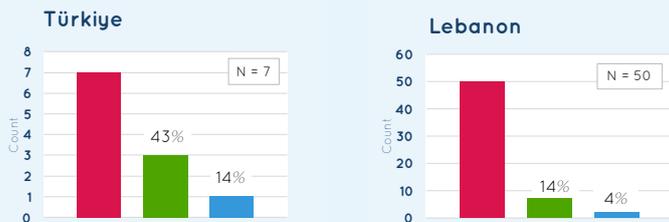
AFRICA



ASIA



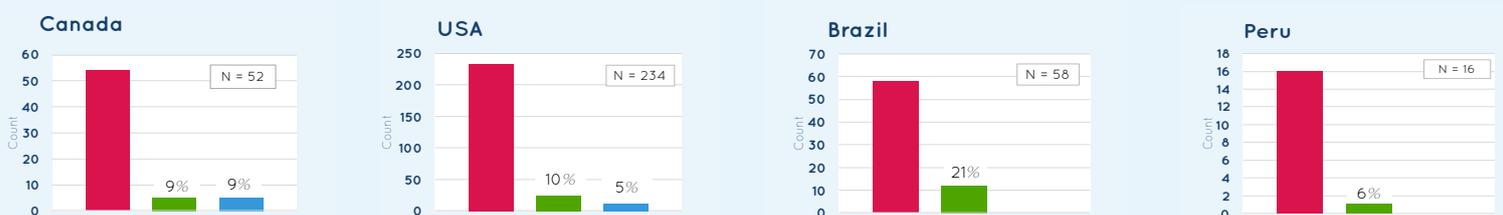
MIDDLE EAST



EURASIA



AMERICAS



Each site is represented with a different scale.

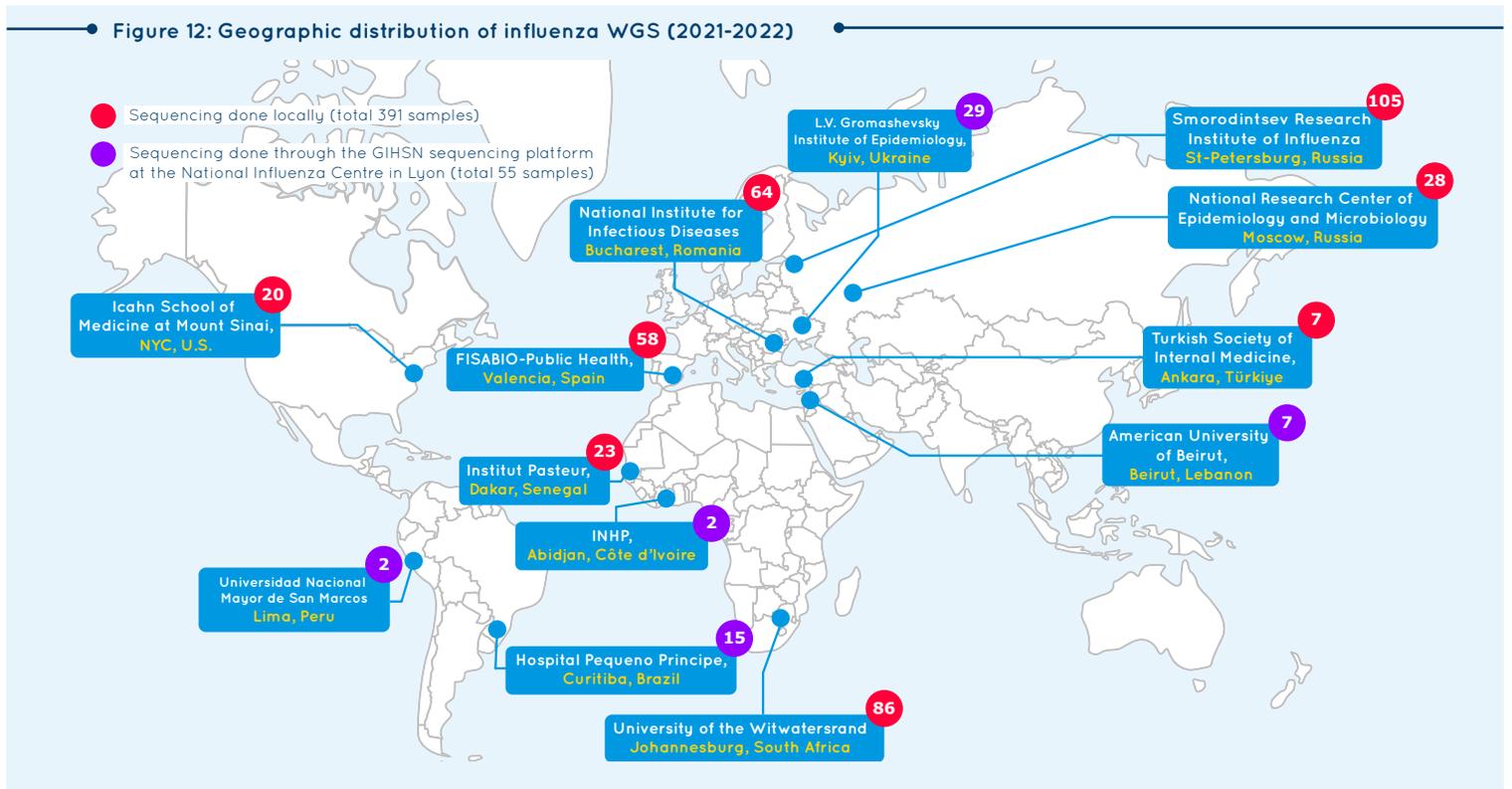
4. Sequencing Analysis of Influenza viruses

As a result of the reduction of mitigation measures put in place during the COVID-19 pandemic, circulation of respiratory viruses returned during the 2021-2022 surveillance period of GIHSN. Nonetheless, there were difficulties with the implementation of the surveillance in the aftermath of the pandemic that affected most of the GIHSN sites, resulting in reduced number of influenza sequences.

4.a. Overview of influenza viruses sequenced

446 influenza positive samples were detected and fully sequenced, either locally by sites (391), or through the GIHSN sequencing platform at the National Influenza Centre in Lyon, France (55) (see details in [Annex 5](#)).

Figure 12: Geographic distribution of influenza WGS (2021-2022)



Most of the viruses detected were influenza type A viruses, as shown in **Figure 13**. The few influenza B viruses detected have not been submitted for sequencing because of low CT values (cycle threshold) or lack of access to sequencing platform. However, the determination of the lineage of these B viruses showed that they all belonged to the Victoria lineage.

As a possible result of the reduction of the circulation of influenza viruses during the COVID-19 pandemic, the influenza B Yamagata lineage has not been detected, and the B Victoria viruses detected matched well with the vaccine strains selected for the vaccine composition of both hemispheres.

All sequences have been uploaded on GISAID database¹².

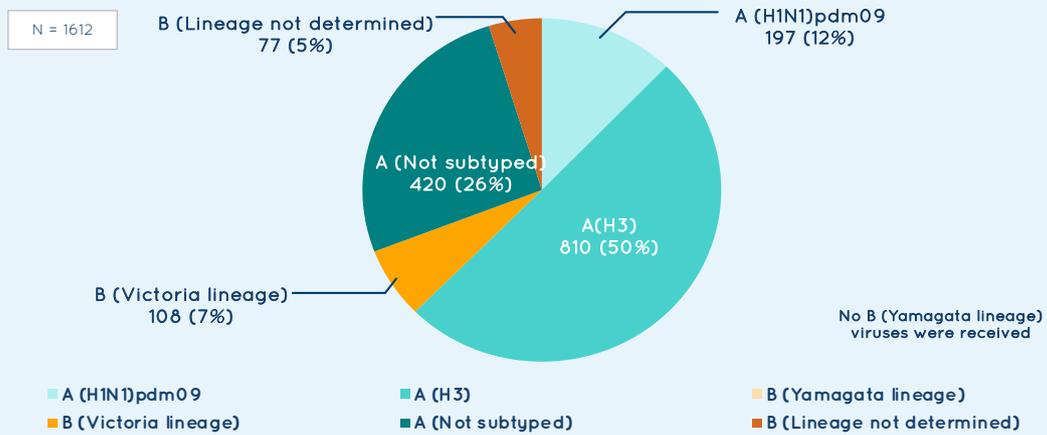
12 <https://gisaid.org/>



4.b. Description of the influenza A H1N1pdm09 viruses

These viruses represented 12% of the circulating viruses.

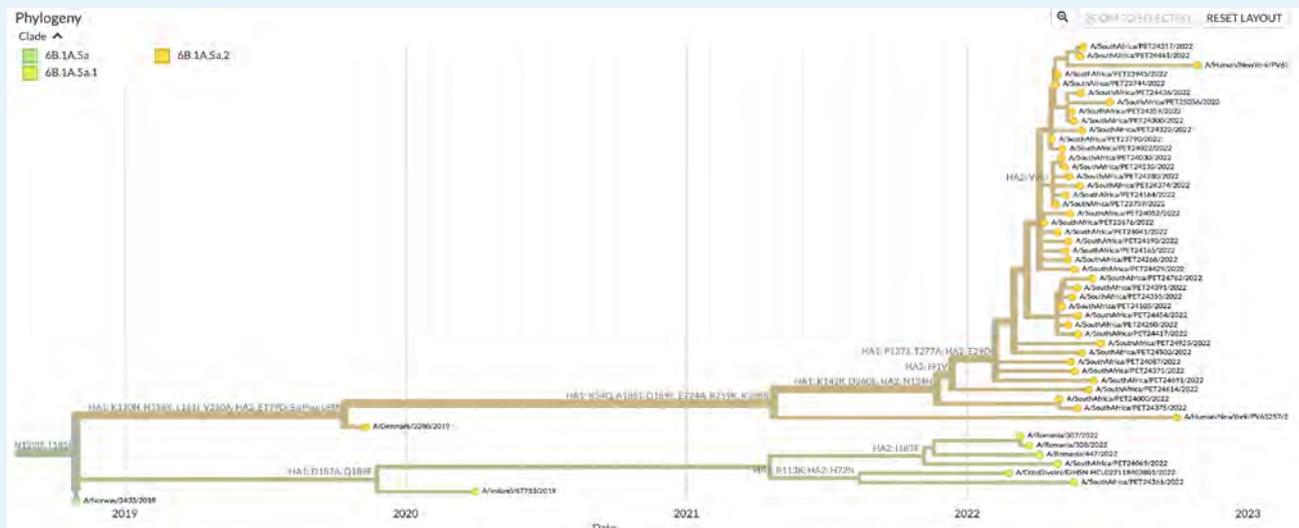
Figure 13: Distribution of laboratory-confirmed influenza cases by influenza virus subtype and lineage (2021-2022)



Most of the H1N1pdm09 viruses analyzed in the GIHSN network belonged to the 6B.1A.5a2 clade, as for most of the recent viruses reported by the global WHO surveillance (Figure 14).

