THE RESPIRATORY SURVEILLANCE SYSTEM IN MADAGASCAR

Norosoa RAZANAJATOVO, PhD, NIC Technical Leader

Madagascar Factsheet

- Geographical location:
  - Island located in the Indian Ocean off the Eastern coast of Southern Africa
  - Separated from the African continent by the Mozambique Channel
- Estimated population: 30.3 millions (in 2023)
- 23 Regions, 114 Districts
- Capital: Antananarivo
- 5 bioclimates: per humid, humid, mountain, sub humid, semi arid
- Currency: Ariary
- Language: Malagasy ☺, French ☺, English 😐

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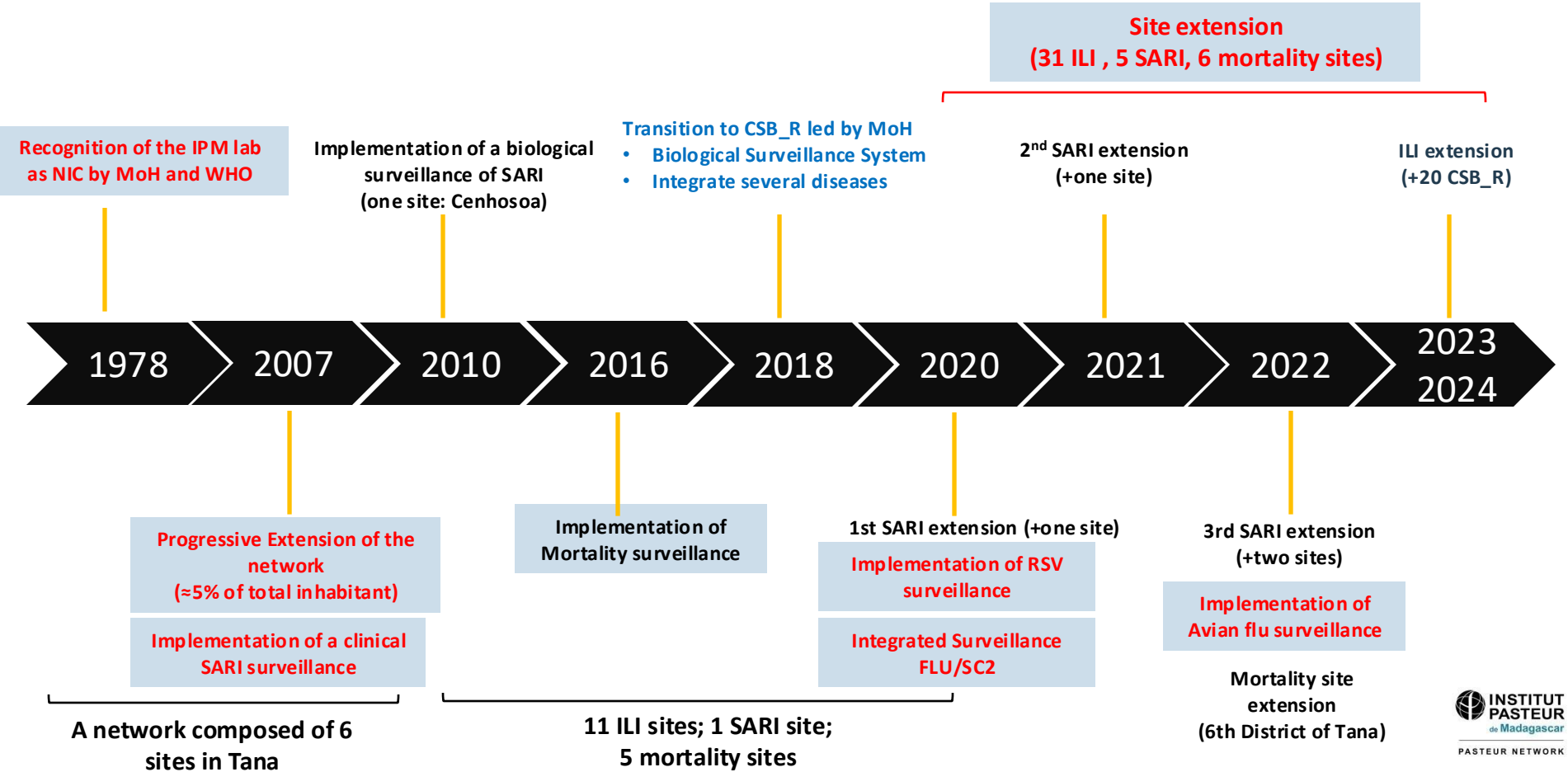
History of the Respiratory Surveillance in Madagascar



