Building genomics Networks in Africa

Prof Tulio de Oliveira
for the Network for Genomic Surveillance South Africa (NGS-SA) and the Africa CDC Pathogen Genomics Initiative (PGI)


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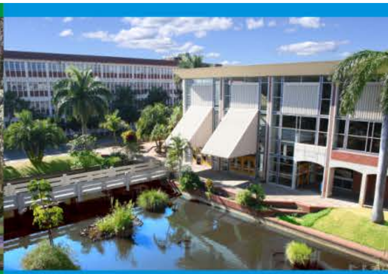
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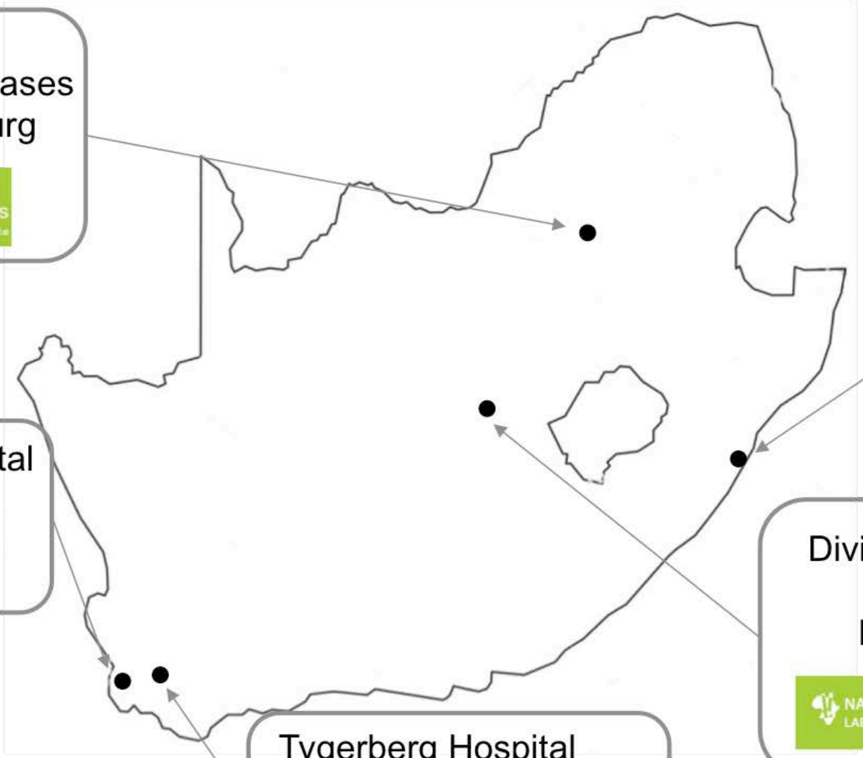
UKZN INSPIRING GREATNESS

Presentation

Network for Genomic Surveillance in South Africa

Africa CDC Pathogen Genomics Initiative (PGI) to expand surveillance to Africa.

Network for Genomic Surveillance in South Africa (NGS-SA)



National Institute for Communicable Diseases (NICD), Johannesburg

NATIONAL INSTITUTE FOR COMMUNICABLE DISEASES
Division of the National Health Laboratory Service

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Msomi N, Mlisana K, *et al*. Lancet Microbe 2020

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INYUVESI YAKWAZULU-NATALI

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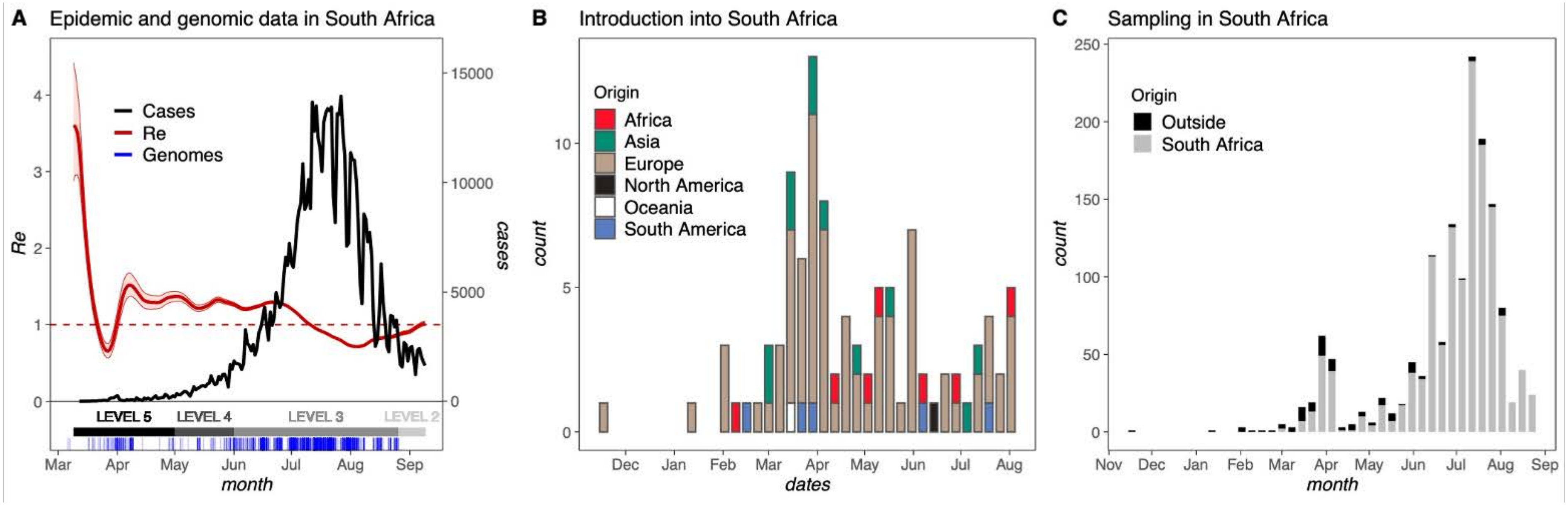
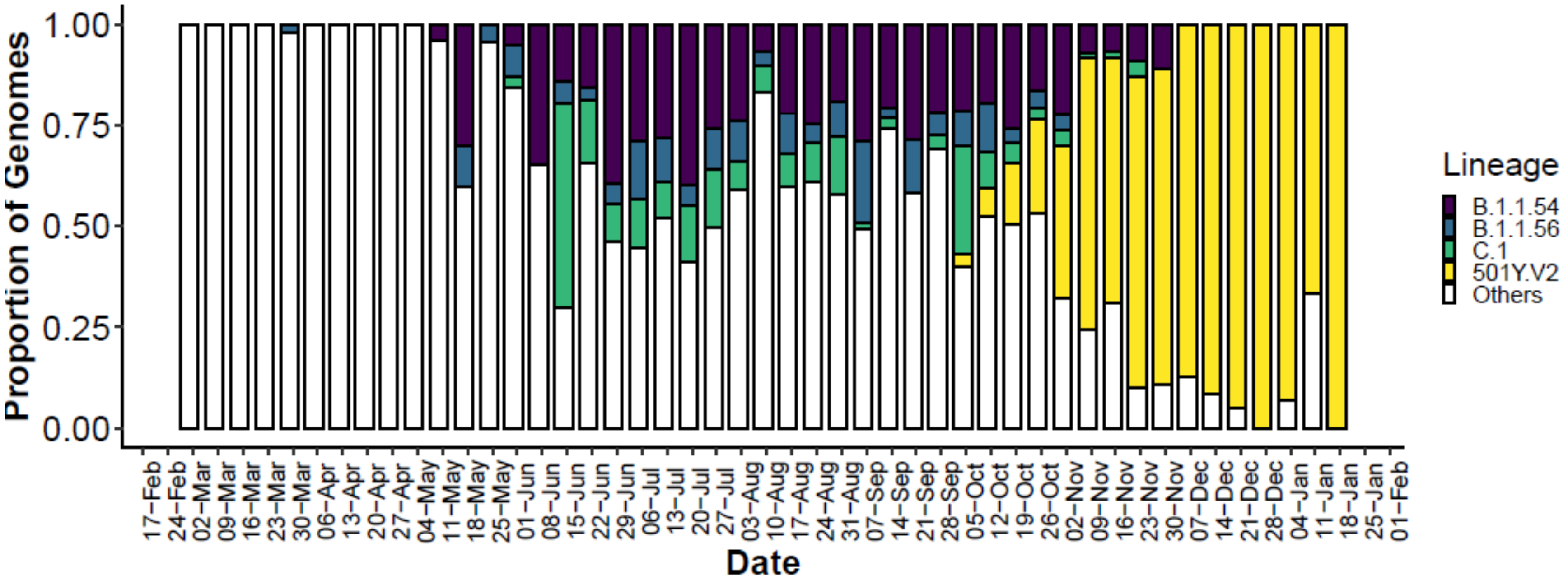
Introductions and local transmission of SARS-CoV-2 (first wave)