Figure 14: Phylogenetic tree of the H1N1pdm09 viruses detected

[Download high-res image](#)



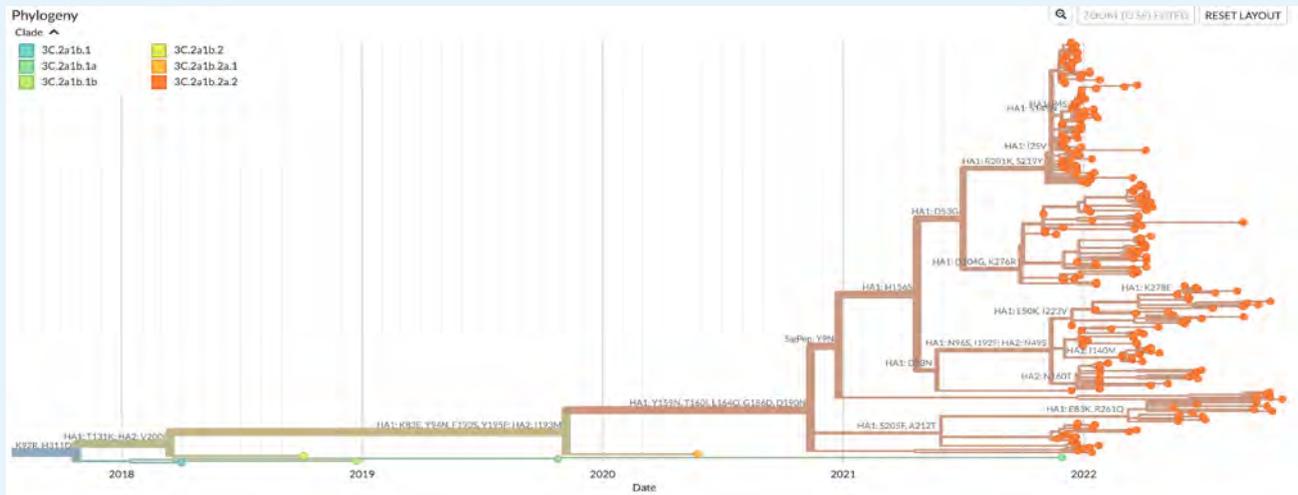
4.c. Description of the influenza A H3N2 viruses

These viruses represented 50% of the circulating viruses.

Most of the viruses sequenced by the GIHSN belonged to the 3C.2A1b.2a.2 clade, as observed with recent viruses in the WHO network (see Figure 15).

Figure 15: Phylogenetic tree of the H3N2 viruses detected

[Download high-res image](#)



5. Results overview: SARS-CoV-2, RSV and other respiratory viruses

5.a. SARS-CoV-2

7 716 laboratory-confirmed SARS-CoV-2 cases were detected during the 2021-2022 season in the 17 sites which tested and/or shared data on SARS-CoV-2 (China and India did not share data on SARS-CoV-2)

Positivity

The SARS-CoV-2 positivity rates vary substantially by site, from 3% in Côte d'Ivoire, up to 62% in Ukraine (this excludes Canada for enrolment strategy).

Figure 16 shows, for each site, the number of patients who were tested for SARS-CoV-2, and the positivity rate, and, among those who were positive, the number of SARS Cov2 viruses which were sequenced.

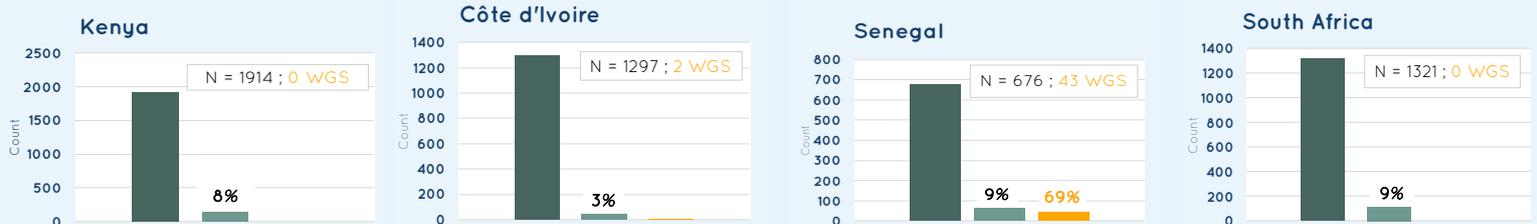
Positivity rate is derived by the number of laboratory-confirmed patients with SARS-CoV-2 among all patients tested. Percentage of whole genome sequencing is derived from the total number of SARS-CoV-2 patients.

As of end of 2022, 11 sites could provide SARS-CoV-2 Whole Genome Sequencing results for the 2021-2022 season. In all, 841 SARS-CoV-2 WGS results were uploaded on GISAID, contributing to COVID-19 pandemic surveillance.

Figure 16: Number of patients tested for SARS-CoV-2, positivity rate and percentage of SARS-CoV-2 viruses with whole genome sequencing data available - By site (2021-2022)

■ #Tested SARS-CoV-2 ■ #SARS-CoV-2+ ■ #WGS SARS-CoV-2

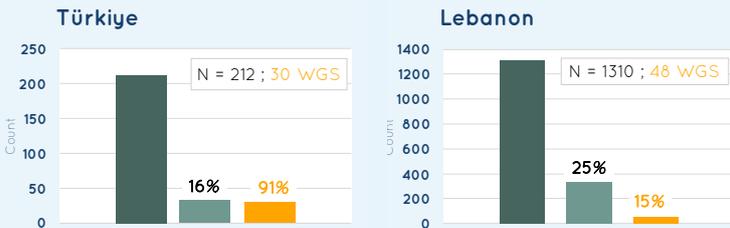
AFRICA



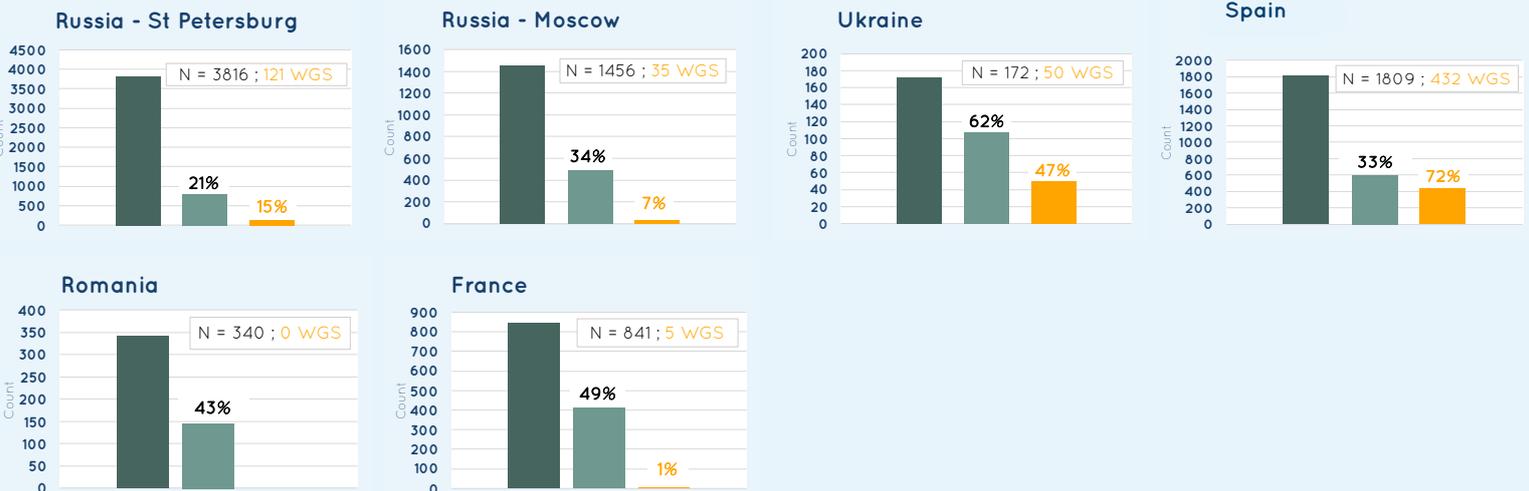
ASIA



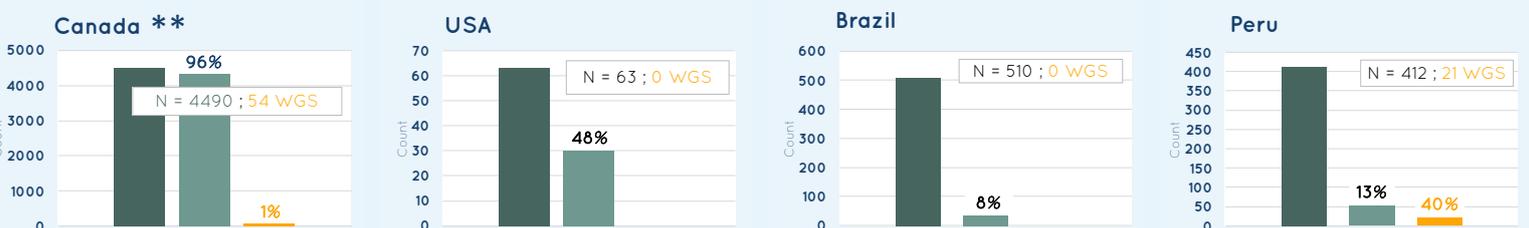
MIDDLE EAST



EURASIA



AMERICAS



Each site is represented with a different scale.