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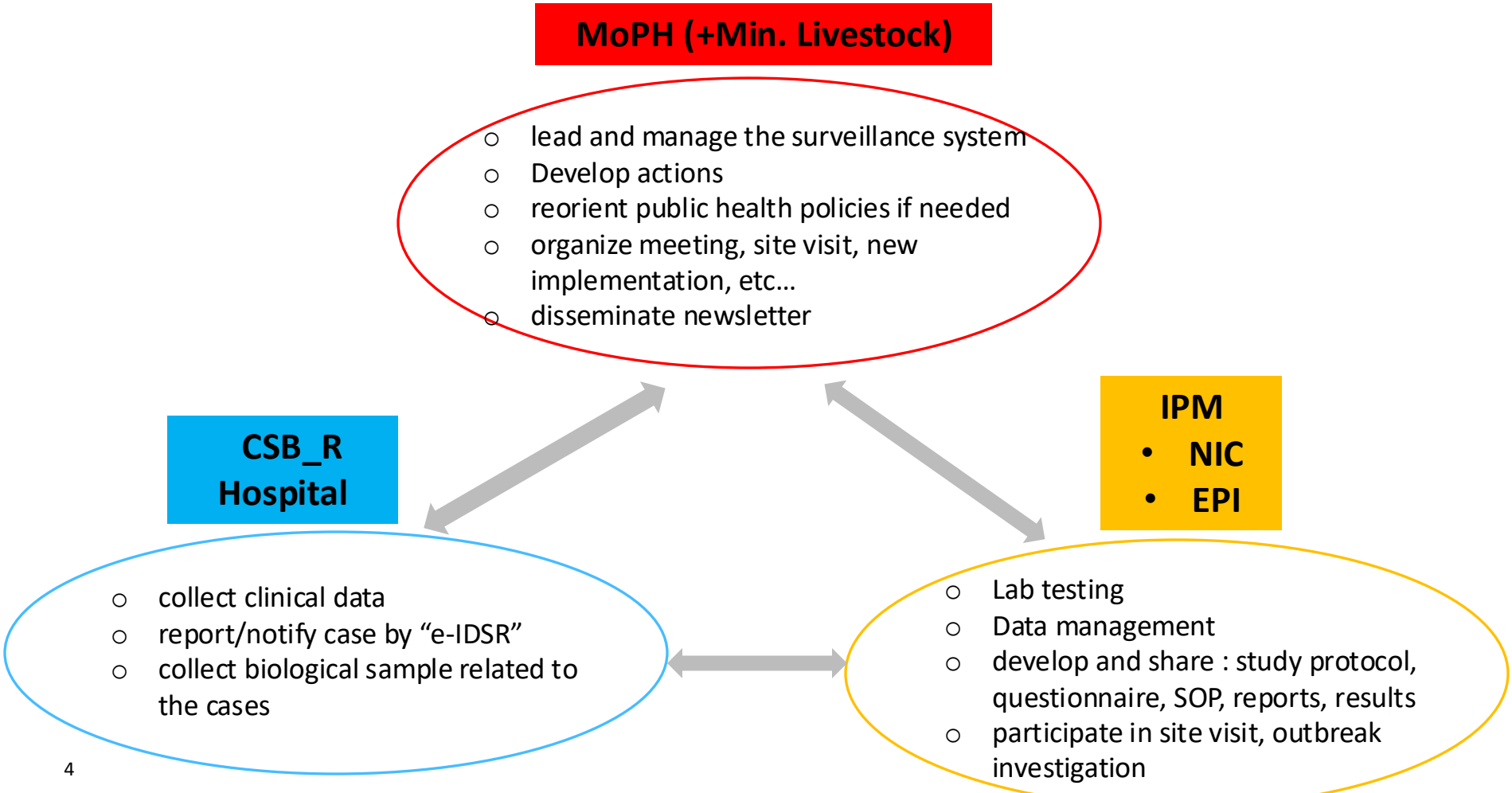
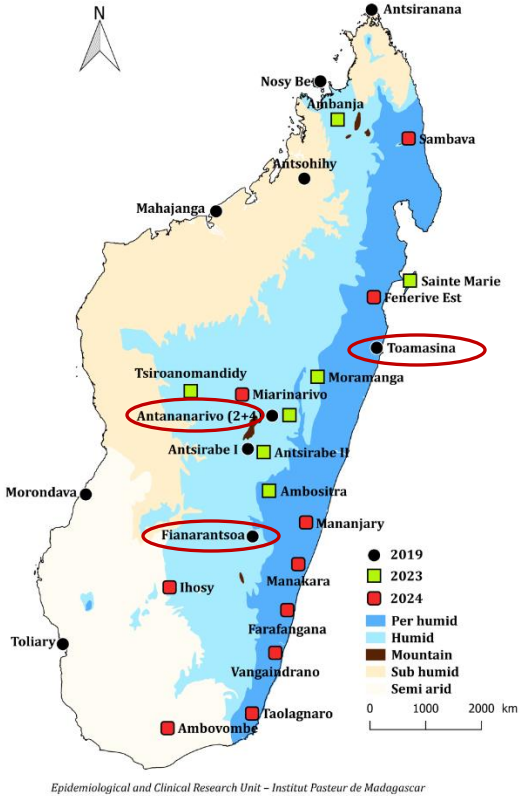
Biological Sentinel Surveillance System

