

PANDEMIC & DISASTER Preparedness Center (PDPC)

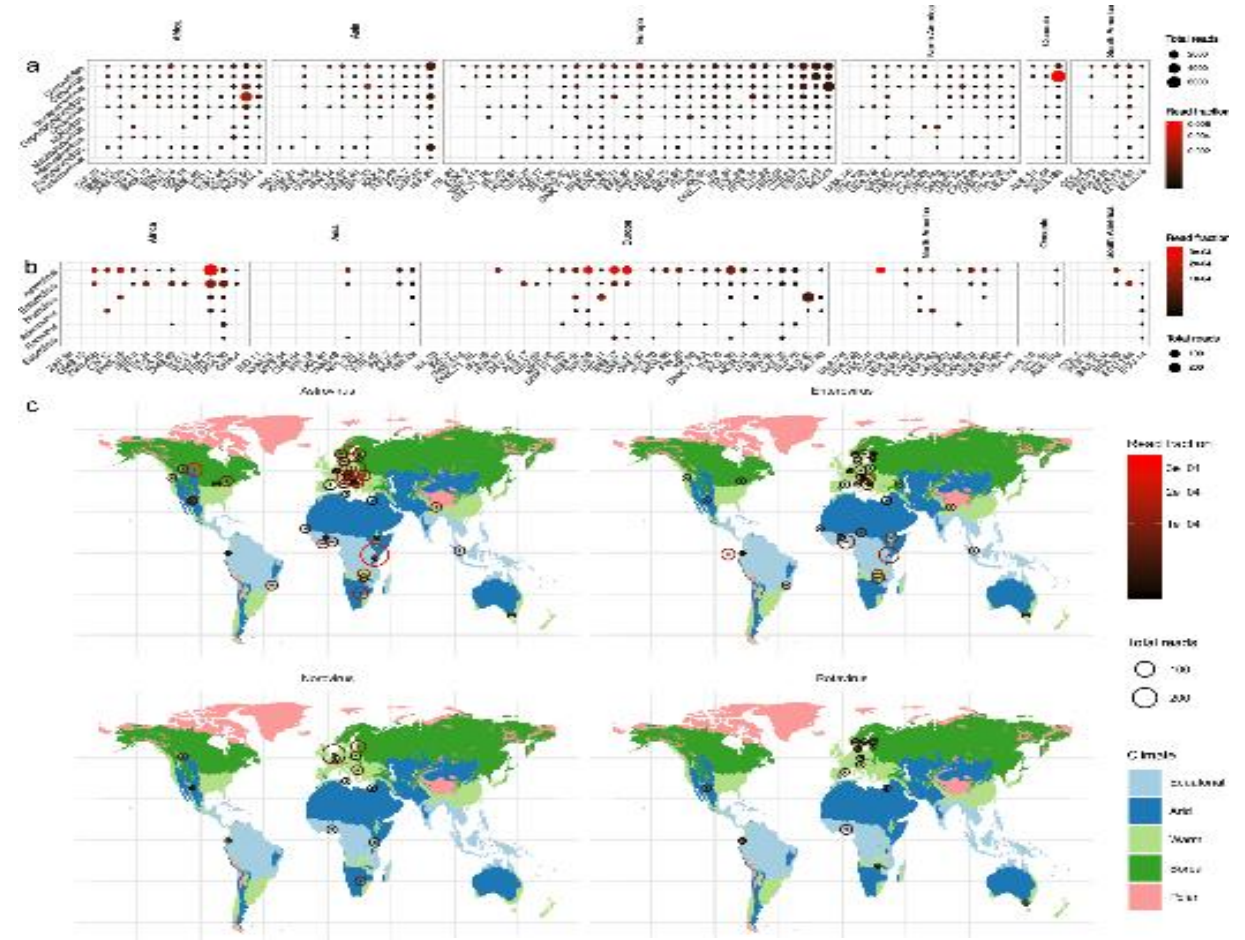
Metagenomic “catch-all” techniques



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Global (vertebrate) virome via wastewater

- Rationale: urban amplification of rare zoonotic spillovers
- 62 countries
- Easy to see the virus ‘haystack’, need to go ‘deep’
- Challenge: from sequence to interpretation of risk