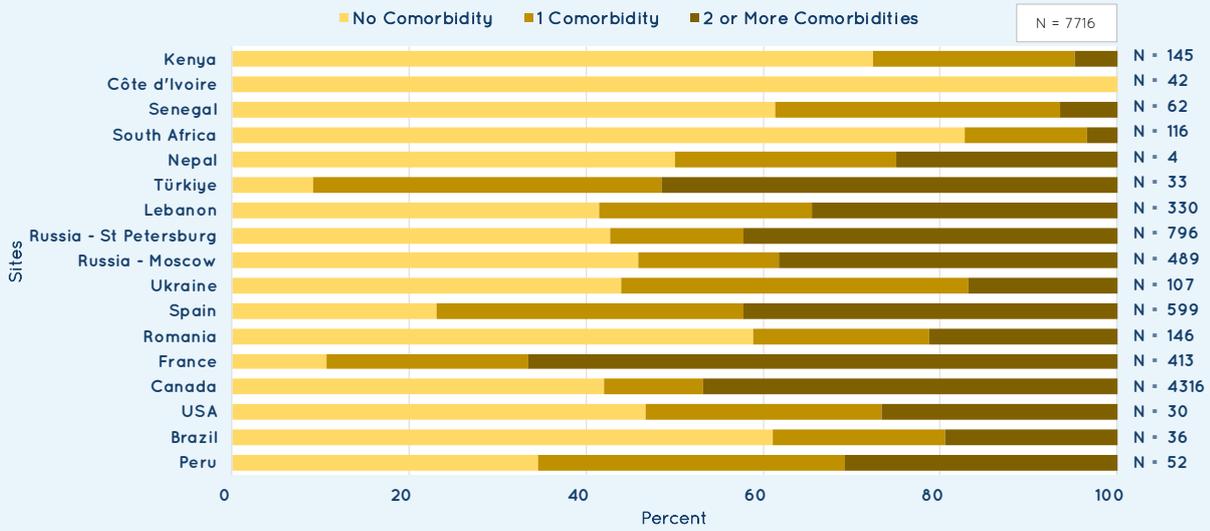
*China and India did not share data on SARS-CoV-2

**Canada high positivity rate is partially due to site enrolment strategy

Comorbidities

Figure 17 shows the number of comorbidities (none / 1 / 2 or more) among laboratory-confirmed SARS-CoV-2 cases, by site (see list of comorbidities in Annex 4).

Figure 17: Presence of comorbidities among laboratory-confirmed SARS-CoV-2 cases - By site (2021-2022)



Severity

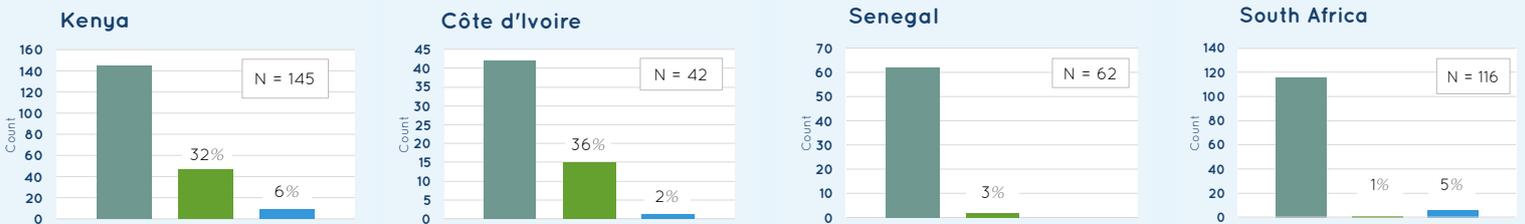
Severity is captured and reported similarly to influenza. **Figure 18** shows ICU admissions and deaths among laboratory-confirmed SARS-CoV-2 cases, in each participating site.

The percentages on top of the bars represent the number of ICU admissions by total patients with SARS-CoV-2. Deaths represent total deaths by the total number of SARS-CoV-2 cases (not within ICU).

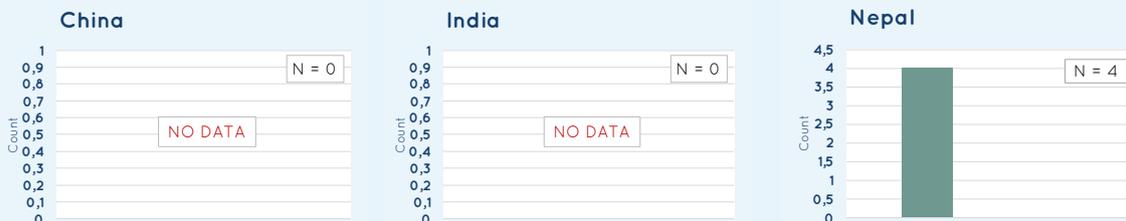
Figure 18: Intensive care unit admissions and deaths among laboratory-confirmed SARS-CoV-2 cases - By site (2021-2022)

#SARS-CoV-2 + #ICU admissions #Deaths

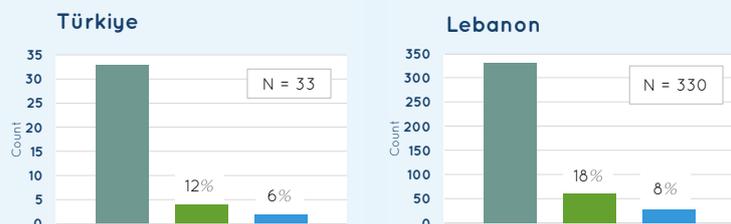
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ASIA



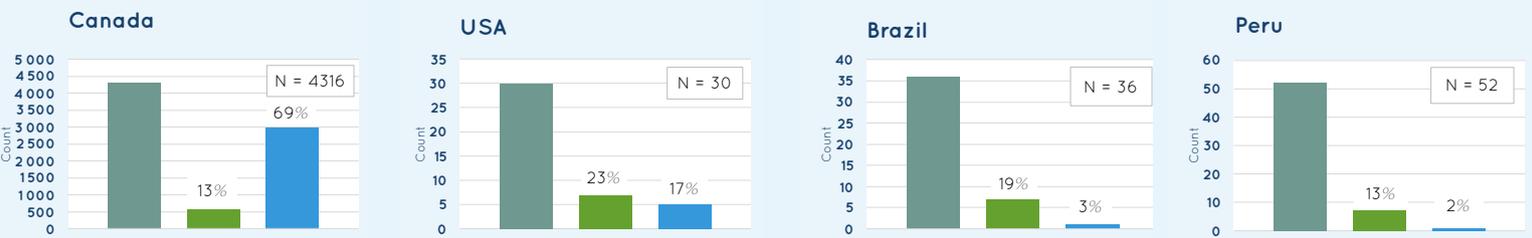
MIDDLE EAST



EURASIA



AMERICAS



Each site is represented with a different scale.

5.b. Respiratory Syncytial Virus (RSV)

1 625 laboratory-confirmed RSV cases were detected during the 2021-2022 season in the 17 sites which tested patients for RSV and/or shared RSV data (Kenya and Nepal did not share data on RSV).

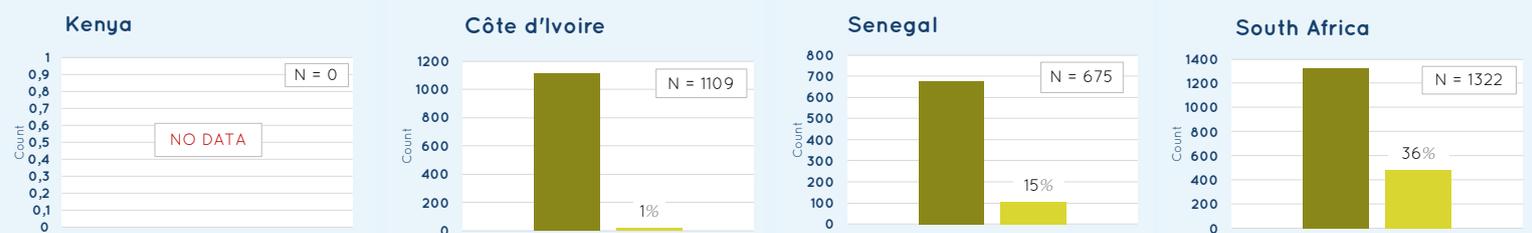
Positivity

Positivity rates vary substantially by site, from 0% in India and Canada, up to 25% in China and 36% in South Africa, which hospitals welcome children only. **Figure 19** shows, for each site, the number of patients who were tested for RSV, and the positivity rate.

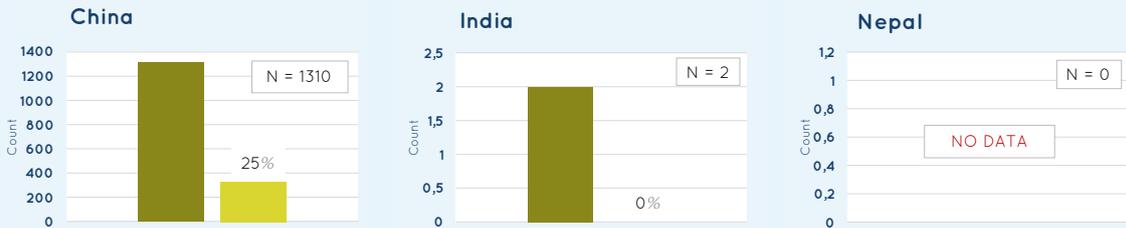
Figure 19: Number of patients tested for RSV and positivity rate - By site (2021-2022)