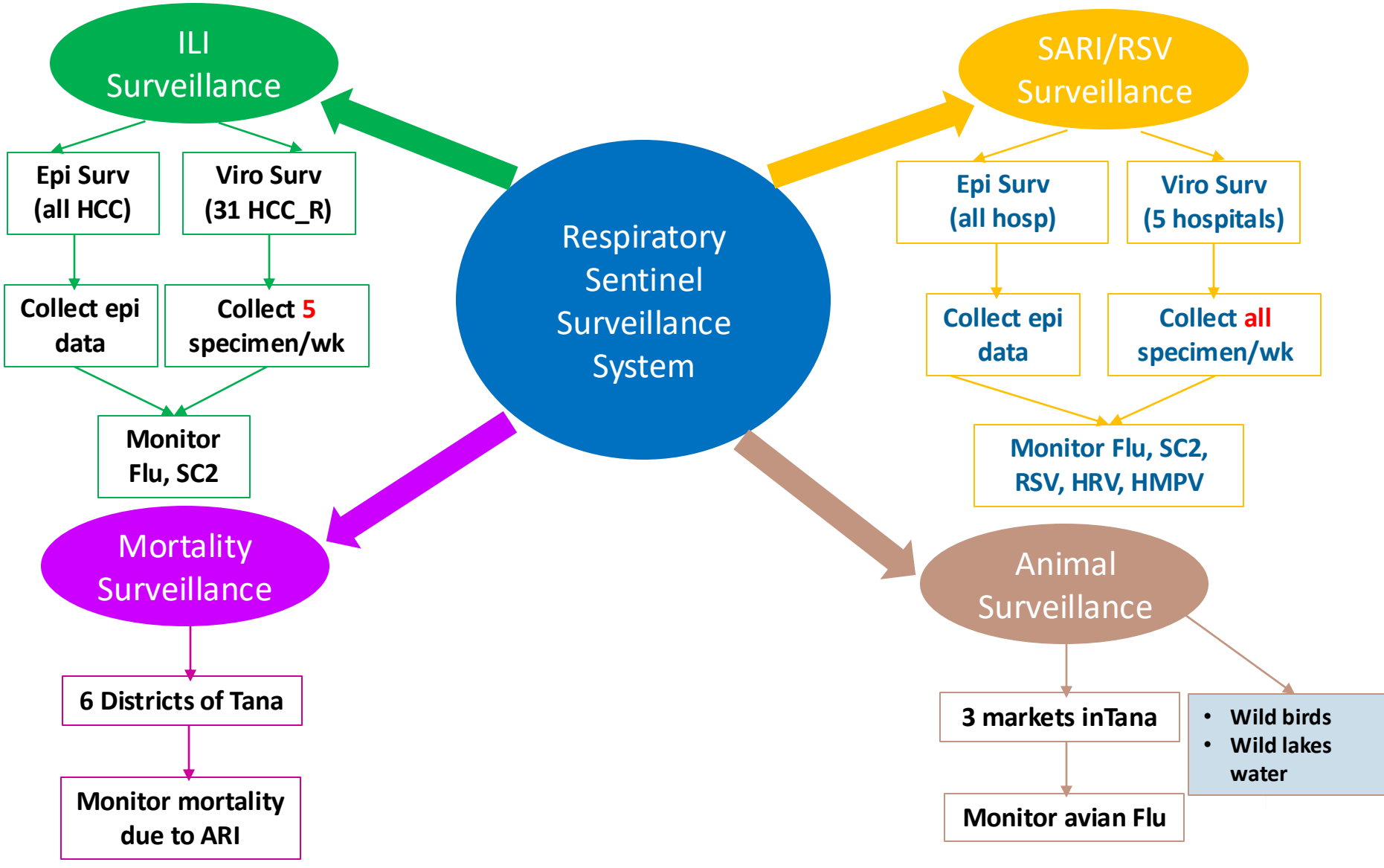


Biological Sentinel Surveillance System



Respiratory surveillance:
✓ 31 ILI sites
✓ 5 SARI sites

Geographical location of the Biological Sentinel Surveillance sites, Madagascar, 2025


Respiratory Sentinel Surveillance System
ILI Surveillance
Epi Surv (all HCC)
Viro Surv (31 HCC_R)
Collect epi data
Collect 5 specimen/wk
Monitor Flu, SC2
SARI/RSV Surveillance
Epi Surv (all hosp)
Viro Surv (5 hospitals)
Collect epi data
Collect all specimen/wk
Monitor Flu, SC2, RSV, HRV, HMPV
Mortality Surveillance
6 Districts of Tana
Monitor mortality due to ARI
Animal Surveillance
3 markets inTana
Monitor avian Flu
Wild birds
Wild lakes water

NIC lab staff in 2025, 15 people

1 NIC Director (coming soon)

1 NIC Deputy head/Technical Leader

2 Coordinators (1 medical doctor, 1 veterinarian)

1 Surveillance Officer (medical doctor)

2 Surveillance assistants

2 Engineers

5 Laboratory technicians

1 Sampler agent

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Other staff involved in NIC activities, 6 people

1 Project managers

2 Administrative assistant

1 Data manager

2 Lab agents

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Epi unit staff in 2025, 5 people

1 Biological Sentinel Surveillance Coordinator (Public health specialist)

1 Clinical Study Technician (Medical doctors)

2 Data managers

1 Clinical Research Manager

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Laboratory surveillance

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Algorythm of sample collection and testing

CLINICAL DIAGNOSTIC

ILI: fever + cough + onset of disease <10 days + no hospitalization

SARI: fever + cough + onset of disease <10 days + need hospitalization

QUESTIONNAIRE SAMPLING

LABORATORY TESTING

PCR influenza (A/H1dpm; A/H3; B/Vic; B/Yam

PCR influenza (A/H1dpm; A/H3; B/Vic; B/Yam

PCR RSV, Rhinovirus, HMPV

PCR avian flu, MERS CoV (depending on Epi context)

PCR SARS-CoV-2

Human laboratory Surveillance

ILI SAMPLES

FLU
SARS-CoV-2

SARI SAMPLES

FLU
SARS-CoV-2
RSV
HRV
HMPV

- ✓ If outbreak or unusual situation ➔ PCR for 14 seasonal respiratory viruses
- ✓ If suspicion of zoonosis ➔ Avian flu, MERS-CoV

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NIC Lab capacity

- **Cell Culture :** isolation of A/H1, A/H3, B in MDCK cell lines, RSV in Hep-2, HRV in MRC5, ADV in RD and Hep-2
- **Serology:**
  - detection of viral Ag by HAI
  - detection of Ab by microneutralisation

- **NSB3 Lab:** cell isolation of avian Flu, SARS-CoV-2

- **NGS sequencing**: SARS-CoV-2, RSV, FLU

- **Molecular detection**
  - A/H1, A/H3, B/Vic, B/Yam
  - SARS-CoV-2
  - 14 seasonal respiratory viruses
  - zoonotic viruses: avian Flu, MERS-CoV