Nieuwenhuijse et al, Sci Rep. 2020; 10(1):13748

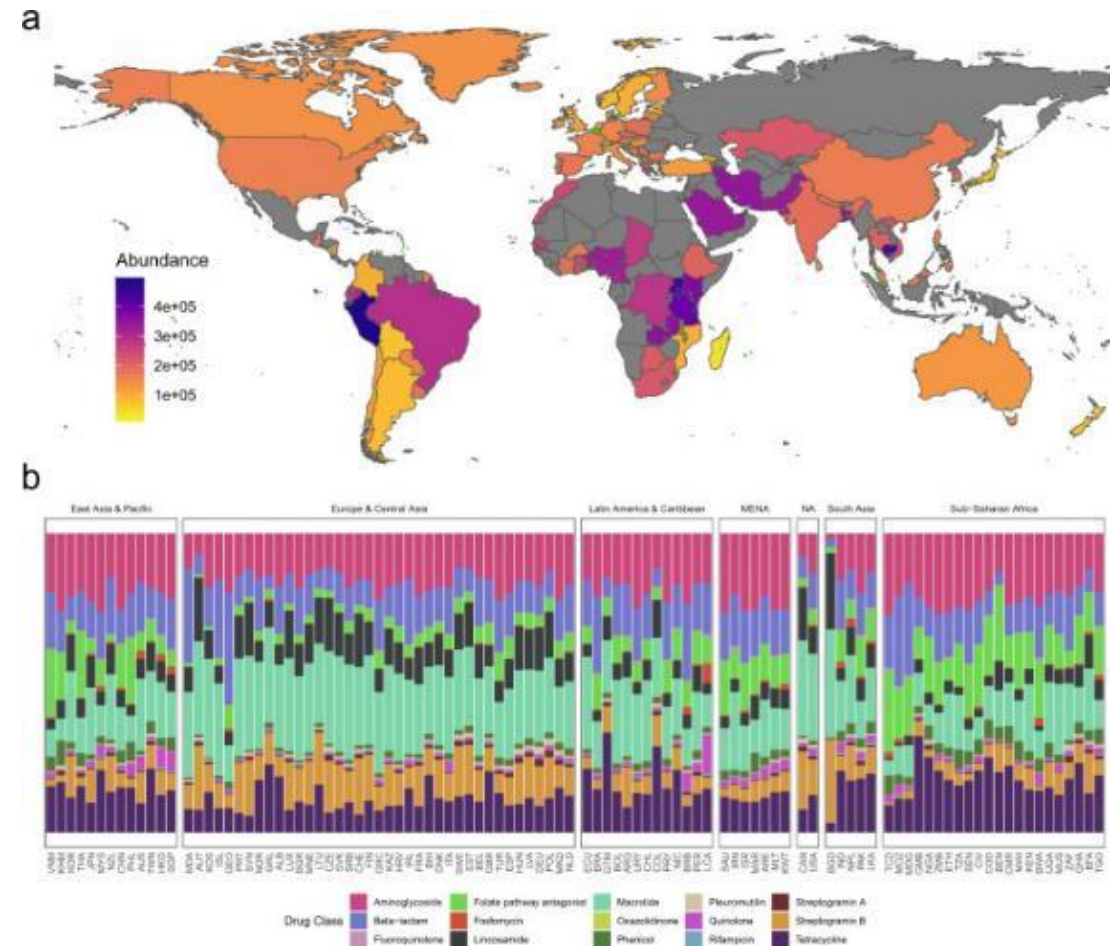
Metagenomic “catch-all” techniques



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Global resistome via wastewater

- Rationale: comparative surveillance, effect of interventions, priorities
- Multiyear, 107 countries
- Resistome is stable over time
- Regional differences
- ARG are mobile