#Tested RSV #RSV+

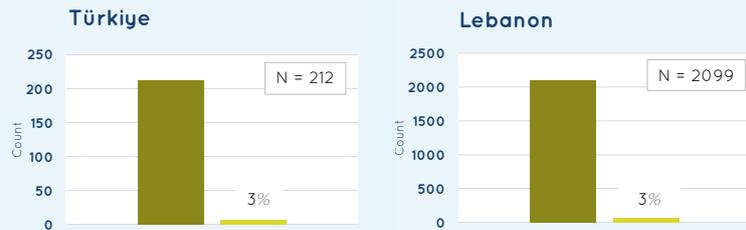
AFRICA



ASIA



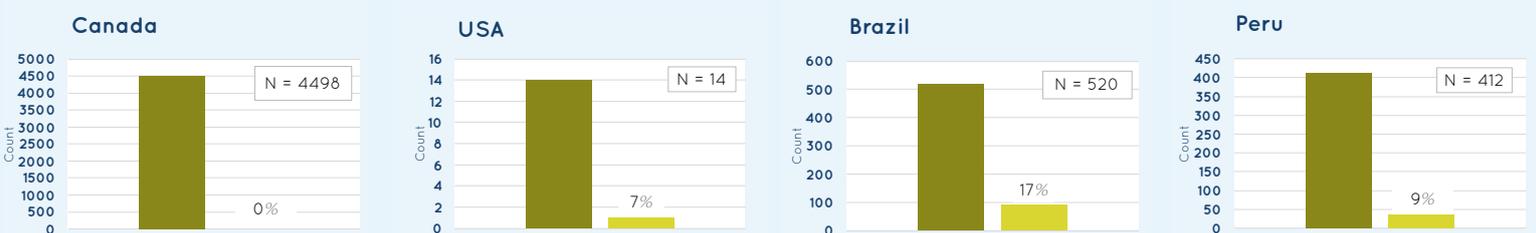
MIDDLE EAST



EURASIA



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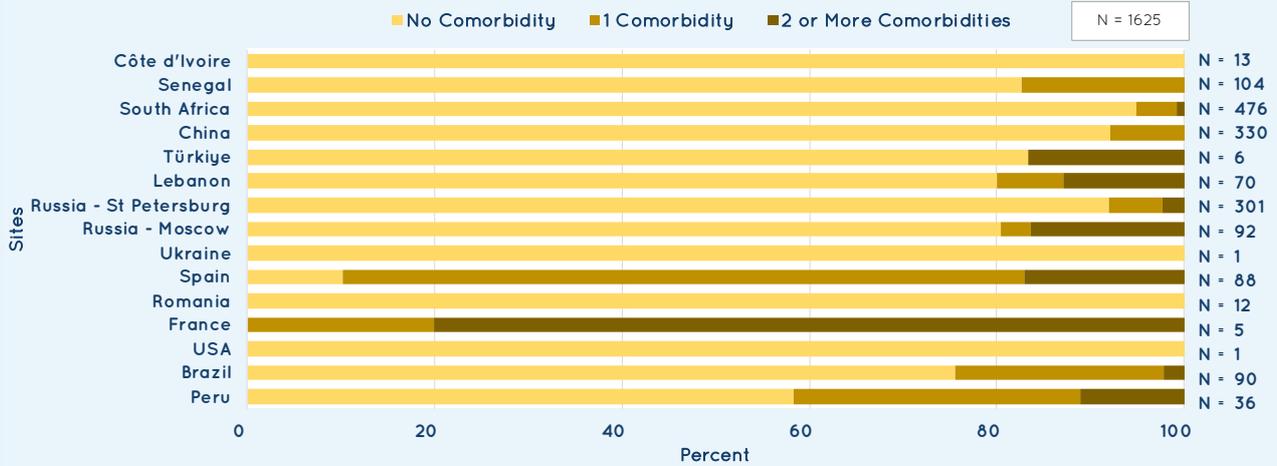


Each site is represented with a different scale.

Comorbidities

Figure 20 shows the number of comorbidities (none / 1 / 2 or more) among laboratory-confirmed RSV cases, by site (see list of comorbidities in Annex 4).

Figure 20: Presence of comorbidities among laboratory-confirmed RSV cases - By site (2021-2022)



Severity

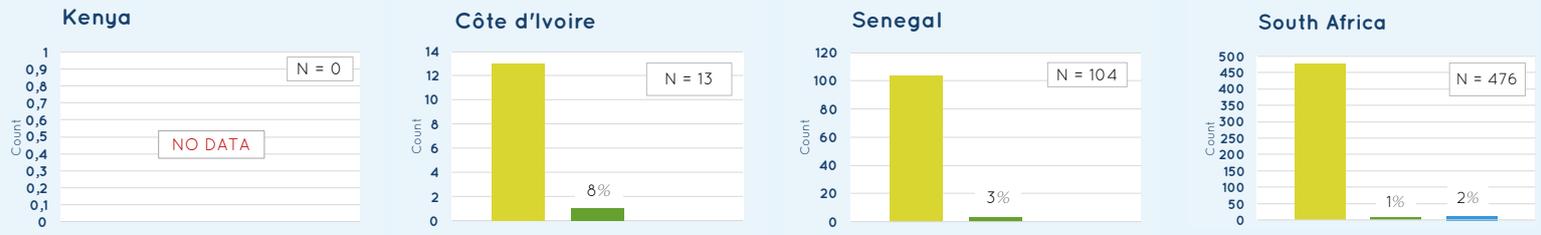
Severity is captured and reported similarly to influenza. **Figure 21** shows ICU admissions and deaths among laboratory-confirmed RSV cases, in each participating site.

The percentages on top of the bars represent the number of ICU admissions by total patients with RSV. Deaths represent total deaths by the total number of RSV cases (not within ICU).

Figure 21: Intensive care unit admissions and deaths among laboratory-confirmed RSV cases - By site (2021-2022)

#RSV + #ICU admissions #Deaths

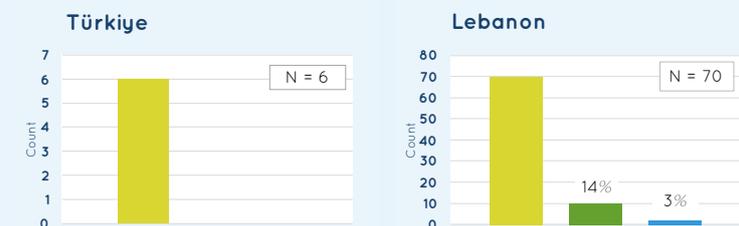
AFRICA



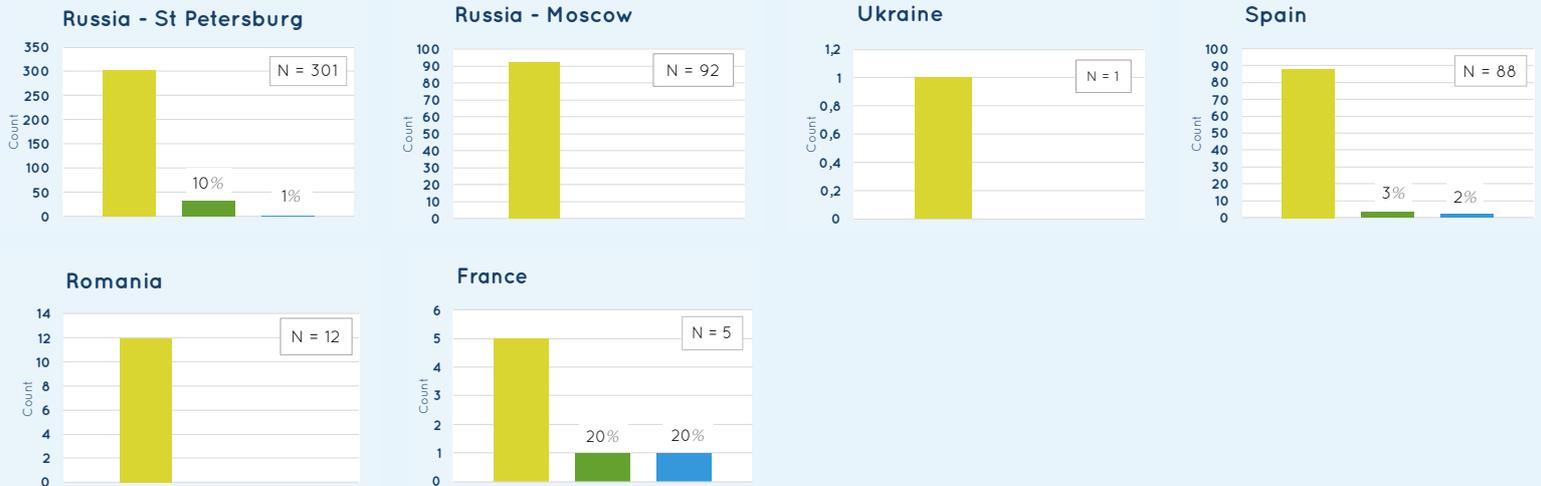
ASIA



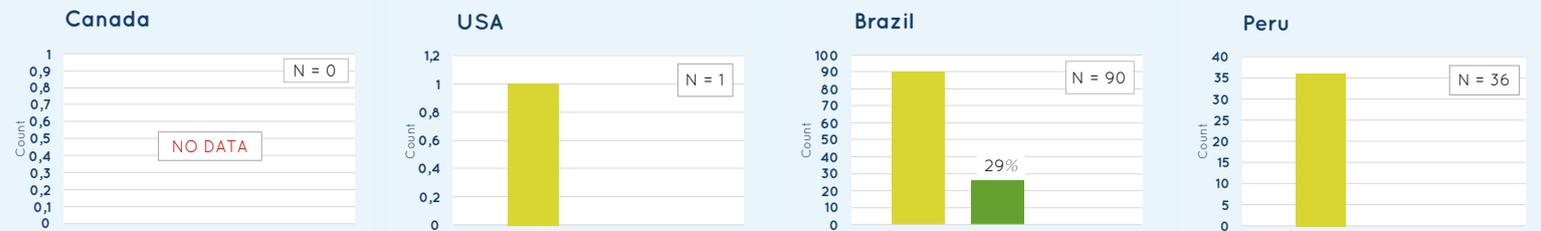
MIDDLE EAST



EURASIA



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Each site is represented with a different scale.

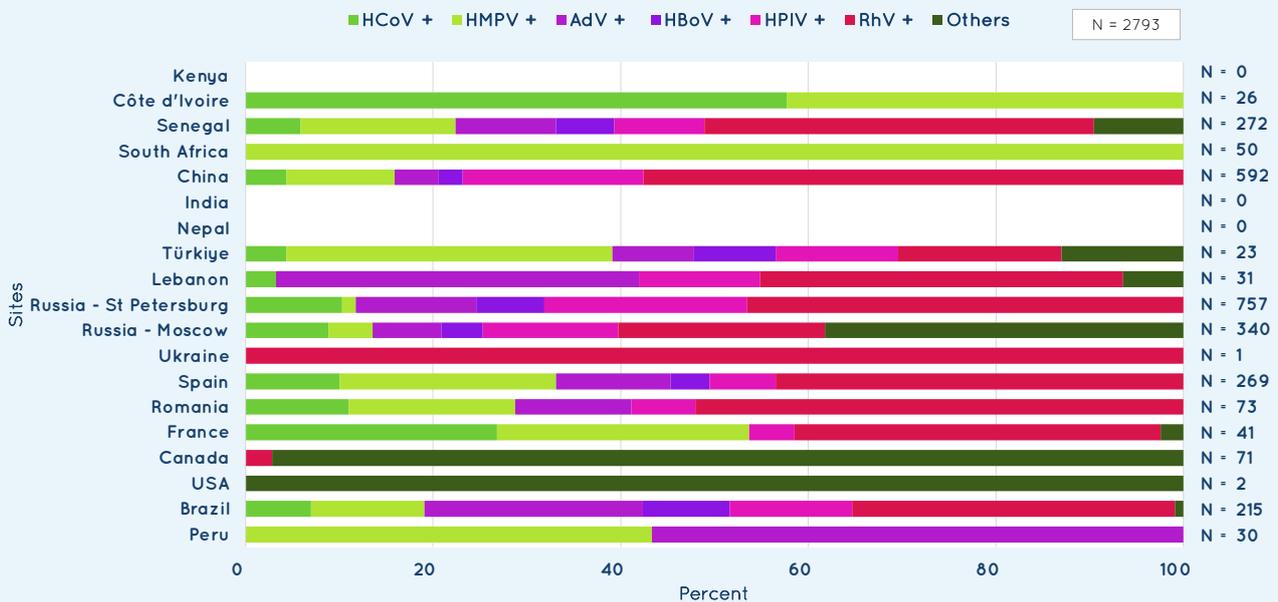
5.c. Other respiratory viruses

2 547 patients were tested positive for one or several other respiratory viruses in the 16 sites which shared data on other respiratory viruses (Kenya, India and Nepal did not share data on other respiratory viruses).