Tegally, Wilkinson et al. *Nature Medicine 2021*

Distribution of SARS-CoV-2 lineages

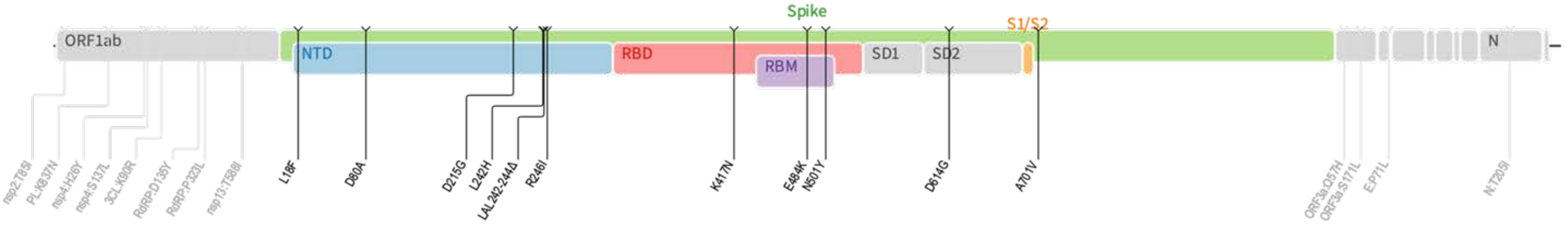
South Africa

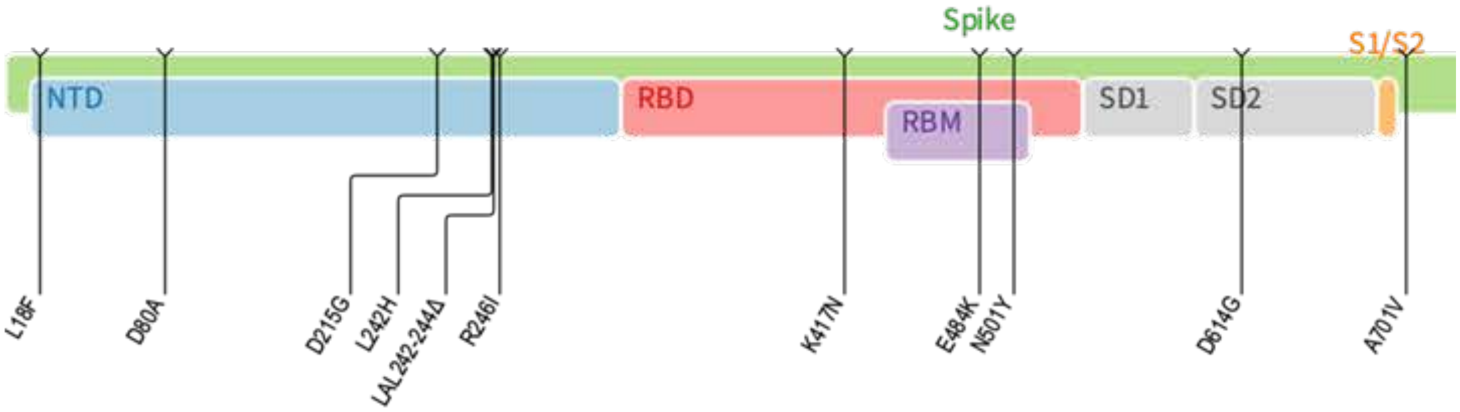


Data from **3324 sequences** from all 9 provinces, collected up to 19 Jan

Tegally, Wilkinson, Giovanetti, et al. *Nature 2021 (in press)*

Genomic map of 501Y.V2 (B.1.351, 20H)





Three mutations in spike receptor-binding domain & cluster of mutations in N-terminal domain

Tegally, Wilkinson, Giovanetti, et al. *Nature 2021 (in press)*

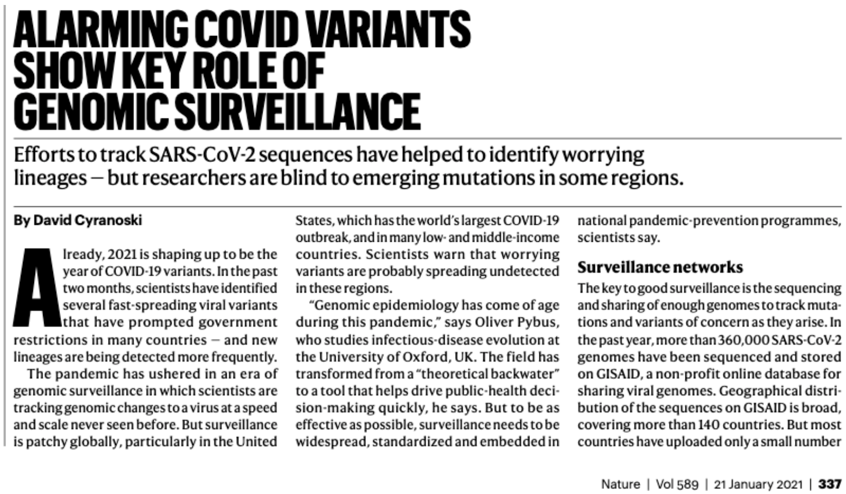
THE LANCET
Microbe

COMMENT | ONLINE FIRST

A genomics network established to respond rapidly to public health threats in South Africa

Nokukhanya Msomi • Koleka Mlisana • Tulio de Oliveira ✉ •
on behalf of the Network for Genomic Surveillance in South Africa writing group † • Show footnotes

Open Access • Published: August 18, 2020 • DOI: https://doi.org/10.1016/S2666-5247(20)30116-6 •



ALARMING COVID VARIANTS SHOW KEY ROLE OF GENOMIC SURVEILLANCE

Efforts to track SARS-CoV-2 sequences have helped to identify worrying lineages – but researchers are blind to emerging mutations in some regions.

By David Cyranoski

Already, 2021 is shaping up to be the year of COVID-19 variants. In the past two months, scientists have identified several fast-spreading viral variants that have prompted government restrictions in many countries – and new lineages are being detected more frequently.

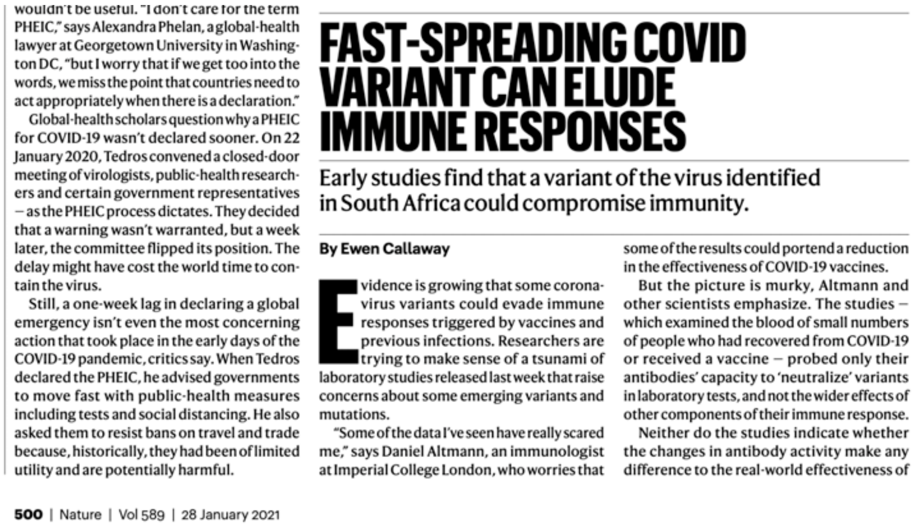
The pandemic has ushered in an era of genomic surveillance in which scientists are tracking genomic changes to a virus at a speed and scale never seen before. But surveillance is patchy globally, particularly in the United States, which has the world's largest COVID-19 outbreak, and in many low- and middle-income countries. Scientists warn that worrying variants are probably spreading undetected in these regions.

"Genomic epidemiology has come of age during this pandemic," says Oliver Pybus, who studies infectious-disease evolution at the University of Oxford, UK. The field has transformed from a "theoretical backwater" to a tool that helps drive public-health decision-making quickly, he says. But to be as effective as possible, surveillance needs to be widespread, standardized and embedded in national pandemic-prevention programmes, scientists say.

Surveillance networks

The key to good surveillance is the sequencing and sharing of enough genomes to track mutations and variants of concern as they arise. In the past year, more than 360,000 SARS-CoV-2 genomes have been sequenced and stored on GISAID, a non-profit online database for sharing viral genomes. Geographical distribution of the sequences on GISAID is broad, covering more than 140 countries. But most countries have uploaded only a small number

Nature | Vol 589 | 21 January 2021 | **337**



wouldn't be useful. "I don't care for the term PHEIC," says Alexandra Phelan, a global-health lawyer at Georgetown University in Washington DC, "but I worry that if we get too into the words, we miss the point that countries need to act appropriately when there is a declaration."

Global-health scholars question why a PHEIC for COVID-19 wasn't declared sooner. On 22 January 2020, Tedros convened a closed-door meeting of virologists, public-health researchers and certain government representatives – as the PHEIC process dictates. They decided that a warning wasn't warranted, but a week later, the committee flipped its position. The delay might have cost the world time to contain the virus.

Still, a one-week lag in declaring a global emergency isn't even the most concerning action that took place in the early days of the COVID-19 pandemic, critics say. When Tedros declared the PHEIC, he advised governments to move fast with public-health measures including tests and social distancing. He also asked them to resist bans on travel and trade because, historically, they had been of limited utility and are potentially harmful.

500 | Nature | Vol 589 | 28 January 2021

FAST-SPREADING COVID VARIANT CAN ELUDE IMMUNE RESPONSES

Early studies find that a variant of the virus identified in South Africa could compromise immunity.