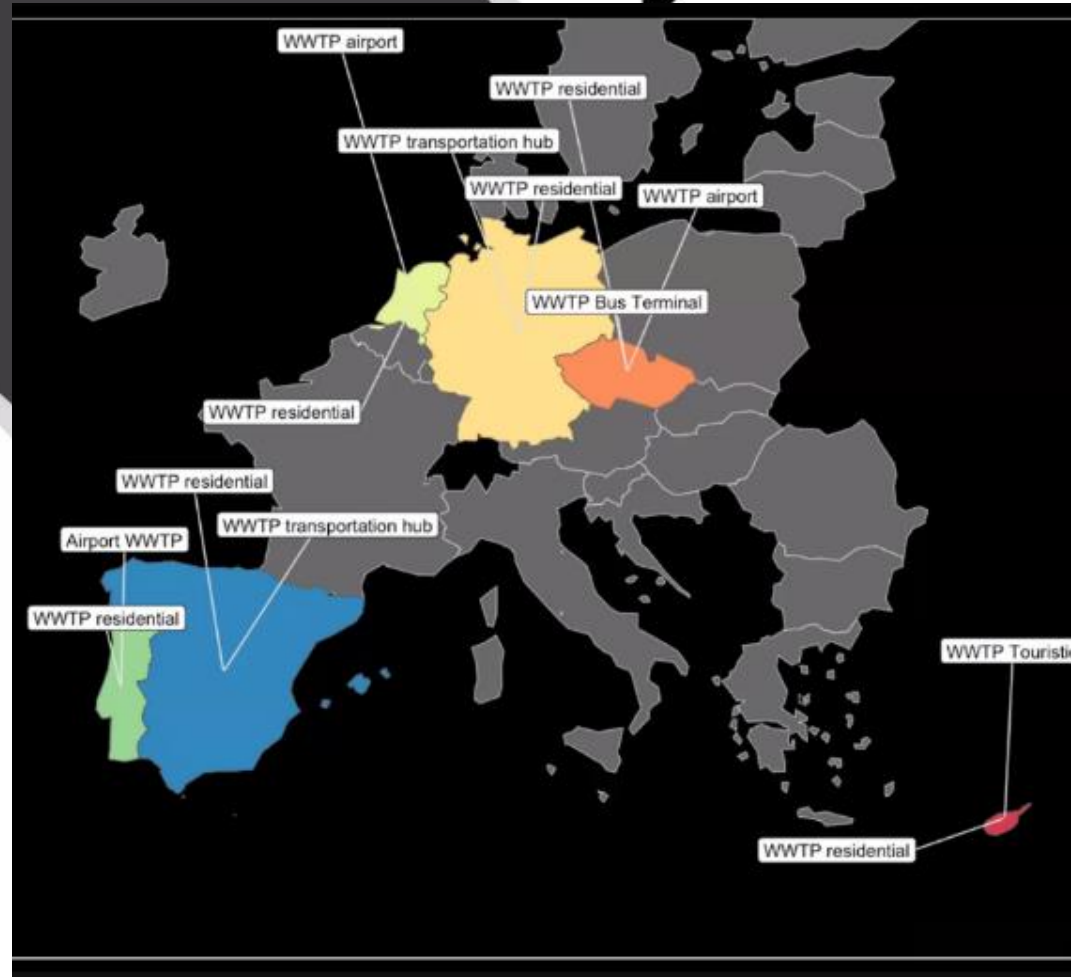
Munk et al, Nat Commun. 2022; 13: 7251

Supersites

Does Wastewater surveillance of Supersites reveal different story compared to the city ?



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Sampling Locations

Total 57 samples

Sampling was done,

- August 2021
- September 2021
- October 2021
- November 2021
- January 2022

gie | Dr.-Ing. Shelesh Agrawal | 3 IWAR

Omicron via air travel



Microbiology[®]
Resource Announcements

OMICS DATA SETS



Genome Sequencing of Wastewater Confirms the Arrival of the SARS-CoV-2 Omicron Variant at Frankfurt Airport but Limited Spread in the City of Frankfurt, Germany, in November 2021

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^cLife Technologies, Darmstadt, Germany

ABSTRACT Wastewater-based severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) surveillance of Frankfurt Airport by genome sequencing was used to detect SARS-CoV-2 variants entering the region. In November 2021, we found all characteristic mutations of Omicron in wastewater originating from Frankfurt Airport before the first confirmed clinical report from an arriving passenger on 26 November 2021.