These viruses included: human coronavirus, metapneumovirus, adenovirus, bocavirus, parainfluenza virus, rhinovirus and others.

Figure 22 shows the distribution of viruses tested, for sites which did test.

Figure 22: Distribution of laboratory-confirmed other respiratory viruses - By site



PART III.

The Foundation for Influenza Epidemiology

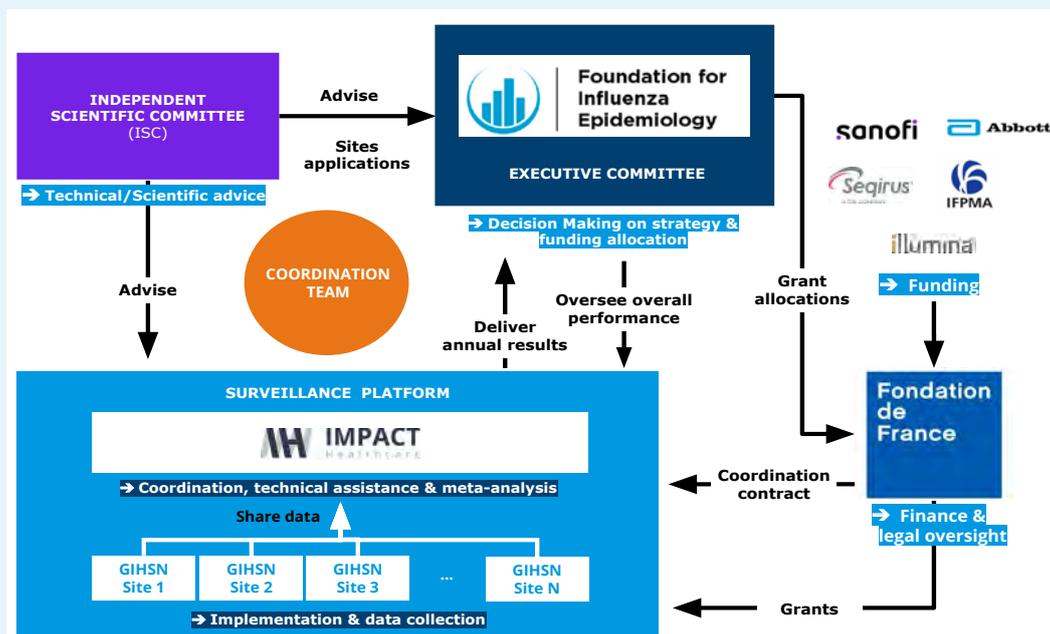
The GIHSN is operated and supported by a dedicated fund, the Foundation for Influenza Epidemiology (FIE), which was created in September 2015 by Sanofi under the auspices of Fondation de France, a leading philanthropy network in France¹³, to formalize several years of commitment to epidemiological research on severe influenza.

The Foundation for Influenza Epidemiology provides catalytic funding to sites, complementary to national and other sources of funding. As of January 2023, donors of the Foundation for Influenza Epidemiology included Sanofi, Seqirus, Illumina, Abbott Diagnostics. All donations collected through this Foundation are dedicated to epidemiological research in the field of severe influenza and other respiratory viral diseases. Data are published yearly. Donors do not have access to the data and there is no commercial use of the data.

1. Governance

Figure 23 presents the governance of the Foundation for Influenza Epidemiology, its committees and stakeholders, with their roles and responsibilities.

Figure 23: Governance of the Foundation for Influenza Epidemiology



¹³ <https://www.fondationdefrance.org/en/homepage>

The governance of the Foundation for Influenza Epidemiology is ensured by an **Executive Committee**, in charge of the strategic directions related to the project. Based on pre-established criteria and advice by the Independent Scientific Committee, the Executive Committee selects applicant sites for funding allocation each year.

Composition of the Executive Committee (as of September 2022)

College of Founders (2 seats):

- Sanofi, represented by Cedric Mahe* and Erica Dueger*

College of Donors (2 seats):

- Seqirus, represented by Mendel Haag*
- Illumina, represented by Vanessa Moeder*

College of Independent Scientific Experts (3 seats):

- Bruno Lina*, University of Lyon, France, Chair of the Independent Scientific Committee
- John Paget*, Nivel, Netherlands Institute for Health Services Research, Netherlands, member of the Independent Scientific Committee
- Melissa K Andrew*, Canadian Serious Outcomes Surveillance Network, Canada, member of the Independent Scientific Committee

Other members invited:

- IFPMA, represented by Paula Barbosa
- Abbott Diagnostics, represented by Francisco Averhoff

**Members with a voting right; a decision is approved if half or more of the entire membership agree (4 out of 7 as of Sep 2022)*

Scientific oversight of the GIHSN is ensured by an **Independent Scientific Committee** (ISC) composed of world leading experts in epidemiology, virology and public health, including representatives from WHO and field-based experts, investigators from GIHSN sites.

Composition of the Independent Scientific Committee (as of September 2022)

Experts:



Bruno Lina,
University of Lyon, France (Chair)



Joseph Bresee,
Task Force for Global Health, USA



John McCauley,
The Francis Crick Institute, London, UK



Justin Ortiz,
University of Maryland, USA



John Paget,
Nivel, Netherlands



Wenqing Zhang,
Head of GIP, WHO, Geneva (Observer)



Sandra S Chaves,
Foundation for Influenza Epidemiology, Paris, France (Observer)

Site representatives:



Melissa K Andrew,
Canadian Serious Outcomes Surveillance Network, Halifax, Canada



Elena Burtseva,
FSBI « N.F. Gamaleya NRCEM », Moscow, Russia



Marta Nunes,
University of the Witwatersrand, South Africa

The Foundation for Influenza Epidemiology members and dedicated resources are presented in [Annex 6](#).

Coordination of the GIHSN, supervision of implementation and data management/data hosting are supported by **Impact Healthcare**, an independent organization based in Paris, France, specializing in the strategic and operational management of large innovative projects in Digital Health and the use of Health data, both in France and internationally¹⁴.

¹⁴ <https://www.impact-healthcare.fr/en/>

2. Site selection process

All investigating sites participating in the GIHSN are selected on a yearly basis, through an annual Call for Proposal. The Call for Proposal is published each year in May on the GIHSN website¹⁵. Sites which meet the eligibility criteria and are interested in participating in the GIHSN can apply online.

Eligibility criteria include the following:

- All sites are non-profit institutions, with experience in hospital-based surveillance for influenza and other respiratory viruses.
- Applicants have to show an excellent connection between a hospital surveillance platform and a virology laboratory in their country, allowing for influenza testing by RT-PCR and subsequent sequencing (subtype/lineage) of the positive specimens from sample collection. All sites must have the capacity to submit WGS at a minimum consensus data of the HA and NA segments to the GISAID EpiFlu™ database.

Applications from institutions meeting the eligibility criteria are reviewed and evaluated by the Independent Scientific Committee of the Foundation according to predefined quality criteria. These include scientific and technical criteria, such as the robustness of study settings, case ascertainment strategy/sampling strategy, laboratory capacities, commitment to timeliness sharing of data besides considerations regarding geographic representativeness. Final decision is made by the Executive Committee of the Foundation.

3. Data management and ethics

To comply with regulations on data access and privacy, the Foundation set up a data warehouse and a data access framework. Impact Healthcare is Data Controller for the GIHSN (jointly with Fondation de France), handling the data collection process and supervising the GIHSN data warehouse. The GIHSN database is hosted in a secured environment (certified secured hosting for health personal data). Data are processed in full accordance with the European General Data Protection Regulation (GDPR) and French data protection regulations.

3.a. Data sharing agreement

A data sharing agreement is signed by each site before field implementation starts. The data sharing agreement recalls the following:

- Sites implementing the GIHSN protocol should be compliant with their ethical and national regulations for the conducting of the surveillance. Any obligation related to data protection and data transfer to the Impact Healthcare platform should be anticipated.
- Data collected by sites receiving funding remains the proprietary of the site. There is no commercial use of the data. Donors do not have access to the data. The data are transferred through a secured channel and sites can ask access to the data they shared at any time.
- Impact Healthcare is given access to the GIHSN data for epidemiological research fulfilling the three following conditions:
 - Analyses can only be performed for research purposes in line with the mandate of the Foundation (i.e. surveillance and monitoring of influenza and other respiratory viruses).
 - Analyses are exclusively performed with strictly anonymous and/or aggregated data.
 - Any analyses plan will need to be approved beforehand by the GIHSN Independent Scientific Committee.
- All analysis results will be submitted for publication. Scientific publications and communications will mention contributing sites with investigators names in the authorship in line with the ICMJE rules (International Committee of Medical Journal Editors).
- Sites will be informed upfront for any planned data analysis beyond the routine annual pooled descriptive analysis, and they have the possibility to opt-out.

3.b. Data collection

Investigating sites follow the GIHSN common protocol and questionnaire for case ascertainment and respiratory sample collection. Data are collected at hospital level, with one or several hospitals being included in the surveillance. Real time completion of the GIHSN eCRF for all cases is expected. Alternatively, data can be uploaded monthly to the Impact Healthcare database using the excel file template provided to participating sites.

WGS data are uploaded to GISAID by site in a reasonable timeframe. If a site has no capacity to generate WGS, the site is offered the possibility to ship its specimens to the GIHSN sequencing platform at the National Influenza Centre in Lyon, France, under specific Terms of Reference for sharing materials. The eCRF includes the link to the GISAID sequence.

¹⁵ See last Call for Proposal: <https://www.gihnsn.org/join-the-gihnsn/call-for-proposal>

3.c. Data analysis

Sites are strongly encouraged to share data with WHO's Global Influenza Surveillance and Response System (GISRS) and with local health authorities in ongoing bases.

Results of local year-round surveillance are presented by each site at the GIHSN Annual Meeting. A pooled descriptive analysis is also proposed combining data from all sites for year-round surveillance and across years. A yearly manuscript is developed under the responsibility of the Independent Scientific Committee.

3.d. Secondary analysis of the GIHSN database

Additional analyses can be performed by research teams after review and approval of their research proposal by the Independent Scientific Committee and the Foundation. A data catalogue is available on the platform, together with sites description¹⁶. This provides a high-level fingerprinting of the GIHSN database and allows researchers to assess the feasibility of their research question. Data access (anonymous and/or aggregated data only) is granted to research teams through a dedicated interface.