By Ewen Callaway

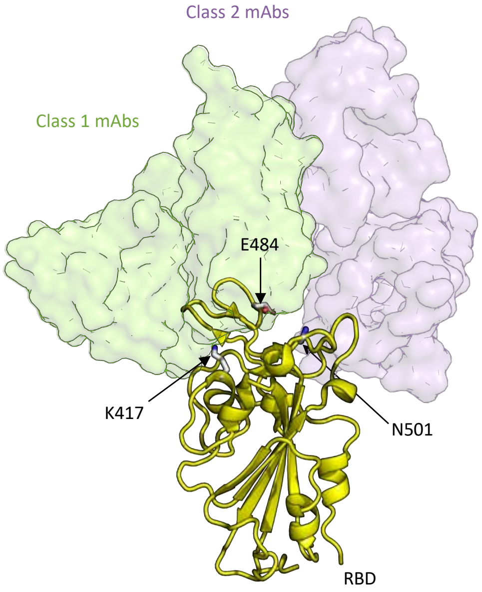
Evidence is growing that some coronavirus variants could evade immune responses triggered by vaccines and previous infections. Researchers are trying to make sense of a tsunami of laboratory studies released last week that raise concerns about some emerging variants and mutations.

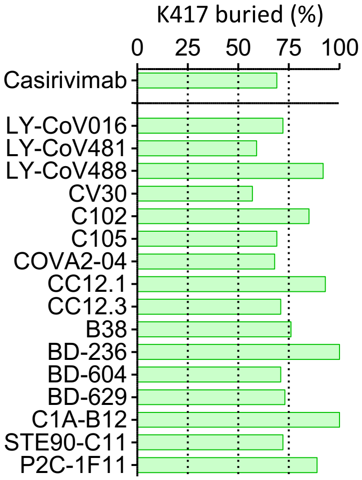
"Some of the data I've seen have really scared me," says Daniel Altmann, an immunologist at Imperial College London, who worries that some of the results could portend a reduction in the effectiveness of COVID-19 vaccines.

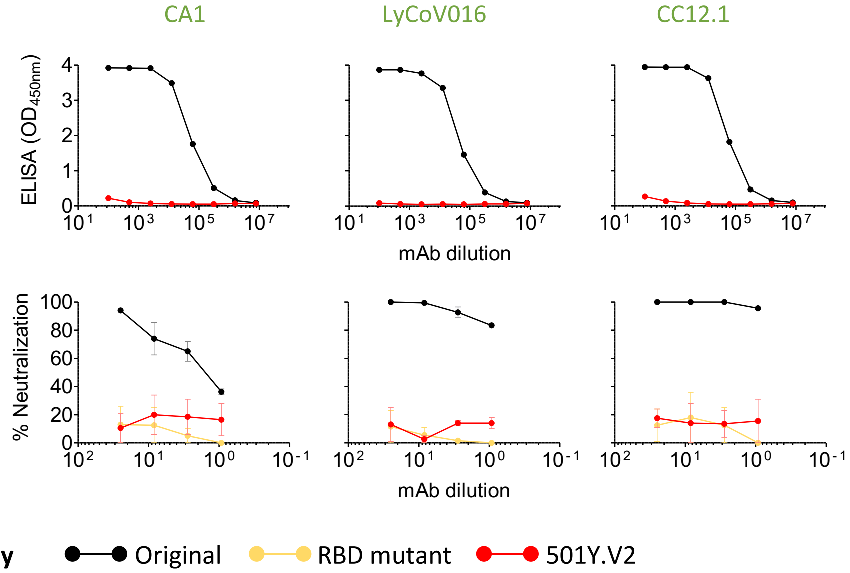
But the picture is murky, Altmann and other scientists emphasize. The studies – which examined the blood of small numbers of people who had recovered from COVID-19 or received a vaccine – probed only their antibodies' capacity to 'neutralize' variants in laboratory tests, and not the wider effects of other components of their immune response.

Neither do the studies indicate whether the changes in antibody activity make any difference to the real-world effectiveness of

Triple RBD mutant and 501Y.V2 resistant to “class 1” mAbs

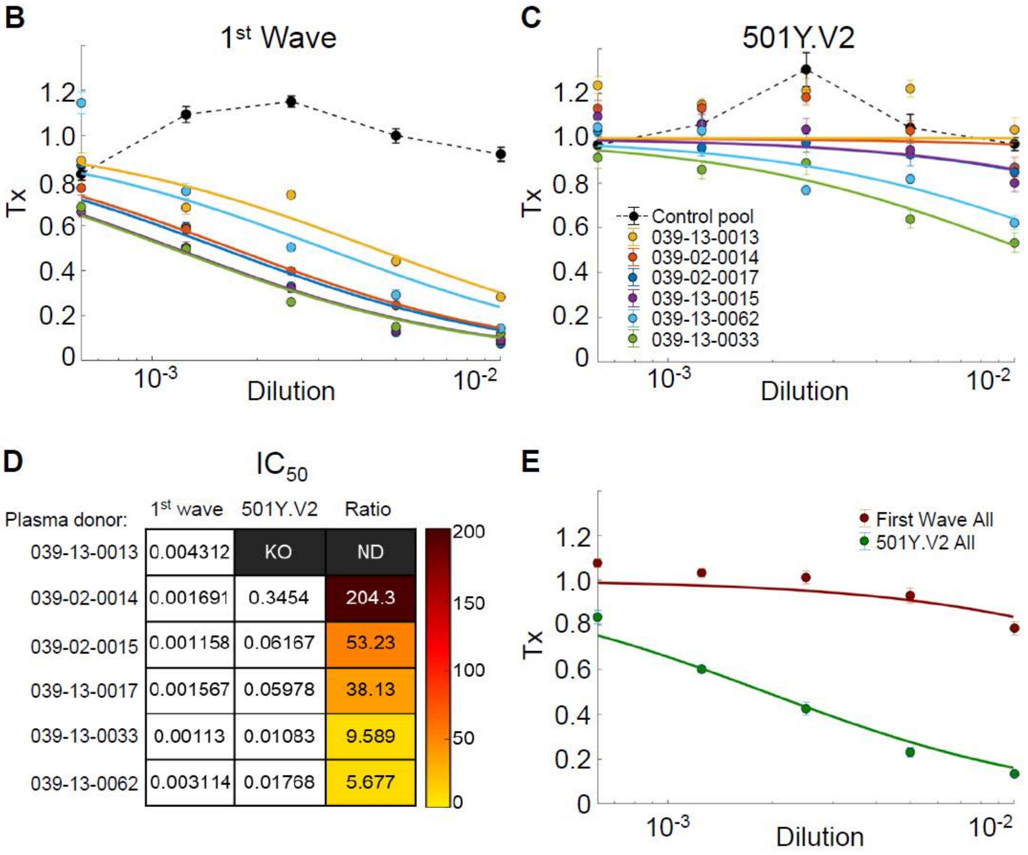






Wibmer et al, 2021 (Nature Medicine in review)

Loss of neutralization with 501Y.V2 (Live Virus)



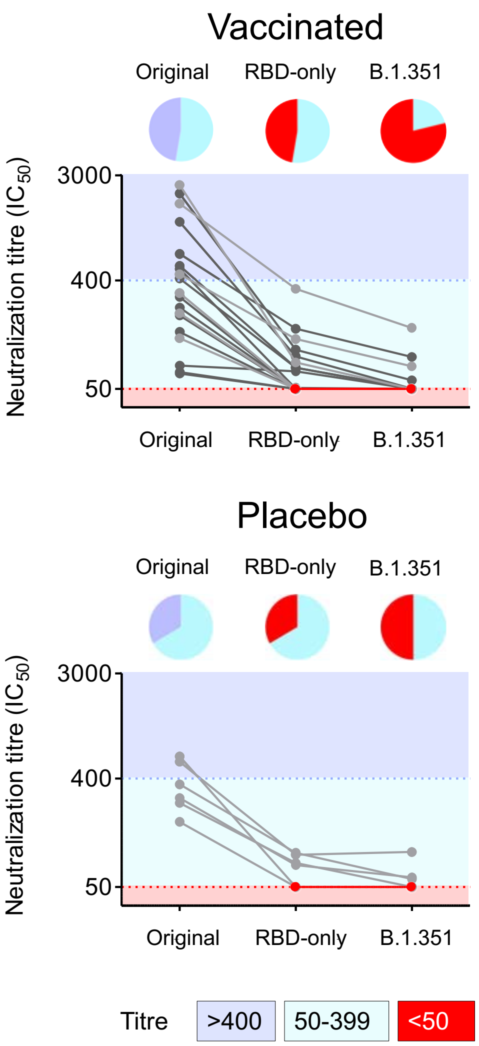
Plasma donor:	1st wave	501Y.V2	Ratio
039-13-0013	0.004312	KO	ND
039-02-0014	0.001691	0.3454	204.3
039-02-0015	0.001158	0.06167	53.23
039-13-0017	0.001567	0.05978	38.13
039-13-0033	0.00113	0.01083	9.589
039-13-0062	0.003114	0.01768	5.677

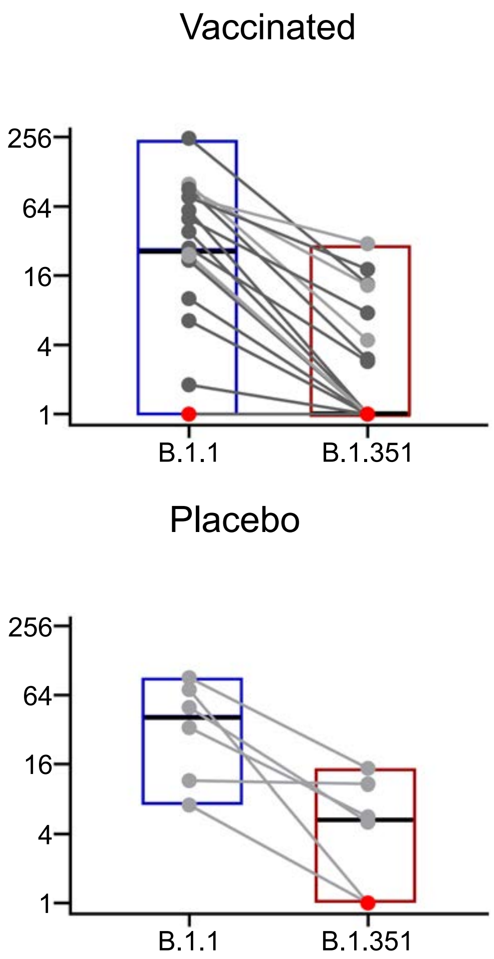
Cele et al. Nature 2021 (in review)

Sensitivity of 501Y.V2 to plasma from ChAdOx vaccinees

PSVN: Penny Moore

LVN: Alex Sigal





Madhi NEJM 2021 (in review)

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Los Angeles Times

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Sharp split on Trump trial

UC poll finds wide divisions in California about ex-president's role in Capitol riot.