Omicron via air travel

Sample date	Sample site
G339D (%)	
N856K (%)	
N501Y (%)	
K417N (%)	
Del69-70 (%)	
LPPA24S (%)	

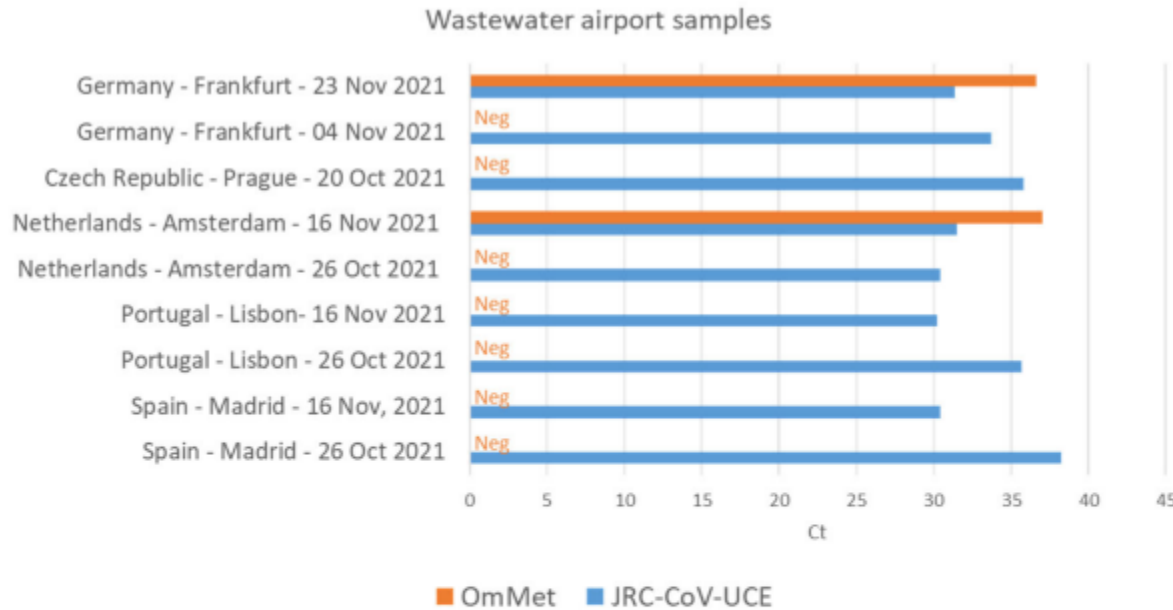


Figure 6. Early detection of Omicron in airport wastewater samples. Samples from the indicated airports were analyzed by RT-PCR with both the JRC-CoV-UCE and the Omicron-specific OmMet [22] assays. SARS-CoV-2 (most likely the Delta variant, which was highly predominant at that time) was identified in all of the samples while Omicron was only detected at lower concentrations (higher Ct numbers) in two samples from airports in Frankfurt and Amsterdam from the middle and end of November 2021. The presence of Omicron was confirmed by genome sequencing [44]. Neg: no detection of Omicron by using the OmMet assay.

Marchini et al 2023, *Viruses*



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Schiphol & Frankfurt:
3 days before first
omicron positive
clinical sample

10/11/2021	16/11/2021	16/11/2021	23/11/2021	23/11/2021
	Netherlands - Schiphol	Netherlands - Amsterdam	Germany - Frankfurt Niederrad	Germany - Frankfurt Airport
	2.8	0	0	2.9
	0	0	0	0
	0	0	0	0
	0	0.9	0	0
	24	0.9	0.5	4

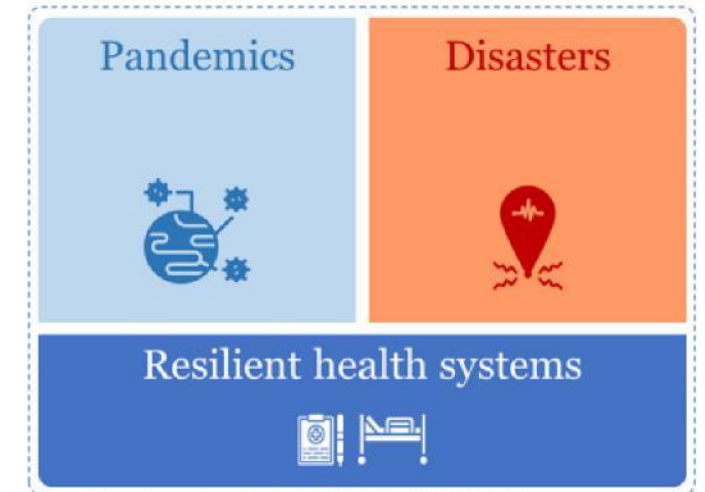
25/01/2022	26/01/2022	26/01/2022	26/01/2022	26/01/2022	26/01/2022	24/01/2022	25/01/2022	09/02/2022	09/02/2022	11/02/2022	09/02/2022	09/02/2022
Spain - Aeropuerto de Barajas	Portugal - Lisboa Beiroas	Portugal - Aeroporto Delgado	Germany - Frankfurt Airport	Germany - Frankfurt Niederrad	Netherlands - Amsterdam	Netherlands - Schiphol	Cyprus, Vathia Gonias Nicosia	Cyprus, Ayia Napa (tourist)	Czech Republic - Prague	Czech Republic - Prague Central Bus Station	Czech Republic - Prague Airport	
98.4	99.8	100	98.3	99.3	99.1	98.7	97.8	95	99.8	100	100	
66	73	66	52	65	66	71	73	80	80	61	75	
0	0	0	0	0	0	0	0	0	0	0	0	
100	99.8	100	98	98.4	100	98.7	98.1	93	100	100	100	
4.6	98.5	69	88.9	88.2	90	92.2	86	63.5	95.6	88	50	
25	17.3	3.9	24	9	12	11.2	10	10	40.4	4.4	2.4	

