Conducting research using genomics platforms in Nepal: Opportunities and challenges

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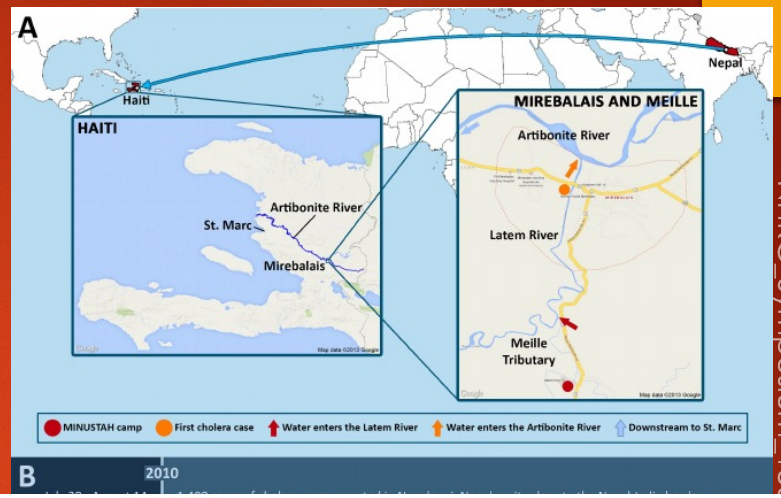
GENERAL SECRETARY, NEPAL PUBLIC HEALTH FOUNDATION

CENTER FOR MOLECULAR DYNAMICS - NEPAL

Center for Molecular Dynamics Nepal

- Center for Molecular Dynamics Nepal (CMDN)- established in 2007
- Non-government, Not-for-profit, Research based Organization
- Research (field and laboratory) into human health and environment: ONE HEALTH approach
- Leading institute in Nepal involved in biomedical and conservation research, and disease surveillance using innovative and latest in molecular and Immuno- diagnostic based technologies.
- Committed to human resource development through various academic and skill enhancing trainings.

Where it started !



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Journal of Nepal Health Research Council

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Outbreak Investigation of Diarrheal Diseases in Jajarkot

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Nepal Health Research Council

PDF

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Methods
Results
Discussion
Conclusion
Competing interests
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References
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Cholera outbreaks (2012) in three districts of Nepal reveal clonal transmission of multi-drug resistant *Vibrio cholerae* O1

Sameer M Dixit[1†], Fatema-Tuz Johura[2†], Sulochana Manandhar[1], Abdus Sadique[2], Rajesh M Rajbhandari[1], Shahnewaj B Mannan[2], Mahamud-ur Rashid[2], Saiful Islam[2], Dibesh Karmacharya[1], Haruo Watanabe[3], R Bradley Sack[4], Alejandro Cravioto[5] and Munirul Alam[2*]

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Bacterial and fungal diseases
Volume 14