By David Lauter

WASHINGTON — Less than five weeks after his riotous supporters stormed the Capitol, Donald Trump is set to go on trial a second time in the Senate — an impeachment proceeding that will give the public the fullest accounting so far of the former president's role in the attack but almost surely not resolve a divided nation's view of his legacy.

The split remains stark nationally and in California, where a new poll finds that more than 9 in 10 Democrats, but fewer than 2 in 10 Republicans, say they believe Trump was a major contributor to the insurrection.

Only 11% of California Republicans favor a Senate conviction of Trump, compared with 92% of the state's Democrats, according to the poll released Monday by UC Berkeley's Institute of Governmental Studies.

Republicans, however, have their own internal divisions over the former president, with a significant minority viewing him as at least partially culpable and rejecting him as a continuing leader for their party.

Similar divides show up in polls nationwide and in comments by Republican [See **Trial**, A8]

Divide in GOP hits California lawmakers

By Melanie Mason

Nearly a month after objecting to electoral votes cast for President Biden, Rep. Mike Garcia wanted to clear the air.

In a lengthy Jan. 30 op-ed in a local newspaper, the Santa Clarita Republican and former Navy fighter-jet pilot denounced the blowback on social media that branded him "a seditionist, a traitor, or even worse."

Roughly 150 miles to the north, Rep. David Valadao also had some explaining to do after voting to impeach President Trump for his part in inciting the riot at the U.S. Capitol. He, like Garcia, was disparaged by some constituents as a traitor.

Two votes in Congress in successive weeks — one to certify Biden's election and another to impeach the president — snared the two California Republicans into the pitched battle over the future of their party: whether the GOP will demand allegiance to Trump or break from his influence.

On one side sit Garcia and most House Republi- [See **Republicans**, A8]

Ashley Landis Associated Press

THE MAGNIFICENT SEVENTH

Tampa Bay's Tom Brady, right, and Rob Gronkowski are jubilant after their Buccaneers defeated the Kansas City Chiefs 31-9 in Super Bowl LV. It was MVP Brady's seventh championship. **SPORTS, D1**

Legacy of Tuskegee: Distrust

Recalling syphilis study, Black Alabamians wary of vaccine

Tuskegee Human and Civil Rights Multicultural Center

A MAN is given medical treatment in a field. The U.S. government launched a syphilis study in Tuskegee and Macon County, Ala.

Julie Bennett For The Times

OMAR NEAL'S uncle, Freddie Lee Tyson, was a victim of the study that enrolled Black men under false pretenses starting in the 1930s.

By Kurtis Lee

TUSKEGEE, Ala. — Omar Neal often thinks back on the calculated betrayal of hundreds of Black men and how it still shapes so much about this rural Alabama community.

He remembers the mechanic who went from house to house fixing cars and the sharecropper who lived off a narrow dirt road. He thinks too of his uncle Freddie Lee Tyson, a carpenter, and how the betrayal shaped his life.

"These men believed so-called medical experts and were deceived," said Neal, a lifelong resident of Tuskegee.

The name of the town evokes feelings of both pride and pain — for its legendary Black airmen and for the infamous government-backed healthcare study. For now, the legacy of the study, in which Black men with syphilis were left untreated for decades, stands front of mind for many contemplating whether to get a COVID-19 vaccine recommended by federal officials.

Neal's uncle was among the more than 600 African American men from here who were enrolled under false pretenses in the deadly long-term health study coordinated and financed by the federal government beginning in the 1930s.

Because the government researchers behind the Tuskegee syphilis study wanted to track the disease's full progression, they treated the Black men in the study like lab rats, withholding for decades lifesaving treatment under the guise of free healthcare.

Before the full scope of the medical negligence was exposed in news reports in the 1970s, and later memorialized in congressional hearings, a stage play and films, more than two dozen men with untreated syphilis died and roughly 100 died of complications related to the disease.

"A trust in medicine, especially when the [See **Tuskegee**, A6]

GAINS IN L.A.: As virus rates continue to fall, variants and Super Bowl parties pose a risk. **CALIFORNIA, B3**

S. Africa's vaccination plans upended

By Melissa Healy and Emily Baumgaertner

The coronavirus strain fueling a resurgence of COVID-19 in South Africa was not slowed down by a vaccine that officials had been counting on to protect its front-line healthcare workers, prompting the government to shelve plans for an inoculation campaign that would have begun this month.

"We have decided to put a temporary hold on the rollout of the vaccine," Dr. Zweli Mkhize, South Africa's health minister, said Sunday. "More work needs to be done."

The experimental vaccine, developed by AstraZeneca and Oxford University, seemed promising just a few months ago.

In clinical trials conducted in South Africa, people who received the vaccine were 75% less likely to develop mild to moderate cases of COVID-19 than were people who received a placebo. The government ordered 1 million doses.

"The AstraZeneca vaccine was showing tremendous potential," said Dr. Shabir Madhi, a vaccine expert at the University of the Witwatersrand in Johannesburg.

But that was before the emergence of a coronavirus strain called B.1.351, which is [See **South Africa**, A4]

Virus inflicts sticker shock

Some patients have out-of-pocket costs waived, but others run into confusing policies and crushing bills.

By Maria L. La Ganga

VACAVILLE, Calif. — It was bad enough that Patricia Mason's husband rushed her to the emergency room on his birthday and didn't see her again for nearly a month.

That she was transferred in the middle of the night to a different hospital, one that could better care for her deteriorating condition, and that her husband had no idea where she was or even how to find her.

That her doctor called him two days later to break the news. His wife, the physician said, had less than a 30% chance of surviving COVID-19.

Then the medical bills began to arrive. The grand total to save the 51-year-old woman's life: $1,339,181.94.

What the Vacaville couple — with five jobs and nine mostly grown children between them — are actually on the hook for: $42,184.20.

The odds that they will pay it off? Zero.

The most serious cases of COVID-19 don't just attack a patient's body, leading to pneumonia, respiratory failure, septic shock, blood clots, brain fog and more than 460,000 deaths in the U.S. to date. They can also damage a virus victim's bank account.

Because, while it is difficult to know who will die from the virus and who will [See **Bills**, A9]

Ron Edmonds AP

Ex-Secretary of State Shultz dies

Influential Cabinet official in Reagan and Nixon administrations shaped U.S. foreign policy. **CALIFORNIA, B1**

Will Biden push for electric cars?

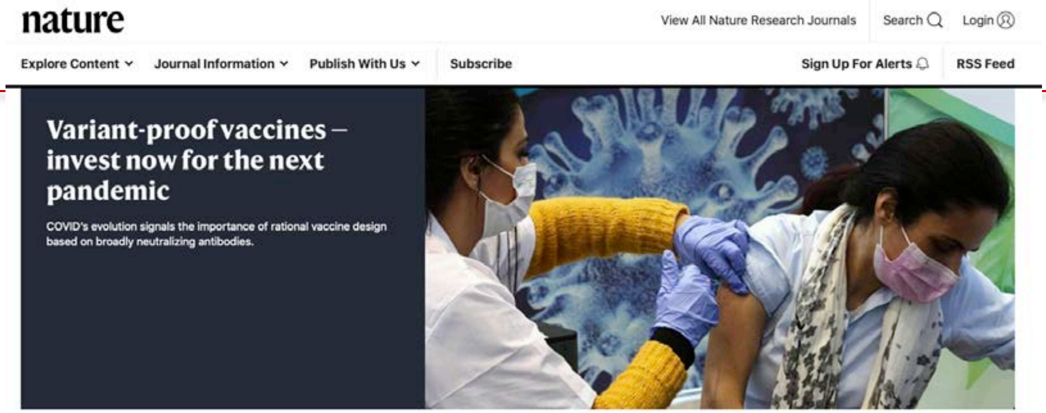
California's plan to ban gas-powered cars in 15 years could become the U.S. model. **NATION, A5**

COVID deepens Mexico's despair

Hospitals overflow and oxygen tanks are scant as the vaccine rollout stalls. **WORLD, A3**

Weather
Partly sunny.
L.A. Basin: 71/53. **B6**

BUSINESS INSIDE: Biden inherits ambiguous regulations for driver-assist technology. A10



nature

Variant-proof vaccines — invest now for the next pandemic

COVID's evolution signals the importance of rational vaccine design based on broadly neutralizing antibodies.

Science

A participant in the South African trial of the AstraZeneca–University of Oxford COVID-19 vaccine has blood drawn before receiving her second dose. AP PHOTO/JEROME DELAY

South Africa suspends use of AstraZeneca's COVID-19 vaccine after it fails to clearly stop virus variant

By Jon Cohen | Feb. 8, 2021, 2:15 PM

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Conclusion I:

- Genomic surveillance is a critical component of the epidemic response – exemplified by early detection, characterization and tracking of this new 501Y.V2 variant within and outside South Africa
- We detected a new lineage with multiple mutations at key sites in spike protein which decrease neutralization of antibodies.
- Variant decrease efficacy of certain vaccines.