PDPC Frontrunner projects



PANDEMIC & DISASTER Preparedness Center (PDPC)

1. Climate change and increased risks of vector-borne virus outbreaks
2. Airborne: Predicting, measuring and quantifying airborne virus transmission
3. Pandemic lessons for flood disaster preparedness
4. Towards social and urban resilience for pandemics and disasters
5. Integrated early warning surveillance methods and tools



Understand
Research & innovation



Signal
Information hub



Experiment
Living labs



Act
Reserve capacity



Frontrunner INSPECT International Network Surveillance for Pandemic EmergenCe via Transport hubs



PANDEMIC & DISASTER Preparedness Center (PDPC)

- Intelligent One Health system for early warning
 - identify critical nodes in the complex global transport of people, animals and goods for the import of new disease agents
 - target these with an innovative early warning surveillance tools. The tools we envisage are rapidly deployable and combine the power of bioinformatics, innovative sampling and detection methods, network data analytics and social media data mining.



Frontrunner INSPECT International Network Surveillance for Pandemic EmergenCe via Transport hubs



PANDEMIC & DISASTER Preparedness Center (PDPC)

- WP1. NL as hub in the global network: map and categorize pandemic risk sources and routes
- WP2. Refine and evaluate targeted detection of (zoonotic) viruses and emerging 'sequences-of-concern' in environmental surveillance of transport and trade hubs
- WP3. Living lab: intelligent pandemic One Health surveillance in the Port of Rotterdam and Schiphol airport

Erasmus MC



KWR

Early warning for new emerging viruses



PANDEMIC & DISASTER Preparedness Center (PDPC)

Create/combine:

- Epidemic intelligence
- Metagenomic intelligence
- Transport network intelligence
- Environmental surveillance tools



European Centre for Disease Prevention and Control

An agency of the European Union

All sections

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< What we do

Surveillance

Epidemic intelligence and outbreak response

Scientific advice

Microbiology

Preparedness

Public health training

Health communication

Partners and networks

ECDC activities on epidemic intelligence and outbreak response



Monitoring and assessing threats to public health in Europe from infectious diseases are core tasks for ECDC, as is providing technical support to the EU-level response to such threats.

The Centre's mission is to identify, assess and communicate current and emerging threats to human health from communicable diseases.

The objective of epidemic intelligence is to rapidly detect and assess public health events of any origin to ensure the EU's health security. Epidemic intelligence can be described as the systematic collection and collation of information from a variety of sources, which is then validated and analysed. The aim is to ensure a timely response, based on an adequate risk assessment with recommendations on appropriate public health measures.

ECDC supports the response to infectious disease threats to EU:

- Coordinate and support the rapid assessment of risks and the identification of options for response.
- Support national and international field response through missions.