Sites are informed upfront of any analysis, and they have the possibility to opt out.

3.e. Ethical considerations

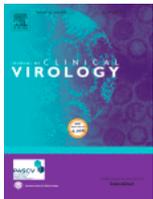
The GIHSN surveillance study has to be approved by local Research Ethics Committees before field implementation starts. The confidentiality legislation and requirements in the handling of personal information has to be strictly followed. Informed consent should be collected as per local requirements. No intervention apart from respiratory specimens (e.g., nasopharyngeal, nasal and oropharyngeal) is associated with the study.

4. Publications and communications

4.a. Scientific papers

All pooled descriptive analyses and results based on the GIHSN database are submitted for publication to peer reviewed journal, under the supervision of a member of the Independent Scientific Committee.

The following paper was published in 2022:



Grégory Quéromès, Emilie Froberta, Elena Burtseva, Anca Drăgănescu, Parvaiz A.Koul, Andrey Komissarov, V. Alberto Laguna-Torres, Jason Leblanc, F-Xavier López-Labrador, Snežana Medić, Alla Mironenko, Nancy A.Otieno, Guillermo M.Ruiz-Palacios, Tanriover MD, NGS team - Lyon, GIHSN collaborators, Laurence Josset, Bruno Lina.

Clinical and phylogenetic influenza dynamics for the 2019-20 season in the global influenza hospital surveillance network (GIHSN) – Pilot study.

Journal of Clinical Virology - July 2022

Yearly analyses for 2020-2021 & 2021-2022 seasons are ongoing.

On top of the yearly analyses, sites are very much encouraged to publish on their own, using the data they generated as part of their contribution in the GIHSN. In 2021-2022, 6 scientific papers led by site investigators were published. All publications are shared on the GIHSN website¹⁷.



Laura Holtman Ferreira, Breno Gonçalves da Silva, Heloisa Ihle Giamberardino, Ana Paula Pacheco, Luciane Aparecida Pereira, Gustavo Genelhoud, Ricardo Rasmussen Petterle, Sonia Mara Raboni.

The association of breastfeeding and other factors on respiratory virus positivity and severity in hospitalized children.

Microbiology and Immunology - 15 February 2022

¹⁶ <https://www.gihsn.org/the-network/contributing-sites>

¹⁷ <https://www.gihsn.org/publications/scientific-papers>





Victor Daniel Miron, Leontina Bănică, Oana Săndules, Simona Paraschiv, Marius Surleac, Dragoș Florea, Ovidiu Vlaicu, Petre Milu, Anca Streinu-Cercel, Anuta Bilașco, Dan Oșelea, Daniela Pițigoi, Adrian Streinu-Cercel, Anca Cristina Drăgănescu.

Clinical and molecular epidemiology of influenza viruses from Romanian patients hospitalized during the 2019/20 season.

PLOS ONE - 12 November 2021



Anna Sominina, Daria Danilenko, Andrey Komissarov, Maria Pisareva, Tamila Musaeva, Mikhail Bakaev, Olga Afanasieva, Kirill Stolyarov, Elizaveta Smorodintseva, Elena Rozhkova, Elena Obratsova, Elena Dondurey, Dmitry Guzhov, Veronica Timonina, Ekaterina Golovacheva, Olga Kurskaya, Alexander Shestopalov, Svetlana Smirnova, Alexander Alimov & Dmitry Lioznov.

Age-Specific Etiology of Severe Acute Respiratory Infections and Influenza Vaccine Effectivity in Prevention of Hospitalization in Russia, 2018–2019 Season.

Springer link - 28 October 2021



Hyder Mir, Inaamul Haq, Parvaiz A. Koul

Poor Vaccine Effectiveness against Influenza B-Related Severe Acute Respiratory Infection in a Temperate North Indian State (2019–2020): A Call for Further Data for Possible Vaccines with Closer Match.

Vaccines MDPI - 28 September 2021



Mir H, Koul PA

Negligible circulation of influenza in COVID times in Northern India.

Lung India 0;0:0 - 17 Jun 2021



Ainara Mira-Iglesias, Beatriz Mengual-Chuliá, Laura Cano, Javier García-Rubio, Miguel Tortajada-Girbés, Mario Carballido-Fernández, Juan Mollar-Maseres, Germán Schwarz-Chavarri, Sandra García-Esteban, Joan Puig-Barberà, Javier Díez-Domingo, F. Xavier López-Labrador, for the Valencia Hospital Network for the Study of Influenza and Respiratory Viruses Disease.

Retrospective screening for SARS-CoV-2 among 5,800 hospitalizations related to influenza-like illness during the 2018-19 pre-pandemic and 2019-2020 pandemic influenza seasons in the VAHNSI network, Spain.

medRxiv - 24 May 2021

4.b. Communications & posters

The GIHSN participated in Options XI for the Control of Influenza, 26-29 September 2022, Belfast, UK, and presented:

Oral presentation:



Lily E Cohen (speaker), Chelsea Hansen, Melissa K Andrew, Shelly McNeil, Philippe Vanhems, Jan Kyncl, Javier Díez Domingo, Tao Zhang, Ghassan Dbaibo, Victor Alberto Laguna Torres, Anca Draganescu, Elsa Baumeister, Doris Gomez, Sonia M Raboni, Heloisa I Giamberardino, Marta Nunes, Elena Burtseva, Anna Sominina, Snežana Medić, Daouda Coulibaly, Afif Ben Salah, Nancy A Otieno, Parvaiz Koul, Serhat Unal, Mine Durusu Tanriover, Marie Mazur, Joseph Bresee, Cecile Viboud, Sandra S Chaves.

Increased severity of influenza-related hospitalizations in resource-limited settings: results from the Global Influenza Hospital Surveillance Network (GIHSN)

Ready2Respond, The Task Force for Global Health

Poster:

Sandra S. Chaves, Catherine Commaillie-Chapus, Laurence Torcel-Pagnon, Mendel Haag, Paula Barbosa, Vanessa Moeder, Erica Dueger, Gavin Cloherty, Melissa Andrew, John Paget, Justin R. Ortiz, John McCauley, Elena Burtseva, Marta Nunes, Joseph Bresee, Wenqing Zhang, Bruno Lina, Cedric Mahe

Ten-year anniversary of the Global Influenza Hospital Surveillance Network (GIHSN)

One poster was presented at the **20th European Congress of Internal Medicine, 9-11 June 2022, Malaga, Spain:**



Mine Durusu Tanriover, Mehmet Cakmak, Metin Ozsoy, Gül Arga, A. Tulay Bagci Bosi, A. Gorkem Er, Oguz Abdullah Uyaroglu, Lale Ozisik, F. Sebnem Erdinc, Halil Ozdemir, Ergin Ciftci, Can Holyavkin, Serhat Unal

Global Influenza Hospital Surveillance Network (GIHSN) 2020-21 season project in Turkey: Utilization of influenza surveillance for tackling SARS-CoV-2

Links to the oral presentation and posters are available on the GIHSN website¹⁸.

5. Research projects

5.a. Call for Research projects

A Call for research projects¹⁹ was launched in July 2021 by the Foundation for Influenza Epidemiology to foster research projects and analytical proposals on influenza and other respiratory viruses that leverage the GIHSN platform.

GIHSN sites or not-for-profit institutions are invited to submit a proposal that includes either novel analyses of existing GIHSN data, or the use of respiratory specimens (from selected participating sites) for pathogen discovery or other relevant studies, or the engagement of site-specific investigators (one or more sites) to collect more/new data to further improve our understanding of influenza and other respiratory viruses and related vaccines.

The three selected research proposals summarized below well illustrate the value of the GIHSN platform and interest to join public and private resources for collaborative research in respiratory viruses and related preventable infectious diseases.

- 1. Analysis of GIHSN data to provide evidence of influenza disease burden in Low and Middle Income Countries (LMIC) and support vaccine use.** This proposal was made by Ready2Respond, the Task Force for Global Health with grant from the Wellcome Trust. The Foundation provided only access to GIHSN aggregated data. An oral presentation was made by Lily Cohen (Ready2Respond, The Task Force for Global Health) at the Options X1 congress in September 2022 (see above).
- 2. Experience of older adults hospitalized with influenza and acute respiratory illness in relation to function in Activities of Daily Living: a report from the GIHSN.** This proposal was made by Melissa Andrew (Canadian Serious Outcomes Surveillance Network, Halifax, Canada). The Foundation authorized dataset access and provided a grant to support this research work. A scientific manuscript presenting the results will be submitted to a peer reviewed journal.
- 3. Develop a severity scale for influenza cases reported to GIHSN.** This project supported by John Paget (Nivel, Utrecht, the Netherlands) aims to develop a severity scale that is age-specific and based on the GIHSN patient questionnaire which would be used for surveillance purposes (e.g. uploaded to GISAID with the whole genome sequence data). The Foundation has authorized dataset access and provided a grant to support this research work. A scientific manuscript presenting the results will be submitted to a peer reviewed journal.

5.b. Possible collaboration to set up surveillance for enterovirus D68 leveraging the GIHSN platform

Abbott Diagnostics approached the GIHSN for a possible collaboration to set up surveillance for enterovirus D68 (EV-D68). GIHSN sites were contacted to understand current resources and willingness to participate. EV-D68 is member of the species Enterovirus D of the Picornaviridae family. This virus typically causes respiratory illness, which ranges from mild (like a common cold) to severe. Severe symptoms may include wheezing and difficulty breathing, mainly in children. It can also cause acute flaccid myelitis (AFM). This virus has caused epidemics documented in North America and some countries in Europe, but understanding of virus circulation, clinical

¹⁸ <https://www.gihsn.org/publications/oral-presentations-and-posters>

¹⁹ <https://www.gihsn.org/publications/call-for-research-projects>



presentation and risk factors for severity is limited at the global level, especially in low- and middle-income countries. The GIHSN provides a unique opportunity to investigate these viruses. Discussions on logistics and how to implement the surveillance leveraging the GIHSN platform is underway.

5.c. The Burden of Influenza and RSV Disease project (BIRD)

The Foundation supported the BIRD project (Burden of Influenza and RSV Disease). The overall objective of the BIRD project was to collect and synthesize various data sources to address the following research questions: What are the countries where data are of sufficient quality to evaluate the burden of influenza and RSV? In these countries, what is the national rate of hospitalization and mortality related to influenza or RSV for various population subgroups (based on age and comorbidity status)? What is the relation between influenza vaccine coverage and national rate of hospitalization and mortality related to influenza?