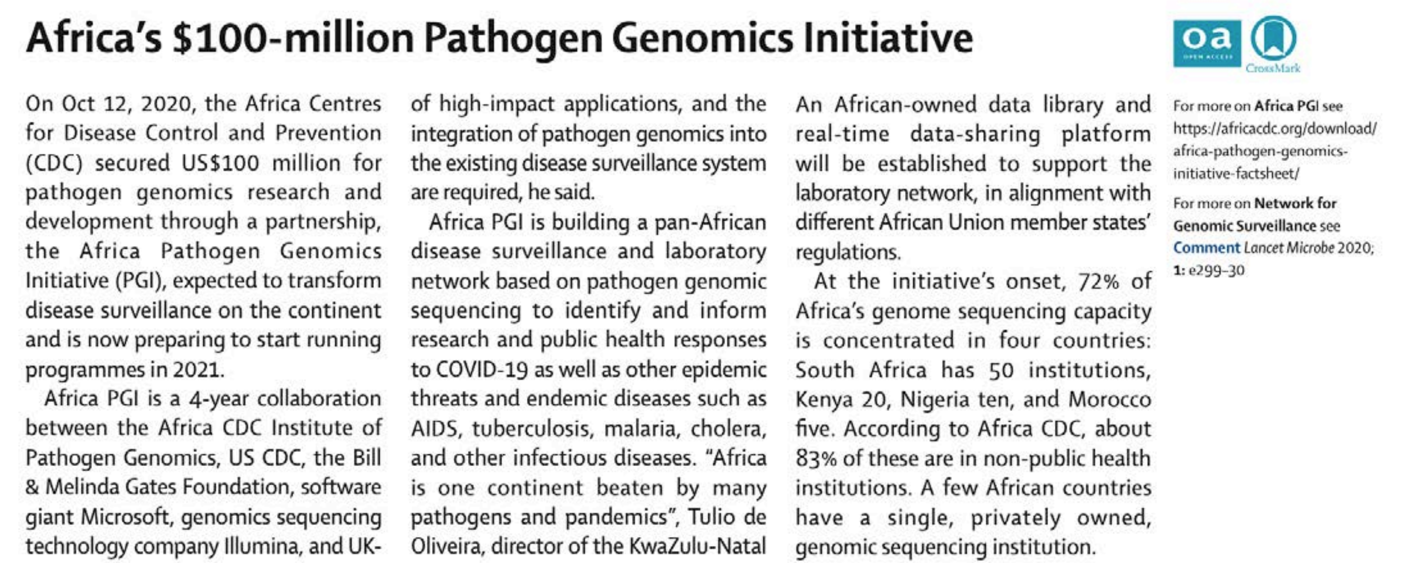
Accelerating SARS-CoV-2 Sequencing in Africa

COMMENT | ONLINE FIRST

Accelerating genomics-based surveillance for COVID-19 response in Africa

Sofonias K Tessema • Seth C Inzaule • Alan Christoffels • Yenew Kebede • Tulio de Oliveira • Ahmed E Ogwell Ouma • Christian T Happi • John N Nkengasong ✉ • Show less

Open Access • Published: August 18, 2020 • DOI: https://doi.org/10.1016/S2666-5247(20)30117-8



Africa’s $100-million Pathogen Genomics Initiative

On Oct 12, 2020, the Africa Centres for Disease Control and Prevention (CDC) secured US$100 million for pathogen genomics research and development through a partnership, the Africa Pathogen Genomics Initiative (PGI), expected to transform disease surveillance on the continent and is now preparing to start running programmes in 2021.

Africa PGI is a 4-year collaboration between the Africa CDC Institute of Pathogen Genomics, US CDC, the Bill & Melinda Gates Foundation, software giant Microsoft, genomics sequencing technology company Illumina, and UK-

of high-impact applications, and the integration of pathogen genomics into the existing disease surveillance system are required, he said.

Africa PGI is building a pan-African disease surveillance and laboratory network based on pathogen genomic sequencing to identify and inform research and public health responses to COVID-19 as well as other epidemic threats and endemic diseases such as AIDS, tuberculosis, malaria, cholera, and other infectious diseases. “Africa is one continent beaten by many pathogens and pandemics”, Tulio de Oliveira, director of the KwaZulu-Natal

An African-owned data library and real-time data-sharing platform will be established to support the laboratory network, in alignment with different African Union member states’ regulations.

At the initiative’s onset, 72% of Africa’s genome sequencing capacity is concentrated in four countries: South Africa has 50 institutions, Kenya 20, Nigeria ten, and Morocco five. According to Africa CDC, about 83% of these are in non-public health institutions. A few African countries have a single, privately owned, genomic sequencing institution.

For more on **Africa PGI** see https://africacdc.org/download/africa-pathogen-genomics-initiative-factsheet/

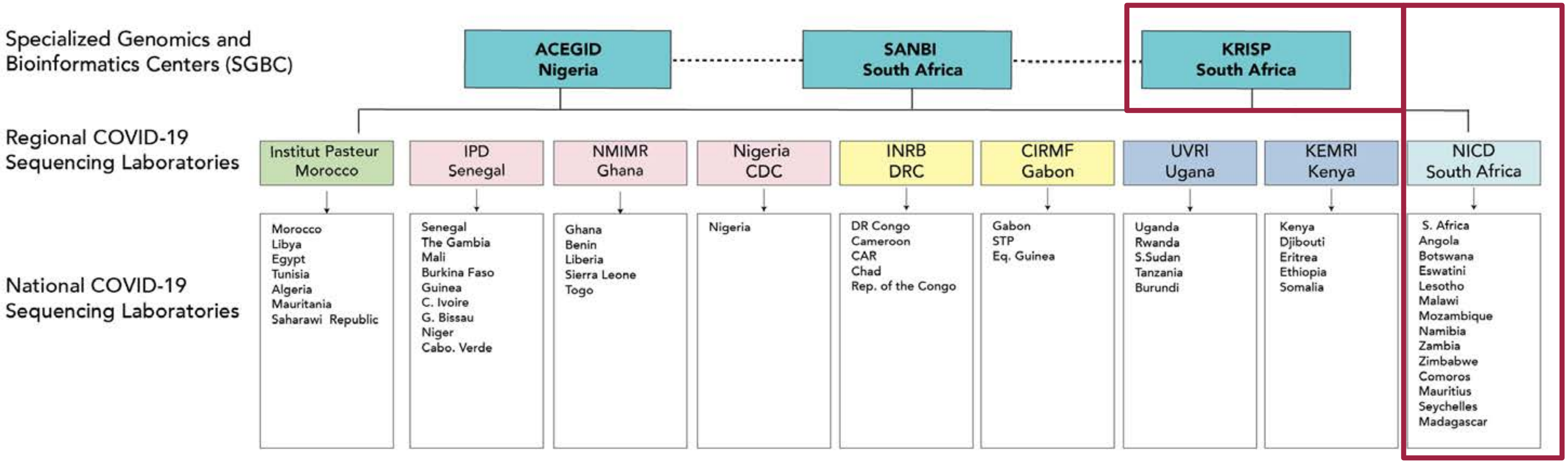
For more on **Network for Genomic Surveillance** see **Comment** *Lancet Microbe* 2020; **1:** e299–30

ACCELERATING SARS-COV-2 SEQUENCING IN AFRICA

Coordination

Operationalization of the network

Leverage on existing capacity



Specialized Genomics and Bioinformatics Centers (SGBC)

ACEGID Nigeria ······ **SANBI South Africa** ······ **KRISP South Africa**

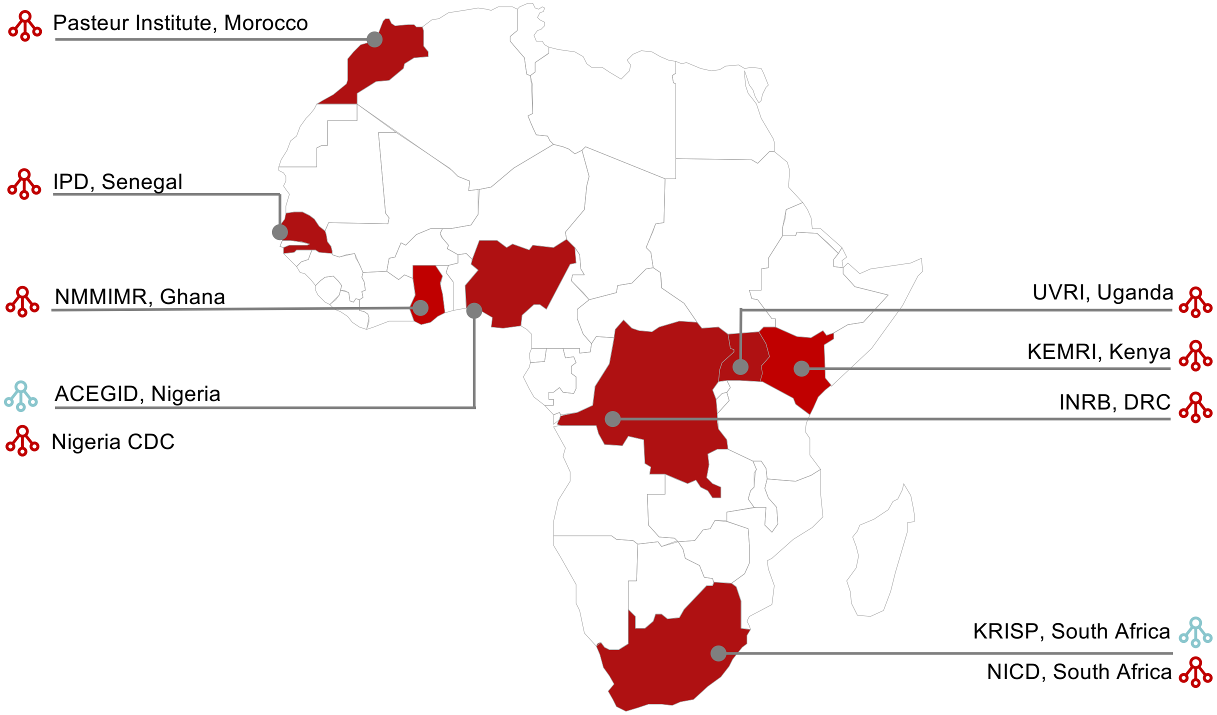
Regional COVID-19 Sequencing Laboratories