Diagnostic kits

Virus	Kits
Influenza detection	CDC Multiplex Flu/SC2 kits from IRR
Influenza subtyping	CDC kits from IRR
SARS-CoV-2	CDC Multiplex Flu/SC2 kits from IRR
RSV typing/subtyping	CDC kits from IRR
Avian flu	CDC kits form IRR Publication
Multiplex seasonal respiratory viruses	Developed from publications

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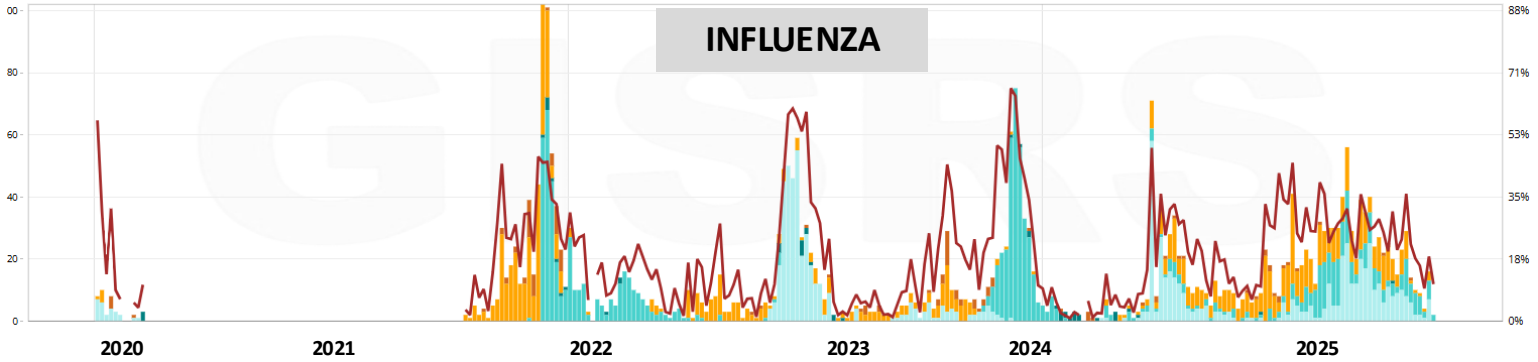