Framework of the project was organized with a consortium including IHME (Institute for Health Metrics and Evaluation), a US-based population health research centre, the Netherlands Institute for Health Services Research (NIVEL) and the Edinburgh University. Scientific oversight of the consortium was ensured by Dr Cécile Viboud (US - National Institutes of Health).

The project resulted in two main publications:



You Li, Emily K Johnson, Ting Shi, Harry Campbell, Sandra S Chaves, Catherine Commaille-Chapus, Izzie Dighero, Spencer L James, Cédric Mahé, Yujing Ooi, John Paget, Tayma van Pomerén, Cécile Viboud, Harish Nair

National burden estimates of hospitalisations for acute lower respiratory infections due to respiratory syncytial virus in young children in 2019 among 58 countries: a modelling study.

The Lancet Respiratory Medicine - Articles | Volume 9, ISSUE 2, P175-185, February 2021



John Paget, Lisa Staadegaard, Xin Wang, You Li, Tayma van Pomerén, Jojanneke van Summeren, Michel Dücker, Sandra S Chaves, Emily K Johnson, Cédric Mahé, Harish Nair, Cecile Viboud, Peter Spreeuwenberg

Global and national influenza-associated hospitalisation rates: Estimates for 40 countries and administrative regions.

Journal of Global Health, 2023



PART IV.

Financial report

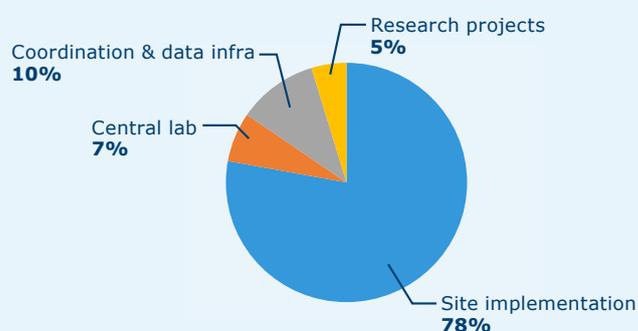
To date, the Foundation for Influenza Epidemiology (FIE) has invested more than 15 M€ to set up and scale up the GIHSN platform over the past 10 years. The FIE has an operating budget which is established from 1st November for a given year to 31 October of the following year. The budget is divided into three sections: unrestricted grants for sites implementation of the GIHSN year-round surveillance and data sharing, fees for Coordination of the GIHSN platform and grants for Research proposals. The yearly FIE budget is endorsed by the Executive Committee in October.

Each year the Foundation is investing part of its budget in new sites to continue building worldwide surveillance capacity and expand its network for a better representativeness. Geographical repartition of the sites translates also grants allocation by country income level (high, upper middle, lower middle). The FIE covers each year around 25% of the overall cost of the GIHSN platform which relies on existing national capacity and infrastructure (co-funding from sites or other sources).

FIE budget spent for 2021-22 (see **Figure 23**):

- 1,4 M€ was committed for sites implementation of the year-round surveillance from 1st November 2021 to 31 October 2022; meanwhile sites declared being supported by local public funding and other sources which represented an addition of 4,5 M€.
 - 17% of this budget was dedicated to pilot the implementation of the GIHSN surveillance in new sites
- 185 K€ was spent to ensure the coordination and data infrastructure of the GIHSN platform; 115k€ was used for centralized laboratory activities and sequencing
- 81 K€ was allocated to selected Research proposals.

● Figure 24: FIE funds repartition for 2021-22 ●



As of October 2022, the FIE has engaged a budget of 1,9M€ for the 2022-23 year-round surveillance of which 74% was allocated to data collection in sites.



PART V.

Perspectives

The GIHSN relies on existing national assets and is complementary to the Global Influenza Surveillance and Response System (GISRS)²⁰ which celebrated in 2022 its 70 years collaboration with 148 National Influenza Centers, seven WHO Collaborating Centers, four Essential Regulatory Laboratories, and 13 H5 Reference Laboratories. 12 GIHSN sites are integrated into their national influenza surveillance systems and most of them are themselves or are close to their National Influenza Centers which contribute in GISRS. What makes the GIHSN unique and complementary to GISRS is the linkage of clinical data on influenza severity with virology and virus sequencing.

Early February 2023, the GIHSN shared with WHO its first descriptive report presenting phylogenetic trees of circulating influenza strains from hospitalized patients captured by the GIHSN surveillance platform. It is expected that those sequencing results from 226 influenza cases collected in 11 countries from 1st September 2022 to 1st February 2023 will add disease severity perspective to the large dataset of influenza surveillance data generated by GISRS and will support the WHO advisory group of experts to issue recommendations on the composition of the influenza vaccines for the following season.

The GIHSN governance under the Foundation for Influenza Epidemiology illustrates the feasibility and relevance of a public-private multi-stakeholder approach to support worldwide respiratory viruses' surveillance and genetic sequencing, key components to the pandemic preparedness ecosystem. The GIHSN has been referenced in the "Existing Data and technology-focused Initiatives" listing of the 2022 Milken Institute "A Global Early Warning System for Pandemics: A Blueprint for Coordination"²¹.

While the Foundation for Influenza Epidemiology is seeking for more donors and long term engagements, its ambition for 2023 and subsequent years is to strengthen the geographical representativeness of the GIHSN network in the WHO influenza transmission zones and to pursue local sequencing capacity development in close connection with recently scaled up capacities post COVID. An action plan has been established by the Foundation with the support of its Independent Scientific Committee to move from an opportunistic to a targeted approach for sites selection and identify as well synergies with other initiatives and stakeholders (e.g. International Vaccine Institute IVI, Institut Pasteur International Network, Abbott Pandemic Defense Coalition sites, Global Virus Network).

The GIHSN is also putting efforts to establish relevant infrastructure and close collaboration with sites to facilitate data sharing practices for ultimately real-time evidence.

Last but not least, the FIE has initiated a proposal for engagement with the World Health Organization (WHO) under its non-state actor framework. The objectives and goals for the proposed engagement are in line with the WHO's vision and mission statements presented in the Global Influenza Strategy 2019-2030 document²², to "build and sustain resilient national, regional and global capacities required to keep the world safe from epidemics and other health emergencies".

GIHSN in a nutshell

The GIHSN offers a capable surveillance platform supported by an effective public-private partnership.

- Empowered and motivated sites combining existing surveillances with capacity building.
- Expanded surveillance for severe respiratory disease with global representation, able to account for circulation of influenza viruses, SARS-COV-2, RSV and other common respiratory viruses.
- Capacity for virus genome sequencing, with linkage to clinical data.
- Research can leverage on the network of scientists and academics and the robust dataset.
- New partners always welcomed by the network members and the Foundation for Influenza Epidemiology.
- Participation of key stakeholders and research networks (WHO, Ready2Response, the Task Force for Global Health, IVI, APDC).

²⁰ <https://www.who.int/initiatives/global-influenza-surveillance-and-response-system>

²¹ [A Global Early Warning System for Pandemics: A Blueprint for Coordination \(milkeninstitute.org\)](https://www.milkeninstitute.org/publications/a-global-early-warning-system-for-pandemics-a-blueprint-for-coordination)

²² <https://apps.who.int/iris/bitstream/handle/10665/311184/9789241515320-eng.pdf?sequence=18&isAllowed=y>

Acknowledgements

Investigating sites:

- **Brazil:** Hospital Pequeno Principe, Curitiba (Sonia Mara Raboni, MD, PhD; Heloisa Isle Giamberardino, MD, PhD)
- **Canada:** The CIRN Serious Outcomes Surveillance (SOS) Network, Halifax (Shelly A. McNeil, MD and Melissa K Andrew)
- **China:** School of Public Health, Fudan University, Shanghai (Tao Zhang, PhD)
- **Côte d'Ivoire:** Institut National d'Hygiène Publique (INHP), Abidjan (Daouda Coulibaly, MD)
- **France:** Inserm, Paris (Odile Launay; Liem Binh Luong; Louise Lefrançois)
- **India:** Sher-i-Kashmir Institute, Srinagar (Parvaiz A Koul, MD)
- **Kenya:** Kenya Medical Research Institute (KEMRI), Nairobi (Nancy A. Otieno, PhD)
- **Lebanon:** American University of Beirut, Beirut, (Dr Ghassan Dbaibo, MD)
- **Nepal:** Patan Academy of Health Sciences (Kedar Baral)
- **Peru:** Instituto de Medicina Tropical Universidad Nacional Mayor de San Marcos, Lima (Victor Alberto Laguna-Torres, MD)
- **Romania:** National Institute for Infectious Diseases "Prof. Dr. Matei Bals", Bucharest (Anca Cristina Draganescu, MD, PhD; Oana Sandulescu)
- **Russian Federation:** Federal Research Budgetary Institute "National Research Center of Epidemiology and Microbiology named after honorary academician N.F. Gamaleya, Moscow (Elena Burtseva, MD, PhD)
- **Russian Federation:** Smorodintsev Research Institute of Influenza, St Petersburg (Anna Sominina, MD, PhD; Daria Danilenko)
- **Senegal:** Institut Pasteur of Dakar (IPD), Dakar (Ndongo Dia, MD)
- **South Africa:** Vaccines and Infectious Diseases Analytics Research Unit, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg (Marta Nunes, PhD)
- **Spain:** Fisabio-Public Health, Valencia (Javier Diez-Domingo, MD, PhD; Ainara Mira Iglesias)
- **Türkiye:** Turkish Society of Internal Medicine, Ankara (Serhat Unal, MD; Mine Durusu Tanriover)
- **Ukraine:** L.V.Gromashevsky Institute of Epidemiology & Infectious Diseases NAMS of Ukraine (Alla Mironenko; Nataliia Teteriuk)
- **USA:** Icahn School of Medicine at Mount Sinai, NYC (Viviana Simon, MD)

Members of the Independent Scientific Committee (previously listed), **Members of the Executive Committee** (previously listed), **Fondation de France, Foundation for Influenza Epidemiology**

National Influenza Center, Lyon, France: Bruno Lina; Antonin Bal; Nathalie Bergaud; Gwendolyne Burfin; Gregory Queromes; Hadrien Regue; Quentin Semanas.

Impact Healthcare: Catherine Commaille-Chapus; Camille Hunsinger; Jean-Yves Robin.