Tools (public access)

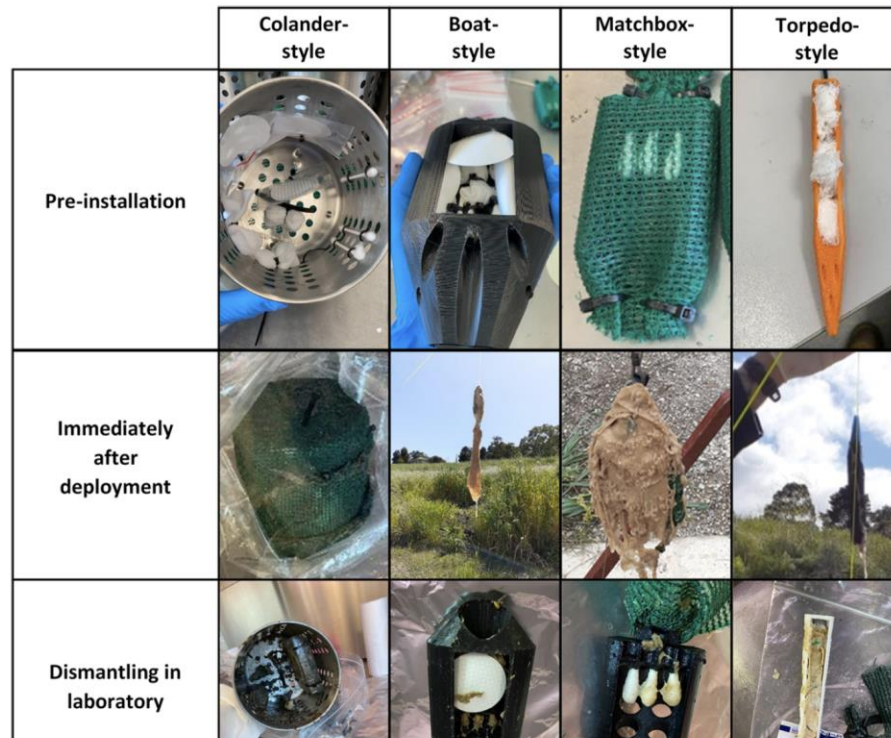
[epitweetr](#)

Early warning for new emerging viruses



PANDEMIC & DISASTER Preparedness Center (PDPCC)

Develop and validate rapidly deployable sampling and analytical/bioinformatic methods for targeted detection and evaluation of emerging viruses and ‘sequences-of-concern’.



- Targeted techniques:
 - q/dPCR for known viruses (variants)
 - Virus panels
- Semi-targeted techniques:
 - Target enrichment of ‘pandemic virus families’ (i.e. coronaviridae)
 - Target enrichment of human viruses
- Non-targeted