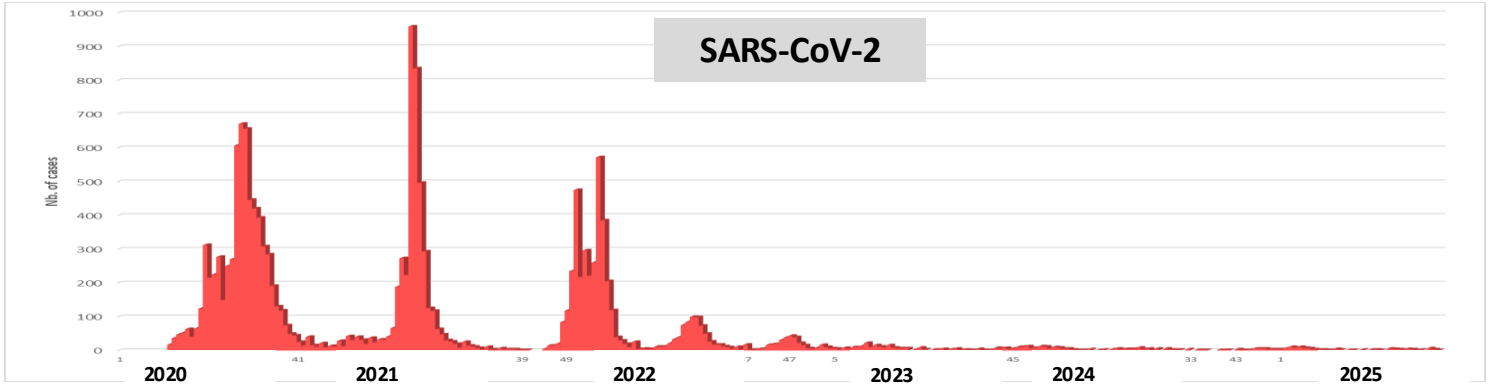

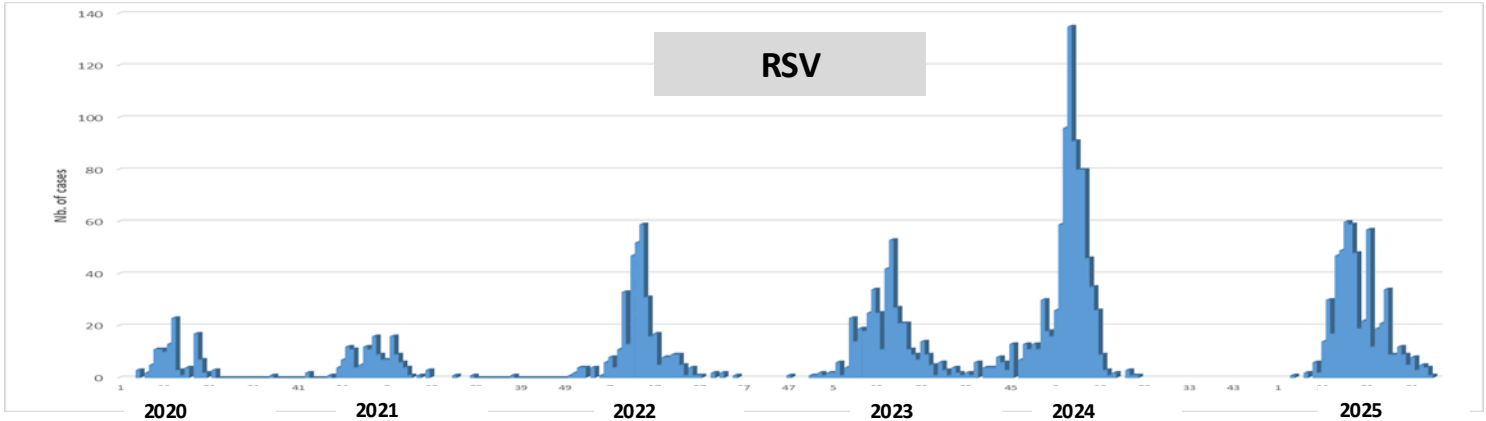

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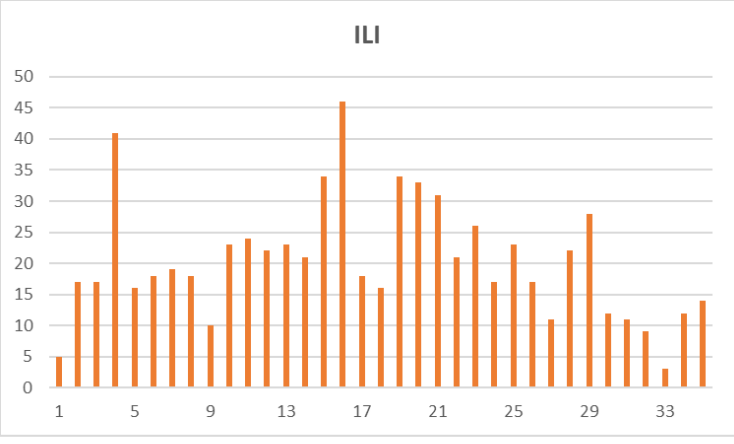
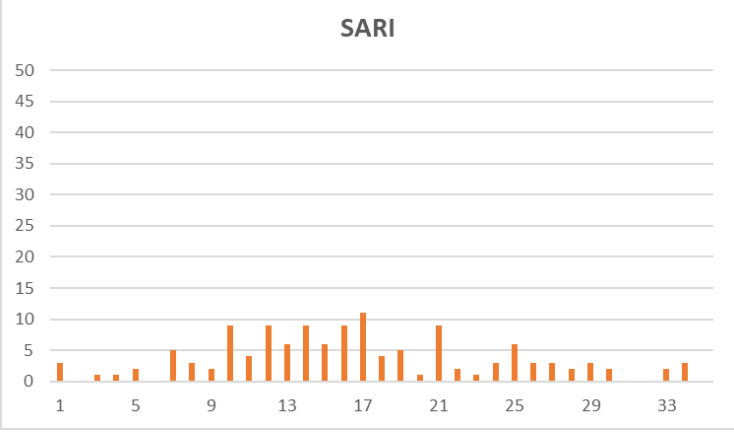
INFLUENZA, 2025





	Tested	Pos	% Pos
ILI	1903	712	37%
SARI	1211	129	11%
Total	3114	841	27%

Subtype	Clade 1	Clade 2
A/H1N1/pdm09	6B.1A.5a.2a	6B.1A.5a.2a.1
A/H3N2	3C.2a1b.2a.2a.3a.1	
B/Vic	V1A.3a.2	

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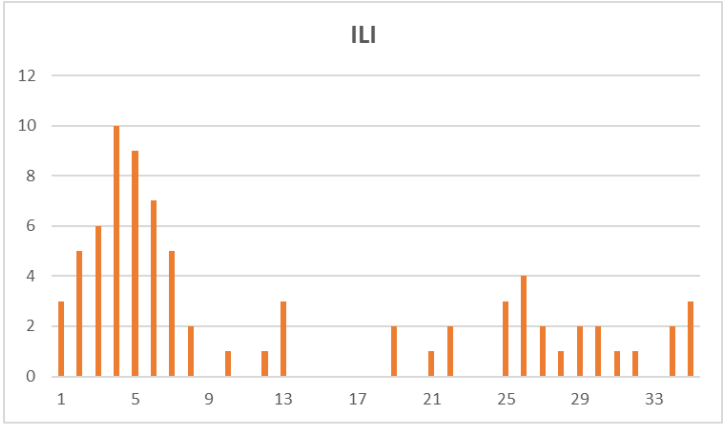
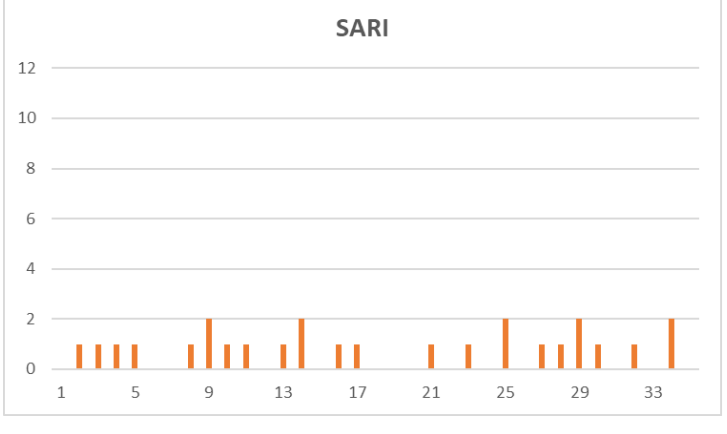
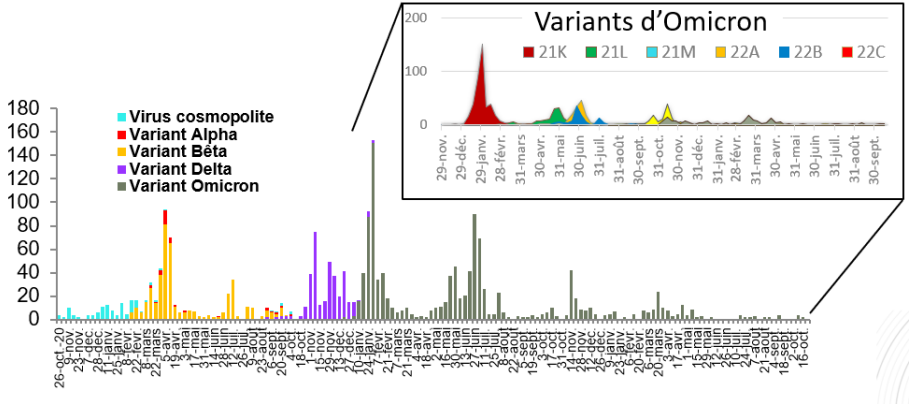
SARS-CoV-2, 2025