National COVID-19 Sequencing Laboratories

Regional COVID-19 Sequencing Laboratories	National COVID-19 Sequencing Laboratories
Institut Pasteur Morocco	Morocco Libya Egypt Tunisia Algeria Mauritania Saharawi Republic
IPD Senegal	Senegal The Gambia Mali Burkina Faso Guinea C. Ivoire G. Bissau Niger Cabo. Verde
NMIMR Ghana	Ghana Benin Liberia Sierra Leone Togo
Nigeria CDC	Nigeria
INRB DRC	DR Congo Cameroon CAR Chad Rep. of the Congo
CIRMF Gabon	Gabon STP Eq. Guinea
UVRI Ugana	Uganda Rwanda S.Sudan Tanzania Burundi
KEMRI Kenya	Kenya Djibouti Eritrea Ethiopia Somalia
NICD South Africa	S. Africa Angola Botswana Eswatini Lesotho Malawi Mozambique Namibia Zambia Zimbabwe Comoros Mauritius Seychelles Madagascar

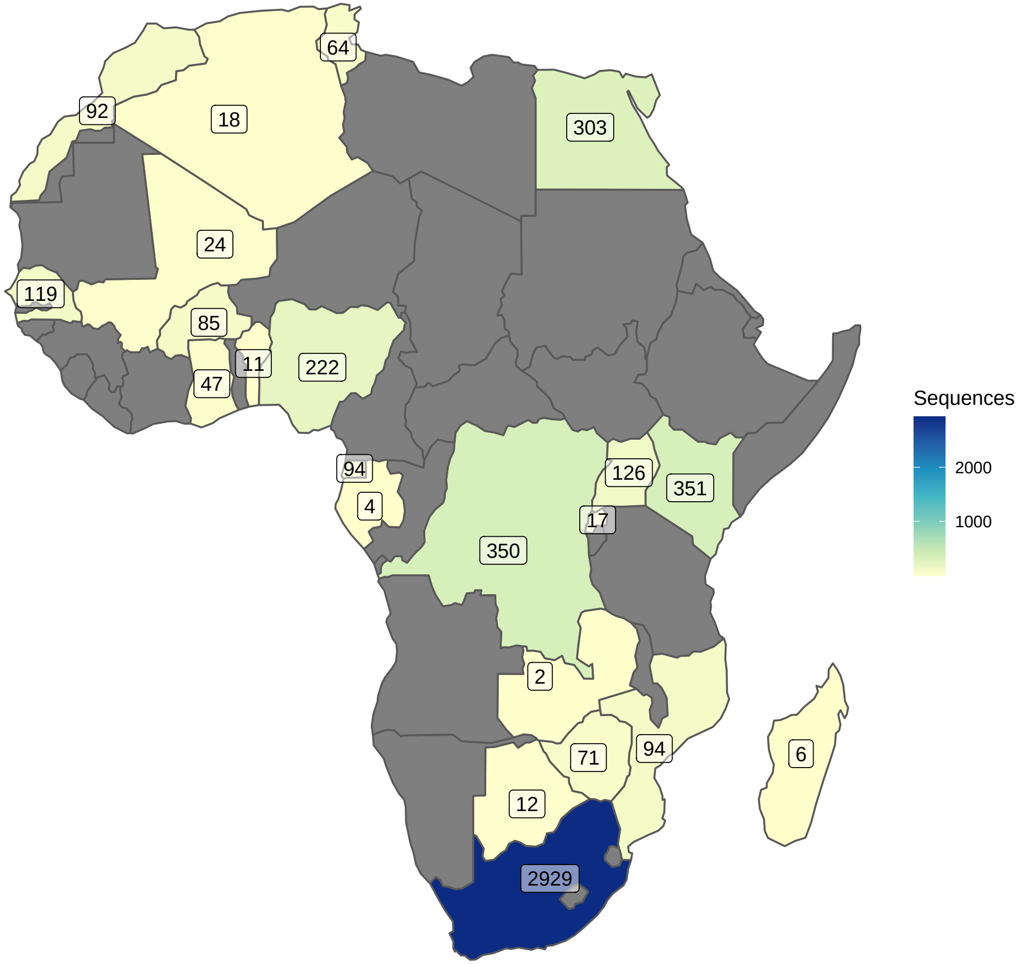
Access to sequencing facility

ACCELERATING SARS-COV-2 SEQUENCING IN AFRICA



1. **Mobilize resources and leverage on existing capacity**
2. **Start simple and establish routine surveillance**
3. **Support sample collection and shipment logistics**
4. **Support sequencing – reagents, equipment upgrades, and personnel**
5. **Support data analysis, sharing, and interpretation**

Sampling and sequencing



Due to various reasons not all African sequences are sufficient for analyses (i.e. to short, clustered SNPs or high number of SNPs). These needs to be removed prior to phylogenetic analyses.