Chang et al, 2021

Early warning for new emerging viruses

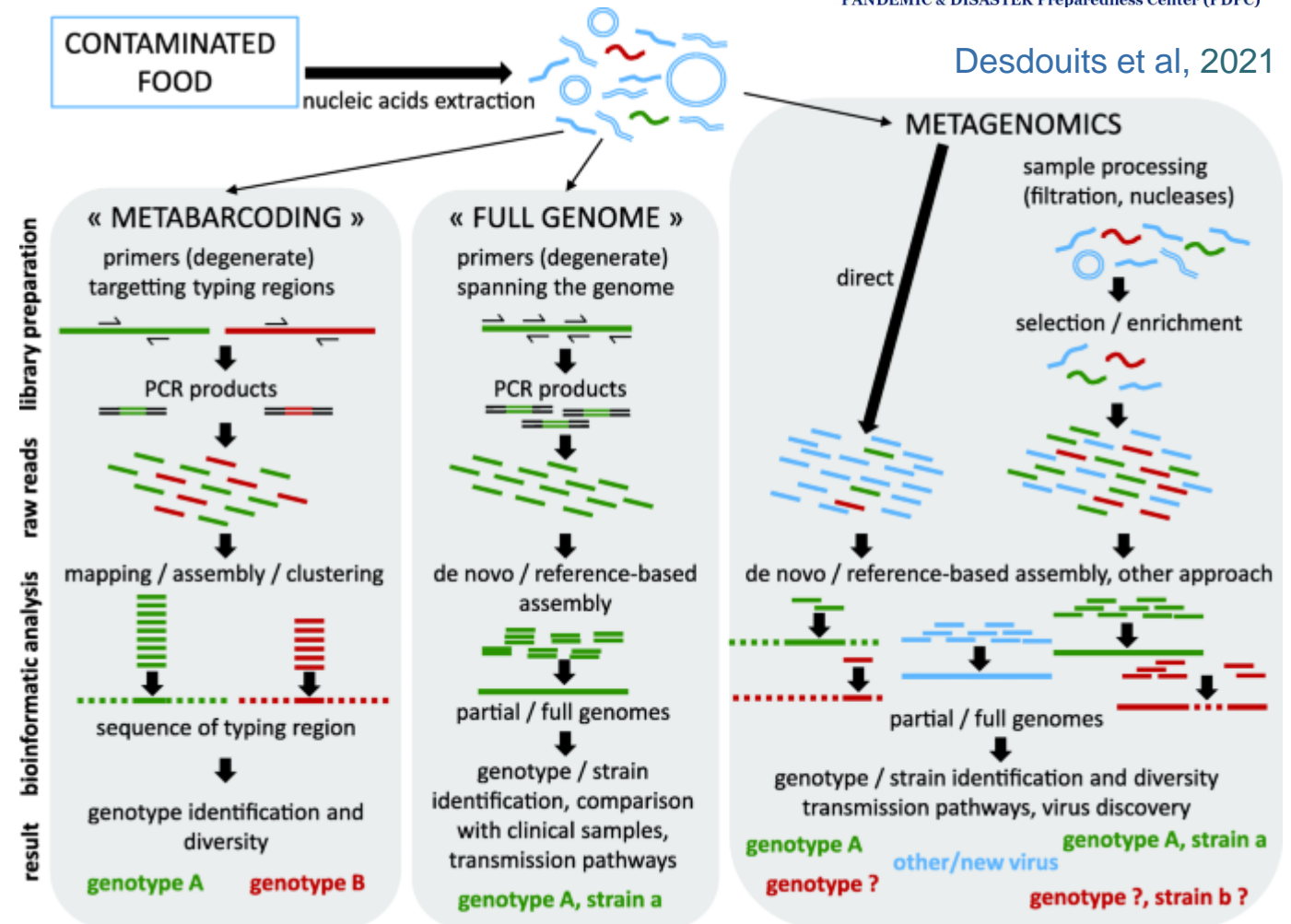


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Desdouits et al, 2021

Metaviromics and bioinformatics

Explore approach developed for food testing



“Sequences of concern”

Which viruses?

enteric (norovirus/enterovirus)
respiratory (influenza)

When should viruses be tested

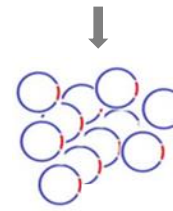
mutations in binding domains
mutations in antigenic domains

Which phenotypic assays

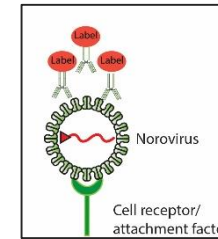
attachment to cells
antibody recognition



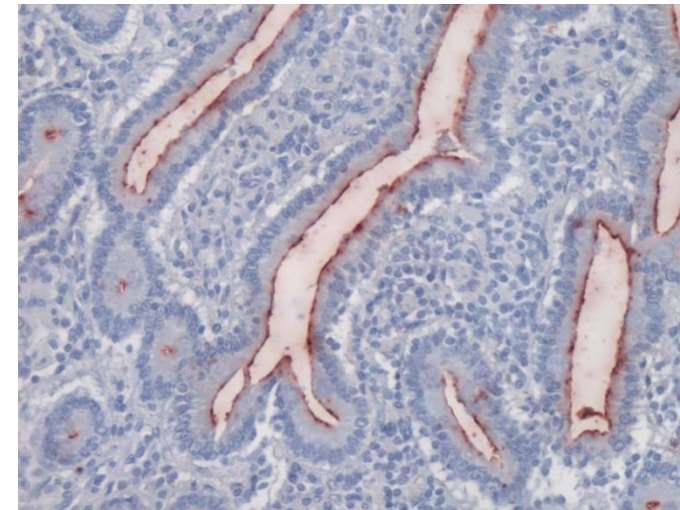
Environmental DNA



Clone libraries



Expression



phenotypic screening



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International Network Surveillance for Pandemic EmergenCe via Transport hubs



- **from surveillance to action:** develop criteria (validity, timeliness, strength, ethics) for intelligent surveillance system to underpin public health actions; develop system to turn surveillance signals into alarms, develop response strategies.
- **ethics:** evaluate how ethical considerations such as anonymity, prior and voluntary informed consent and the data protection regulation (eg GDPR) interplay with the data collection and response

Frontrunner INSPECT
International Network Surveillance for
Pandemic EmergenCe via Transport hubs



PANDEMIC & DISASTER Preparedness Center (PDPC)

PhD's



Putri Ayu Fajar



Ege Sener



Pouria Paridar