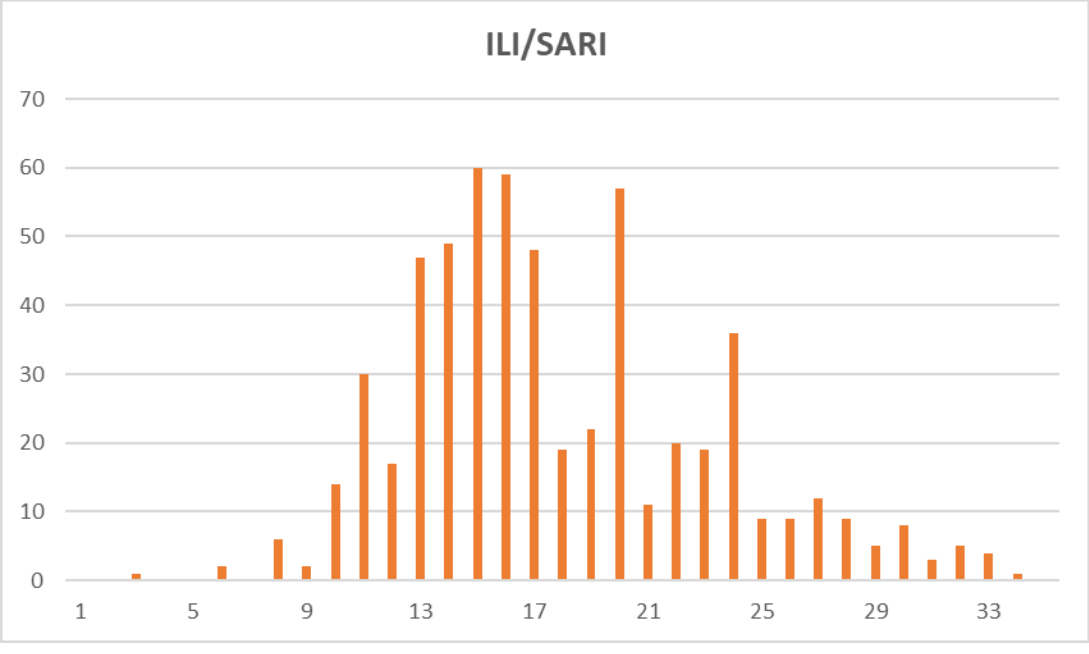


	Tested	Pos	% Pos
ILI	1903	78	4%
SARI	1009	26	3%
Total	2913	104	4%



Répartition hebdomadaire des différents virus du SARS-CoV-2 détectés à Madagascar

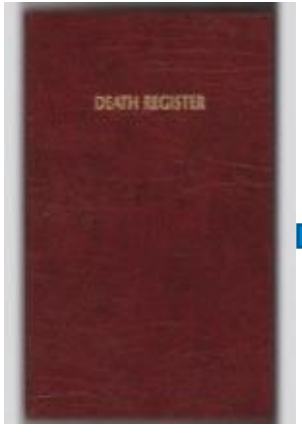
RSV, 2025

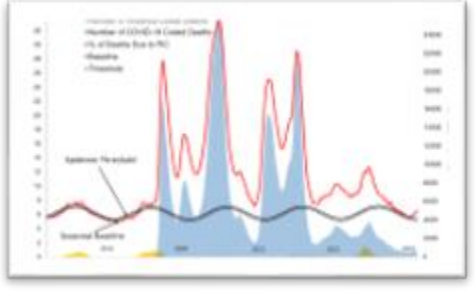


	Tested	Pos	% Pos
ILI	716	91	13%
SARI	1009	493	49%
Total	1927	584	30%

Subtype	Lineage
RSV A	AD1
RSV B	BD

Mortality surveillance





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Mortality surveillance

- Since 2016
- 6 Districts of Antananarivo
- Collect of mortality data via tablets
- Codification of deaths according to CIM-10
- 2 staffs of IPM, 13 staffs of BMH and urban commune of Antananarivo

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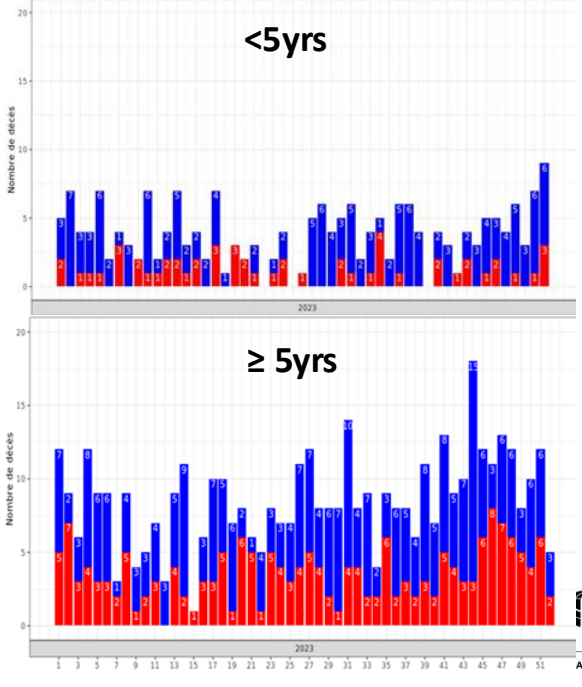
Achievements, 2023-2025