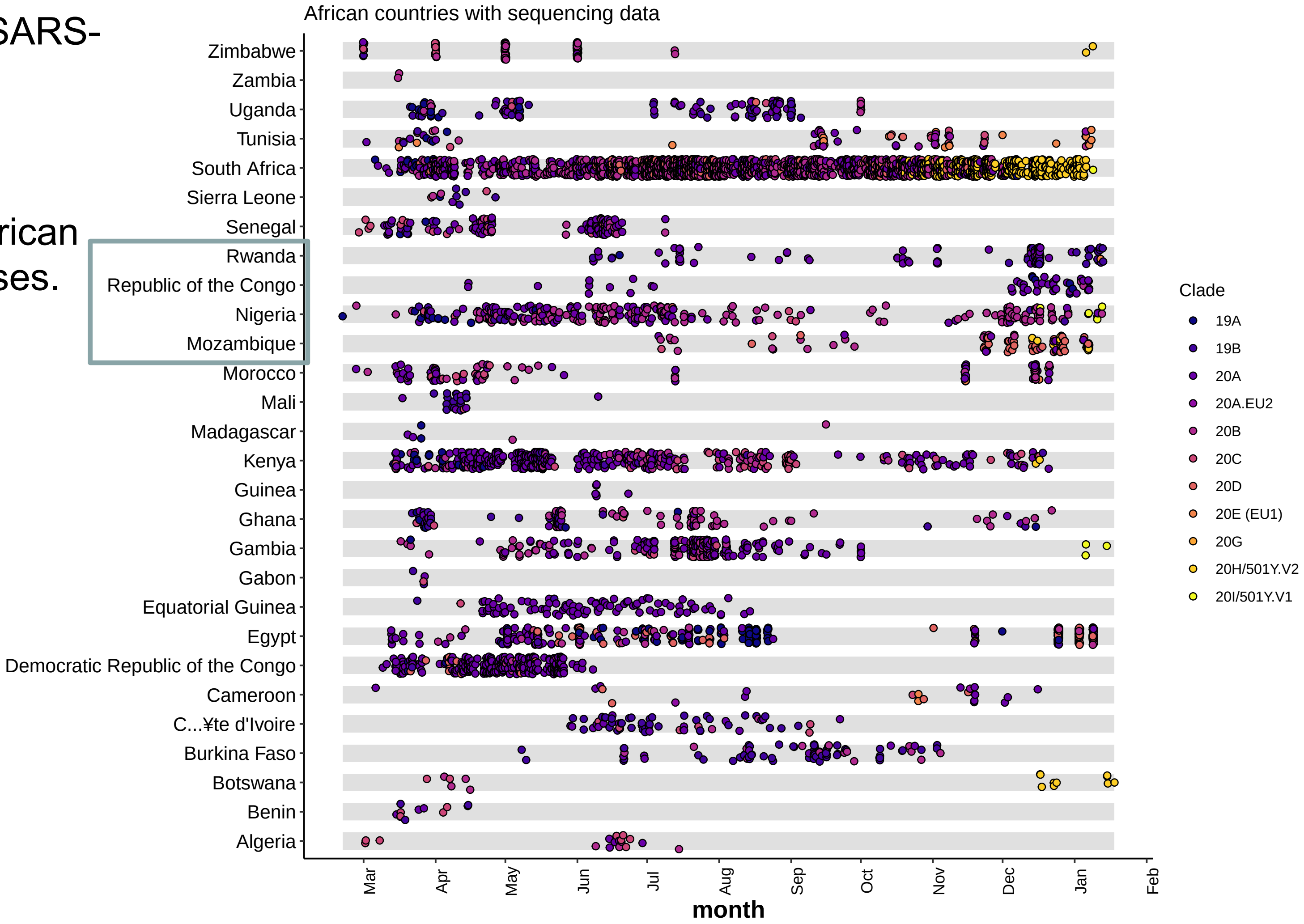
Done in *NextClade*

https://clades.nextstrain.org

Sampling and sequencing

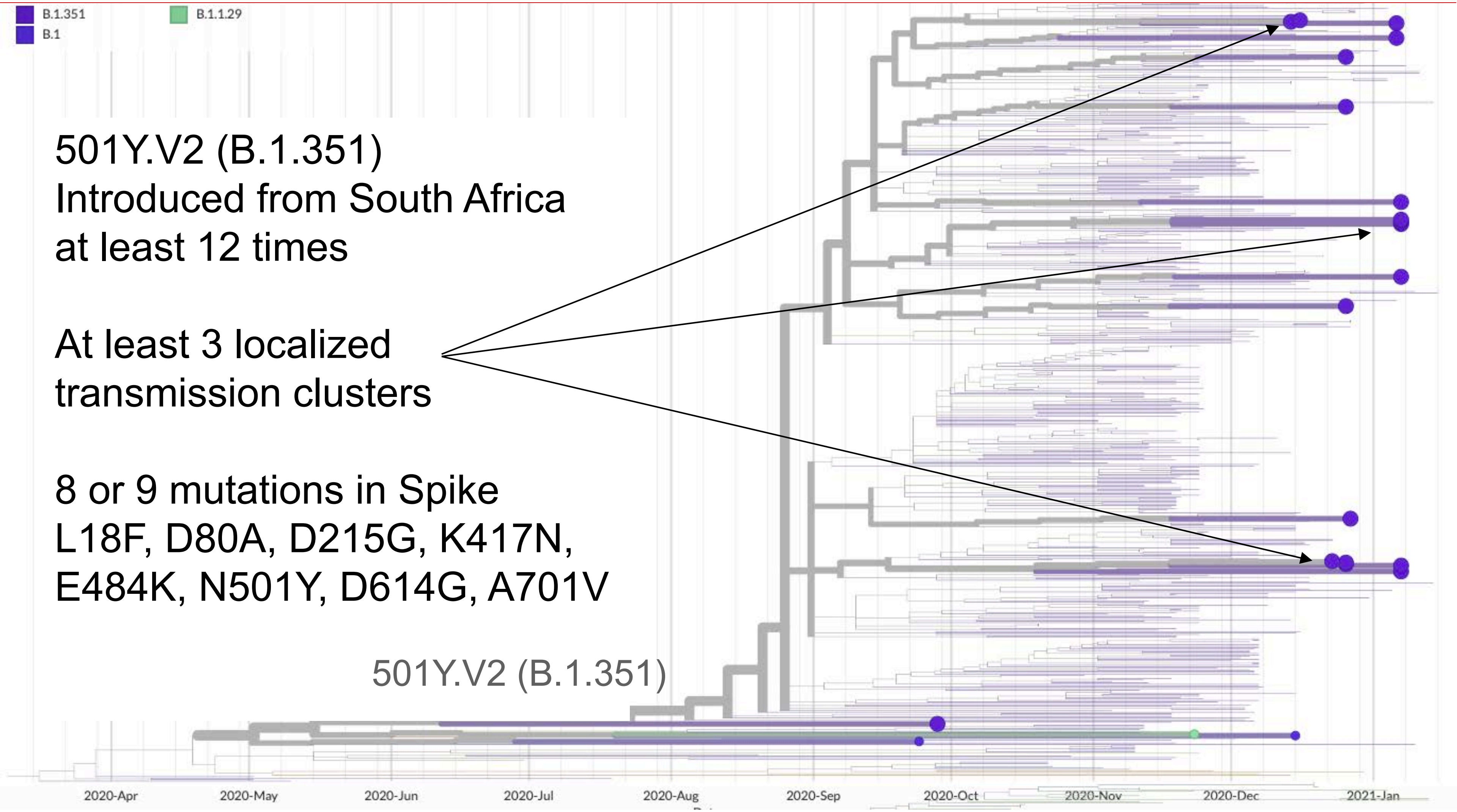
Genomic data from SARS-CoV-2 sequencing in Africa.

5438 good quality African sequences for analyses.


African countries with sequencing data

501Y.V2 in Mozambique

Data from Instituto Nacional de Saúde (INS)



501Y.V2 (B.1.351)
Introduced from South Africa
at least 12 times

At least 3 localized
transmission clusters

8 or 9 mutations in Spike
L18F, D80A, D215G, K417N,
E484K, N501Y, D614G, A701V

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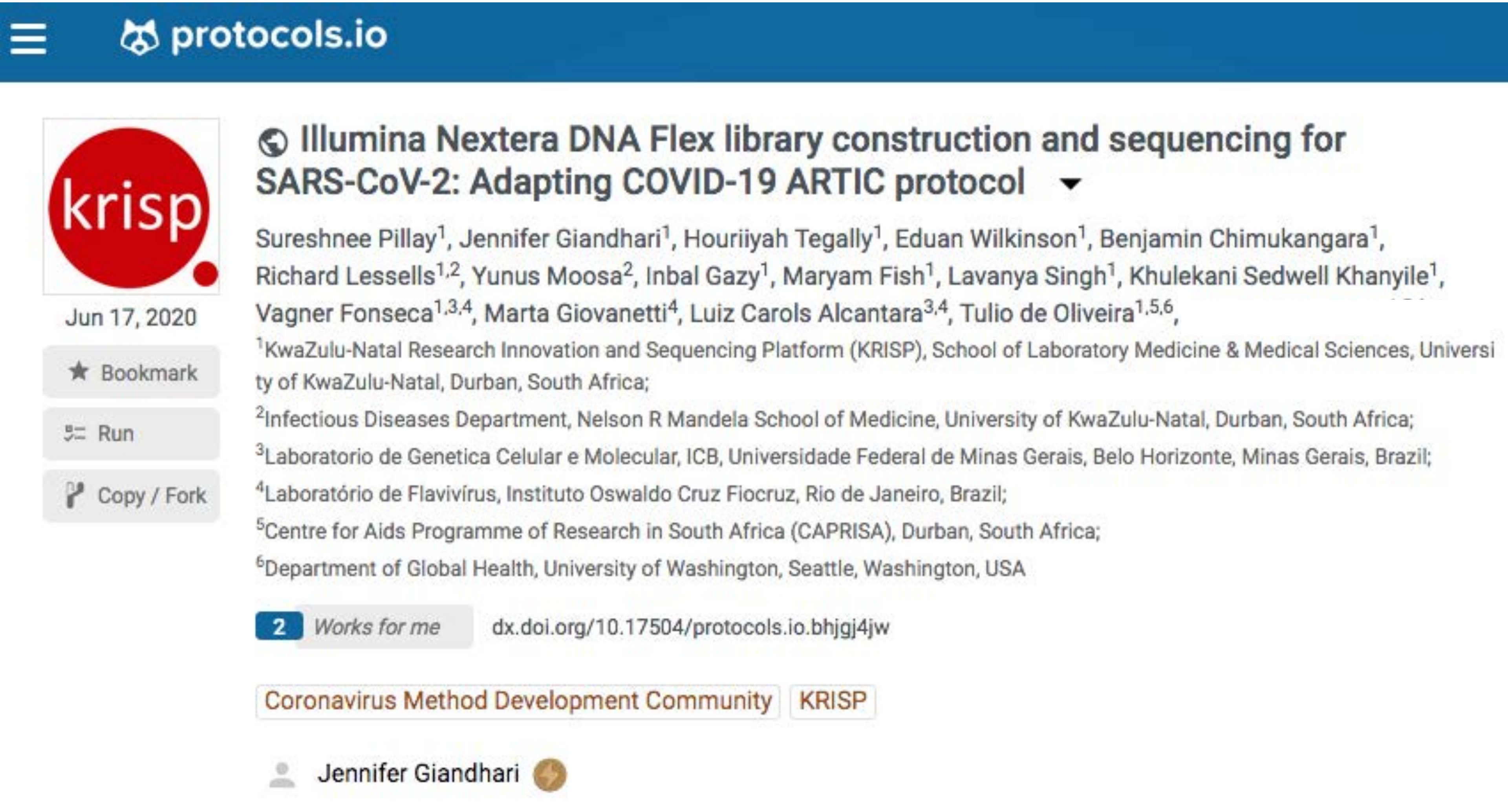
NATIONAL INSTITUTE FOR COMMUNICABLE DISEASES Division of the National Health Laboratory Service

ACCELERATING SARS-COV-2 SEQUENCING IN AFRICA

Current challenges

1. Lack of standardized sampling framework tailored to the African setting (what to sequence?)
2. Market and custom issues on the timely availability of reagents
3. Material Transfer Agreements and import permits
4. Standardized data analysis, sharing, and reporting frameworks



Jun 17, 2020

Illumina Nextera DNA Flex library construction and sequencing for SARS-CoV-2: Adapting COVID-19 ARTIC protocol

Sureshnee Pillay[1], Jennifer Giandhari[1], Houriiyah Tegally[1], Eduan Wilkinson[1], Benjamin Chimukangara[1], Richard Lessells[1,2], Yunus Moosa[2], Inbal Gazy[1], Maryam Fish[1], Lavanya Singh[1], Khulekani Sedwell Khanyile[1], Vagner Fonseca[1,3,4], Marta Giovanetti[4], Luiz Carols Alcantara[3,4], Tulio de Oliveira[1,5,6],