Annexes

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Annex 1: List of sites which contributed data in the GIHSN over the seasons (2012-2013 to 2021-2022)

Site	Institution	12_13	13_14	14_15	15_16	16_17	17_18	18_19	19_20	20_21	21_22
Africa											
Kenya	Kenya Medical Research Institute (KEMRI), Nairobi						*	*	*	*	*
Côte d'Ivoire	Institut National d'Hygiène Publique (INHP), Abidjan						*	*	*	*	*
Senegal	Institut Pasteur of Dakar (IPD), Dakar										*
South Africa	University of the Witwatersrand, Johannesburg					*	*	*		*	*
Tunisia	Institut Pasteur de Tunis, Tunis						*				
Asia/Pacific											
China	School of Public Health, Fudan University, Shanghai					*	*	*	*	*	*
India	Sher-i-Kashmir Institute, Srinagar				*	*	*	*	*	*	*
Nepal	Patan Academy of Health Sciences								*	*	*
China	School of Public Health University of Hong Kong, China		*	*	*						
Kazakhstan	Scientific Practical Center of Sanitary and Epidemiological Expertise and Monitoring" filial branch of the National Centre of Public Health, Ministry of Health Republic of Kazakhstan, Almaty					*					
Middle East											
Türkiye	Turkish Society of Internal Medicine, Ankara	*	*	*	*	*			*	*	*
Lebanon	American University of Beirut, Beirut							*	*	*	*
Eurasia											
Russia - St Petersburg	Smorodintsev Research Institute of Influenza, St Petersburg, Russia	*	*	*	*	*	*	*	*	*	*
Russia - Moscow	FSBI "N.F. Gamaleya NRCEM" Ministry of Health, Moscow	*	*	*	*	*	*	*	*	*	*
Ukraine	L.V.Gromashevsky Institute of Epidemiology & Infectious Diseases, Kyiv								*	*	*
Spain	FISABIO, Valencia	*	*	*	*	*	*	*	*	*	*
Romania	National Institute for Infectious Diseases "Prof. Dr. Matei Bals", Bucharest					*	*	*	*	*	*
France	INSERM, Paris								*	*	*
France	Hôpital Edouard Herriot, Lyon						*	*	*		
Serbia	Institute of Public Health of Vojvodina, Novi Sad Faculty of Medicine, University of Novi Sad, Serbia						*	*	*		
Poland	Medical University of Warsaw, Warsaw						*				
Czech Republic	National Institute of Public Health, Prague			*	*	*	*				
North America											
Canada	The CIRN Serious Outcomes Surveillance (SOS) Network, Halifax						*	*	*	*	*
USA	Icahn School of Medicine at Mount Sinai, NYC										*
Mexico	Instituto Nacional de Ciencias Medicas y Nutricion Salvador Zubiran, Mexico City				*	*	*	*	*	*	
South America											
Brazil	Hospital Pequeno Principe, Curitiba							*	*	*	*
Peru	Instituto de Medicina Tropical, Lima					*	*	*	*	*	*
Argentina	National Reference Laboratory for Viral Respiratory Diseases, Virology Department, INEI-ANLIS, Buenos Aires						*	*			
Columbia	UNIMOL Laboratory, University of Cartagena, Cartagena							*			

Annex 2: Sites which contributed data in the GIHSN in the 2021-2022 season

Country	Site/Institution	#Hospitals	Population	Integrated into national influenza surveillance system	Sequencing infrastructure
Africa					
Kenya	Kenya Medical Research Institute (KEMRI), Nairobi	7	All Ages	Yes	NIC Lyon and locally
Côte d'Ivoire	Institut National d'Hygiène Publique (INHP), Abidjan	7	All Ages	Yes	NIC Lyon
Senegal	Institut Pasteur of Dakar (IPD), Dakar	3	All Ages	Yes	Locally
South Africa	University of the Witwatersrand, Johannesburg	1	All Ages	No*	Locally
Asia/Pacific					
China	School of Public Health, Fudan University, Shanghai	1	Peds	Yes	Locally
India	Sher-i-Kashmir Institute, Srinagar	1	All Ages	No	Locally
Nepal	Patan Academy of Health Sciences	2	All Ages	Yes	Locally
Middle East					
Türkiye	Turkish Society of Internal Medicine, Ankara	3	All Ages	No	Locally
Lebanon	American University of Beirut, Beirut	6	All Ages	Yes	NIC Lyon
Eurasia					
Russia - St Petersburg	Smorodintsev Research Institute of Influenza, St Petersburg, Russia	9	All Ages	Yes	Locally
Russia - Moscow	FSBI "N.F. Gamaleya NRCM" Ministry of Health, Moscow	2	All Ages	Yes	Locally
Ukraine	L.V.Gromashevsky Institute of Epidemiology & Infectious Diseases, Kyiv	5	All Ages	Yes	NIC Lyon
Spain	FISABIO, Valencia	4	All Ages	No	Locally
Romania	National Institute for Infectious Diseases "Prof. Dr. Matei Bals", Bucharest	1	All Ages	No	Locally
France	INSERM, Paris	5	All Ages	No**	NIC Lyon
North America					
Canada	The CIRN Serious Outcomes Surveillance (SOS) Network, Halifax	11	Adults / Ederly	Yes	Locally
USA	Icahn School of Medicine at Mount Sinai, NYC	8	All Ages	No***	Locally
South America					
Brazil	Hospital Pequeno Principe, Curitiba	1	Peds	Yes	NIC Lyon
Peru	Instituto de Medicina Tropical, Lima	4	All Ages	Yes	NIC Lyon
Total		81			

* Study specific surveillance for other respiratory funded by the BMGF pathogens

** The study is not nested into the national influenza surveillance system but the data are shared with the influenza surveillance institute "Santé Publique France" and published with their data

*** Part of the Centers of Excellence for Influenza Research and Response (CEIRR)

Annex 3: Distribution of patients by site: number of enrolled patients and viruses tested and detected (2021-2022)

Country	Site/Institution	#Enrolled*	#Influenza +	#Tested SARS-CoV-2	#SARS-CoV-2 +	#Tested RSV	#RSV +	#Tested ORV**	#ORV +	#WGS Total	#WGS Influenza	#WGS SARS-CoV-2
Africa												
Kenya	Kenya Medical Research Institute (KEMRI), Nairobi	1951	187	1914	145	0		0				
Côte d'Ivoire	Institut National d'Hygiène Publique (INHP), Abidjan	1332	30	1297	42	1109	13	1124	17	4	2	2
Senegal	Institut Pasteur of Dakar (IPD), Dakar	676	34	676	62	675	10.4	676	235	66	23	43
South Africa	University of the Witwatersrand, Johannesburg	1322	100	1321	116	1322	476	1322	50	86	86	0
Asia/Pacific												
China	School of Public Health, Fudan University, Shanghai	1310	73	0		1310	330	1310	541	0	0	0
India	Sher-i-Kashmir Institute, Srinagar	321	3	0		2	0	0		0	0	0
Nepal	Patan Academy of Health Sciences	155	0	121	4	0		0		0	0	0
Middle East												
Türkiye	Turkish Society of Internal Medicine, Ankara	246	7	212	33	212	6	212	15	37	7	30
Lebanon	American University of Beirut, Beirut	2237	50	1310	330	2099	70	22	22	53	7	48
Eurasia												
Russia - St Petersburg	Smorodintsev Research Institute of Influenza, St Petersburg, Russia	3820	261	3816	796	3820	301	3820	702	226	105	121
Russia - Moscow	FSBI "N.F. Gamaleya NRCEM" Ministry of Health, Moscow	1456	218	1456	489	1118	92	1134	324	63	28	35
Ukraine	L.V.Gromashevsky Institute of Epidemiology & Infectious Diseases, Kyiv	198	35	172	107	6	1	6	1	79	29	50
Spain	FISABIO, Valencia	1811	100	1809	599	1809	88	1809	251	486	58	432
Romania	National Institute for Infectious Diseases "Prof. Dr. Matei Bals", Bucharest	346	88	340	146	333	12	172	64	64	64	0
France	INSERM, Paris	841	66	841	413	265	5	261	39	5	0	5
North America												
Canada	The CIRN Serious Outcomes Surveillance (SOS) Network, Halifax	4498	52	4490	4316	4498	0	4498	71	54	0	54
USA	Icahn School of Medicine at Mount Sinai, NYC	245	234	63	30	14	1	17	2	20	20	0
South America												
Brazil	Hospital Pequeno Principe, Curitiba	521	58	510	36	520	90	520	18.4	15	15	0
Peru	Instituto de Medicina Tropical, Lima	412	16	412	52	412	36	412	29	23	2	21
Total		23698	1612	20760	7716	19524	1625	17315	2547	1281	446	841

* All tested for influenza

** ORV: Other Respiratory Viruses. Tests vary by sites and can include any of the followings : Adenovirus, Bocavirus, Human Coronavirus, Metapneumovirus, Parainfluenzavirus, Rhinovirus, or other respiratory viruses not predefined

Annex 4: List of comorbidities

The list of comorbidities captured is provided below:

- Cardiovascular disease
- Chronic lung disease (such as chronic obstructive pulmonary disease [COPD] and cystic fibrosis)
- Asthma
- Diabetes
- Immunodeficiency (except human immunodeficiency virus) / organ transplant
- Renal impairment
- Rheumatologic disease / autoimmune disease
- Neurological or neuromuscular disease
- Cirrhosis / liver disease
- Neoplasm (active)
- Obesity
- Active tuberculosis
- Malnutrition (only for children < 5 years)
- HIV infection
- HIV exposure (if children < 5 years)
- Hemoglobinopathies
- Born premature, ie. <37-week gestation (only for children < 5 years)

Annex 5: Number of influenza positive samples sequenced and uploaded on GISAID - By site (2021-2022)

Sites	Number
Sequenced locally (WGS)	
Romania	64
Russia - Moscow	28
Russia - St Petersburg	105
Senegal	23
South Africa	86
Spain	58
Turkey	7
United States	20
Total of sequences done locally	391
Sequenced at the GIHSN sequencing platform in Lyon (WGS)	
Brazil	15
Côte d'Ivoire	2
Lebanon	7
Peru	2
Ukraine	29
Total of sequences done by NIC Lyon	55
Total of sequences uploaded on GISAID for the GIHSN	446

Annex 6: The Foundation for Influenza Epidemiology – Members and dedicated resources (as of September 2022)

FTEs* are allocated to the Foundation by Sanofi (in-kind contribution)

- **Cédric Mahé**, President (0.1 FTE)
- **Sandra Chaves**, Scientific Executive officer (0.25 FTE)
- **Laurence Torcel-Pagnon**, Executive officer (0.25 FTE)
- **Myriam Beigeaud**, Administrative officer (0.1 FTE)

Fondation de France

- **Charlotte Von Thienen Bardinnet**, Responsable Programmes et Fondations abritées Santé et recherche médicale

*FTE = Full-Time Equivalent



Global Influenza
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GIHSN Annual Report

SEASON 2021-22

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