Leading causes of death from 01 January 2023 to 30 March 2025, Antananarivo

Cause of death	< 5 yrs	5-24 yrs	25-44 yrs	45-64 yrs	>65 yrs	Total
Stroke	26	23	486	1500	1288	**3323**
Heart Failure	34	91	309	598	875	1907
ARI (J00-J22)	**436**	116	189	318	384	**1443**
All causes	3522	1730	4931	8166	7793	**26142**

- In all ages, ARI ➔ 3rd cause of deaths (6% of all deaths)
- In children < 5 years, ARI ➔ 1st cause of deaths (13% of all deaths)

Monitoring of ARI mortality pattern via web application of urban commune of Antananarivo



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Animal surveillance

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Animal surveillance

- Since August 2021
- In collaboration with the Ministry of Livestock and Agriculture
- 3 live-bird markets in Antananarivo
- Sample collection on a weekly basis
- Collect of throat and fecal swabs
- PCR screening of influenza A
- Three targeted avian influenza A subtypes: A/H5; A/H7 and A/H9
- Sequencing of positive/non subtypable by NGS Illumina

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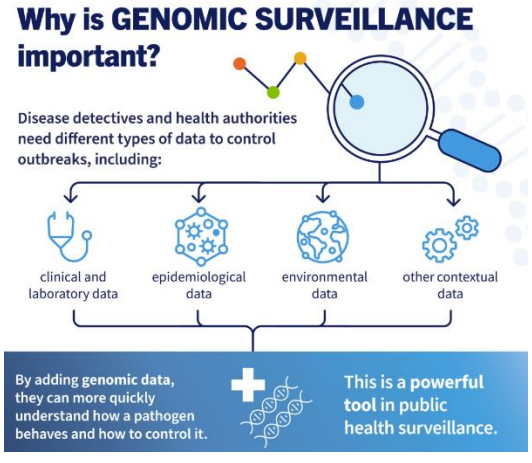
Genomic surveillance

Flu, RSV, SARS-CoV-2



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Sequencing and Bioinformatics capacities

- Three trained people
- Two technologies:
  - Nanopore: MinION (May 2021)
  - Illumina: ISeq 100 (March 2020)
    MiniSeq (October 2023)
- Targeted sequencing/Metagenomic sequencing
- Use of LIMS
- Data storage: local server
- Tools for analysis: pipeline
  - Influenza: MIRA
  - RSV: CZID
  - SARS-CoV-2: Institut Pasteur Paris

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SARS-CoV-2 sequencing

- July 2020: first SARS-CoV-2 sequences generated locally
- Samples from SARI and ILI (selection depending on situation)
- Cut off: ct=28
- From July 2020-Aug 2025: 2 267 sequences generated at IPM (samples from IPM and LA2M)
- Periodic sharing of sequences on GISAID (961 sequences uploaded)

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RSV sequencing

- Implemented in 2022 with Illumina (Iseq100)
- Before 2025, sequencing under specific project
- 2025: routine sequencing under surveillance activities planned
- Samples from SARI (and ILI if required)
- Cut off: ct<28
- 184 sequences generated
- Periodic sharing of sequences on GISAID (64 sequences uploaded on GISAID)

The iSeq 100 system

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Influenza sequencing

- Developed in April 2024 with MinION
- Performed routinely
- Samples from human (ILI and SARI) and avian
- Cut off: ct<28
- 1769 sequences generated in country
- Periodic sharing of sequences on GISAID (All sequences uploaded)
- The NIC continue sending shipment to WHO CC (CDC Atlanta and the Francis Crick Institute London)

Reporting and Sharing

Sharing and reporting (National)

Individual report (for Sentinel sites)

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UNITE DE VIROLOGIE
CENTRE NATIONAL DE REFERENCE OMS POUR LA GRIPPE

RESULTAT DU DIAGNOSTIC VIROLOGIQUE DES INFECTIONS RESPIRATOIRES
ANNEE 2023

Centre sentinelle : CSB-R Tanambao Toamasina **Code : TOA**

Médecin responsable : Dr BABA Clovis **District : TOAMASINA**

NumViro	Nom	PRENOM	Date de naissance	Sexe	date de prélèvement	DATE_RECEPTION	Résultats Grippe
00443-23	ANDRIANIRINA	Elenita	18/06/2012	F	15/02/2023	17/02/2023	Négatif
00381-23	FRANCISE	Wardie	29/11/2021	F	07/02/2023	10/02/2023	Négatif
00301-23	RANARIJAN	Wardy Djaidy	02/10/2018	M	01/02/2023	03/02/2023	Négatif
00442-23	RAFANOMEZANTSOA	Ali Hasinah Jamel	16/04/2019	F	13/02/2023	17/02/2023	Négatif
00300-23	NIRIANA	Nathalie	11/05/2002	F	01/02/2023	03/02/2023	Négatif

Antananarivo le 28 Février 2023

Weekly report (for MoH)

- Syndrome grippal
  - 29 échantillons naso-pharyngés en provenance de 7/11 CSB_R étaient reçus et analysés
  - S43 : 3,45 % (1/29) étaient positifs à SARS-CoV2
    - ➔ La recherche de FLUA et FLU B est en cours