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2 *Works for me*

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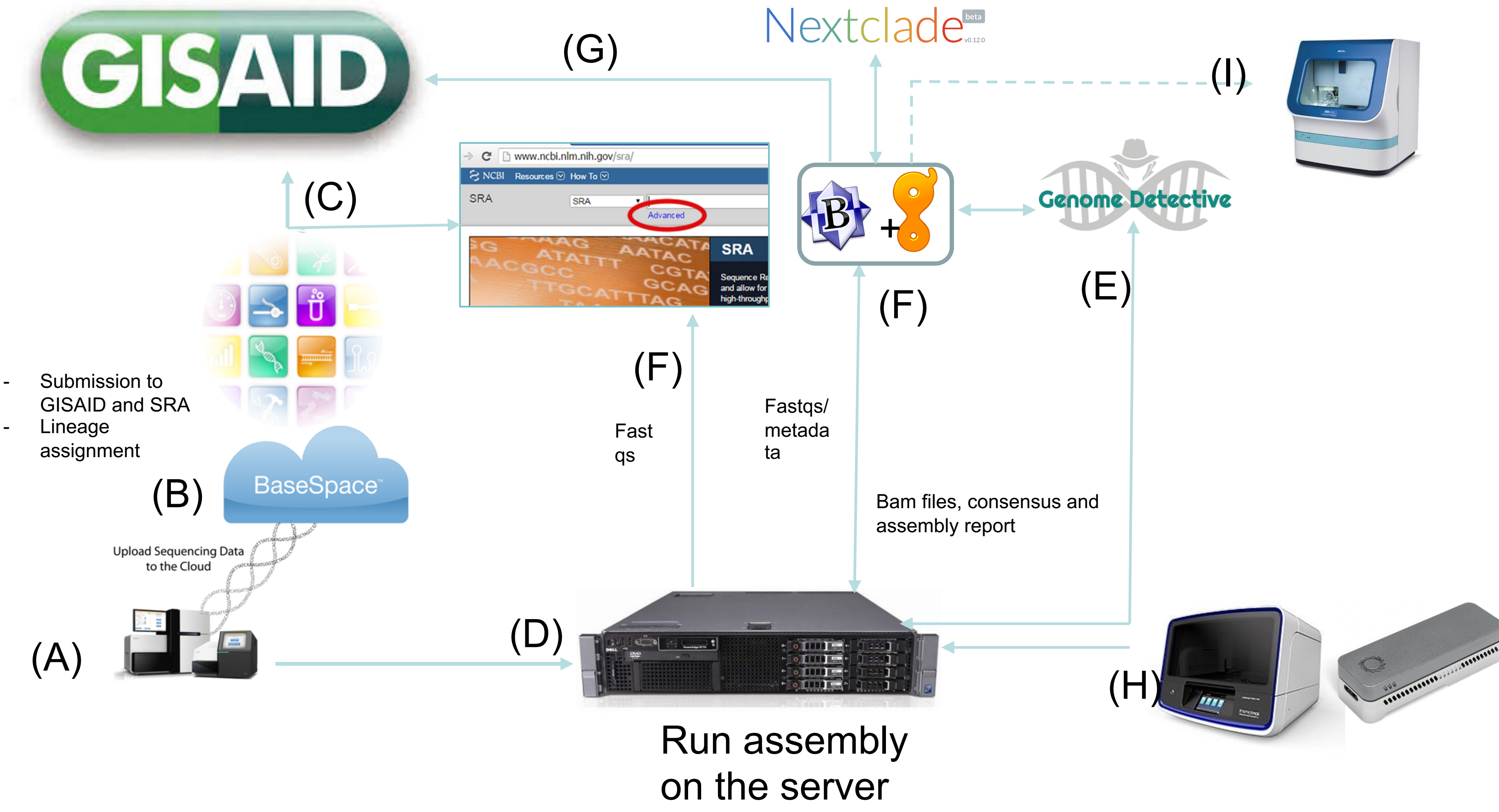
Coronavirus Method Development Community | KRISP

Jennifer Giandhari

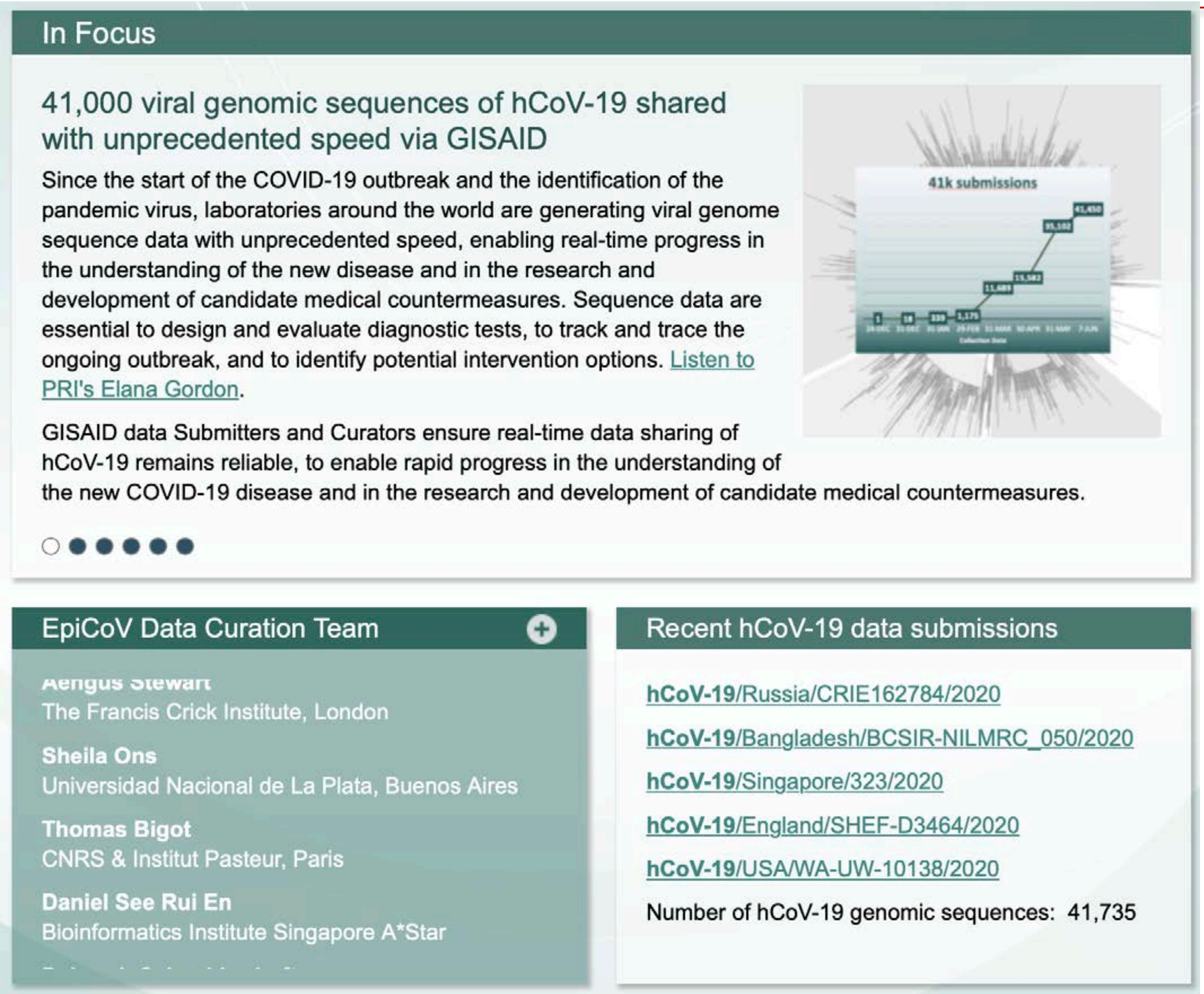
Assembly Automation – Illumina, S5Ion and Nanopore



- Submission to GISAID and SRA
- Lineage assignment

Run assembly
on the server

Data is only analyzed when in GISAID!



41,000 viral genomic sequences of hCoV-19 shared with unprecedented speed via GISAID

Since the start of the COVID-19 outbreak and the identification of the pandemic virus, laboratories around the world are generating viral genome sequence data with unprecedented speed, enabling real-time progress in the understanding of the new disease and in the research and development of candidate medical countermeasures. Sequence data are essential to design and evaluate diagnostic tests, to track and trace the ongoing outbreak, and to identify potential intervention options. Listen to PRI's Elana Gordon.

GISAID data Submitters and Curators ensure real-time data sharing of hCoV-19 remains reliable, to enable rapid progress in the understanding of the new COVID-19 disease and in the research and development of candidate medical countermeasures.

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EpiCoV Data Curation Team

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CNRS & Institut Pasteur, Paris

Daniel See Rui En
Bioinformatics Institute Singapore A*Star

Recent hCoV-19 data submissions

hCoV-19/Russia/CRIE162784/2020

hCoV-19/Bangladesh/BCSIR-NILMRC_050/2020

hCoV-19/Singapore/323/2020

hCoV-19/England/SHEF-D3464/2020

hCoV-19/USA/WA-UW-10138/2020

Number of hCoV-19 genomic sequences: 41,735

Webinar Series on COVID-19 Genomic Surveillance in Africa

/Technical Session/

SARS-CoV-2 whole genome sequencing and quality control

Dr. Jennifer Giandhari

Sureshnee Pillay

Houriiyah Tegally

Emmanuel James San

Wednesday, 05 August 2020
2:00PM - 3:00PM East Africa Time

TO REGISTER VISIT: https://bit.ly/2Okfoqy

Organized by:

African Union

AFRICA CDC
Centres for Disease Control and Prevention
Safeguarding Africa's Health

In partnership with:

SANBI
South African National Bioinformatics Institute

krisp

Institut Pasteur de Dakar

H3ABioNet

Weekly Seminar Series

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