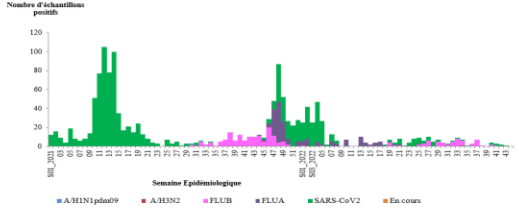
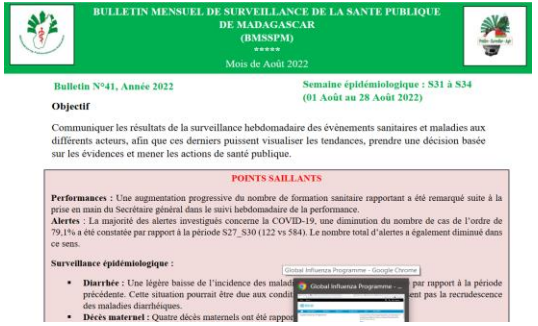


Figure 2 : Cas confirmés de grippe et COVID-19, CSB_R, Madagascar, S01/2021 à S43/2022, n=1861
Source: CNRG IPM

IDSR Monthly report (for MoH and local partners)



BULLETIN MENSUEL DE SURVEILLANCE DE LA SANTE PUBLIQUE
DE MADAGASCAR
(BMSSPM)
*****
Mois de Août 2022

Bulletin N°41, Année 2022 **Semaine épidémiologique : S31 à S34 (01 Août au 28 Août 2022)**

Objectif

Communiquer les résultats de la surveillance hebdomadaire des événements sanitaires et maladies aux différents acteurs, afin que ces derniers puissent visualiser les tendances, prendre une décision basée sur les évidences et mener les actions de santé publique.

POINTS SAILLANTS

Performances : Une augmentation progressive du nombre de formation sanitaire rapportant a été remarqué suite à la prise en main du Secrétaire général dans le suivi hebdomadaire de la performance.
Alertes : La majorité des alertes investigués concerne la COVID-19, une diminution du nombre de cas de l'ordre de 79,1% a été constatée par rapport à la période S27_S30 (122 vs 584). Le nombre total d'alertes a également diminué dans ce sens.

Surveillance épidémiologique :

- **Diarrhée :** Une légère baisse de l'incidence des malad… par rapport à la période précédente. Cette situation pourrait être due aux condit… ent pas la recrudescence des maladies diarrhéiques.
- **Décès maternel :** Quatre décès maternels ont été rappo…

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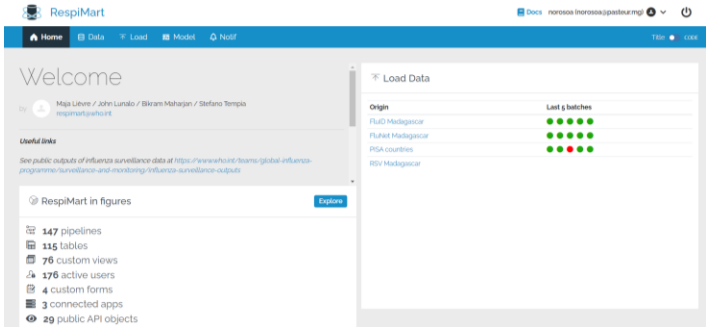
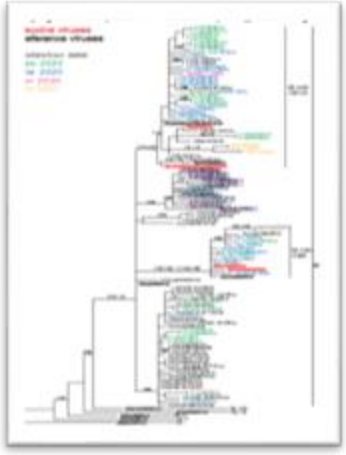
Sharing and reporting (International)

1. **Weekly report of data to RespiMart**
   - Flunet (lab data) by NIC
   - FluID (Epi data) by MoH
   - PISA by NIC
2. **Weekly report to GIHSN (Epi and lab data)**



3. **Shipment of specimens to WHO CC**
   - 4 seasonal shipments per year for Flu
   - Shipment of RSV samples if required
   - Shipment of avian Flu samples if required



4. **Upload of genomic sequences on GISAID**
   - Influenza, RSV, SARS-CoV-2

CHALLENGES

Challenges (1)

- Sites
  - Work overload (need of dedicated staff for data)
    - Completeness of CRF
    - Delay in data entry in DHIS2
  - Frequent staff turnover
  - Lack of awareness of clinicians
  - Lack of motivation
  - Electricity and water supplies

Challenges (2)

- EPI and data management
  - Ensure data quality
  - Difficulty to link Epi and Lab data (interoperability system)
  - Insufficient HR (only 3 people from EPI-RC)
  - Insufficient IT equipment for data management

Challenges (3)

- Lab
  - Delays in supplies, reagents and equipment procurement
  - Delays in reporting results (depending on priority disease and response)
  - Limited access to advanced diagnostic tools
  - Maintenance of equipment (need continuous funding)
  - Challenge of international shipment procedure

Challenges (4)

- Lab Sequencing
  - Infrastructure and equipment
    - Unstable power supplies; slow connexion (internet)
    - Outdating of equipment and reagents (e.g Illumina) – need to renew
  - Cost of reagents (eg. Illumina)
  - Limited capacity on NGS sequencing (in terms of reagents)
  - Obtain sufficient materials for genetic sequencing
  - Limited qualified personnel

Challenges (5)

- Other challenges

  - Sustainability of fundings (Funding dependance from external partners/donors (ex. CDC coag)
  - Limited support from government
  - Lack of fluid communication
  - Insufficient capacity buildings
  - Lack of routine refresh trainings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