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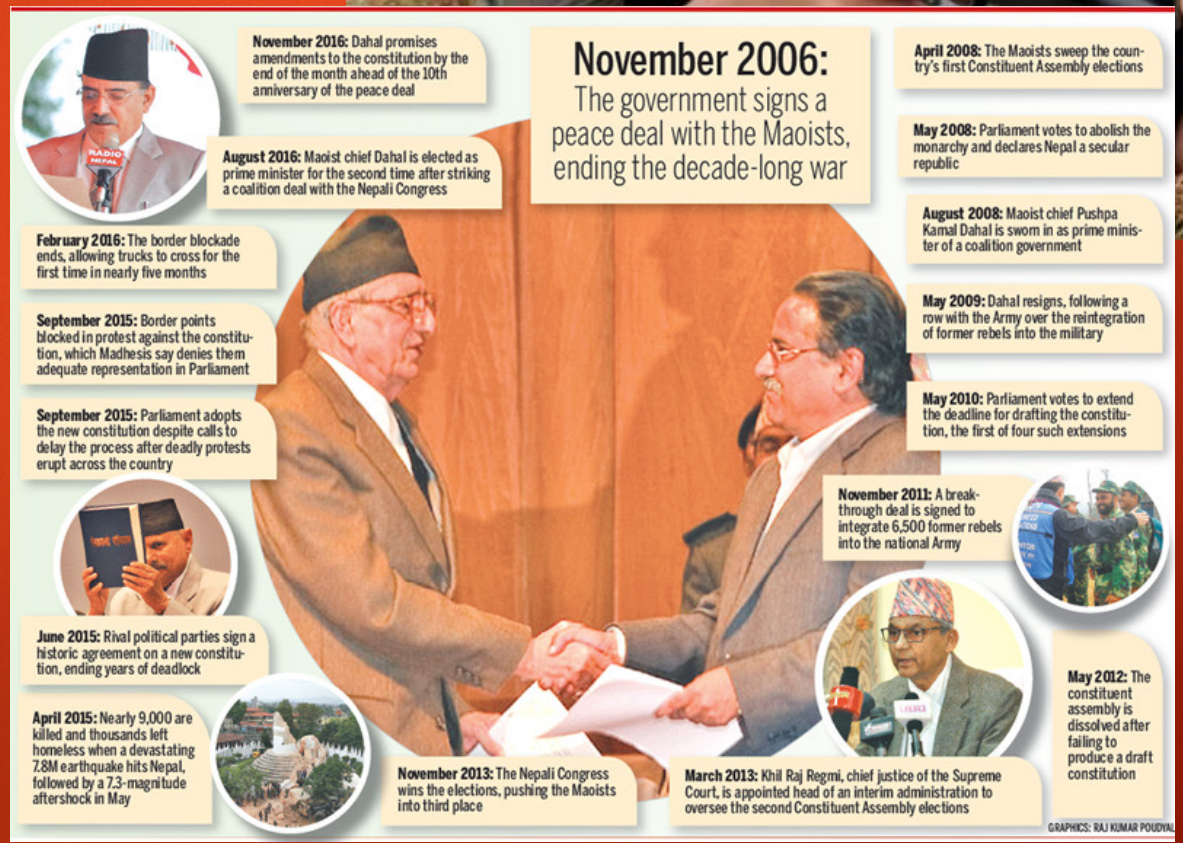
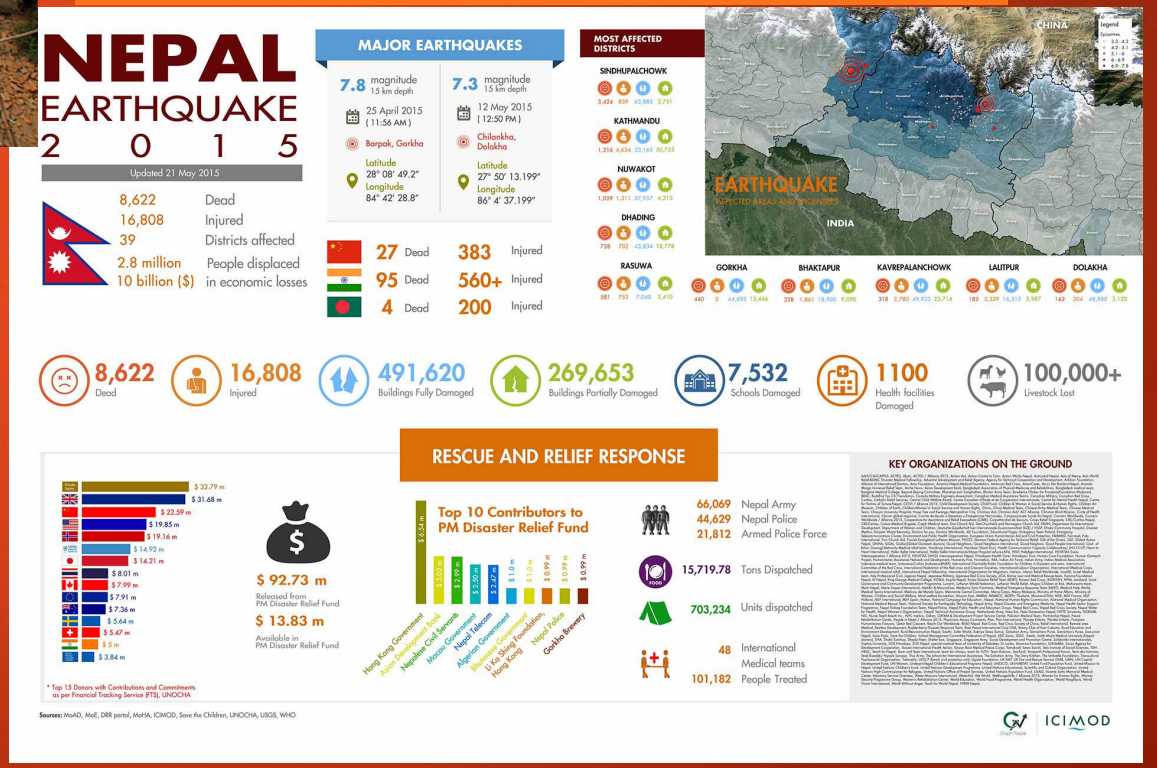
This had just ended…



Maoist Insurgency 1996-2006

..But this happened

NEPAL EARTHQUAKE: April 24, 2015



..and this too

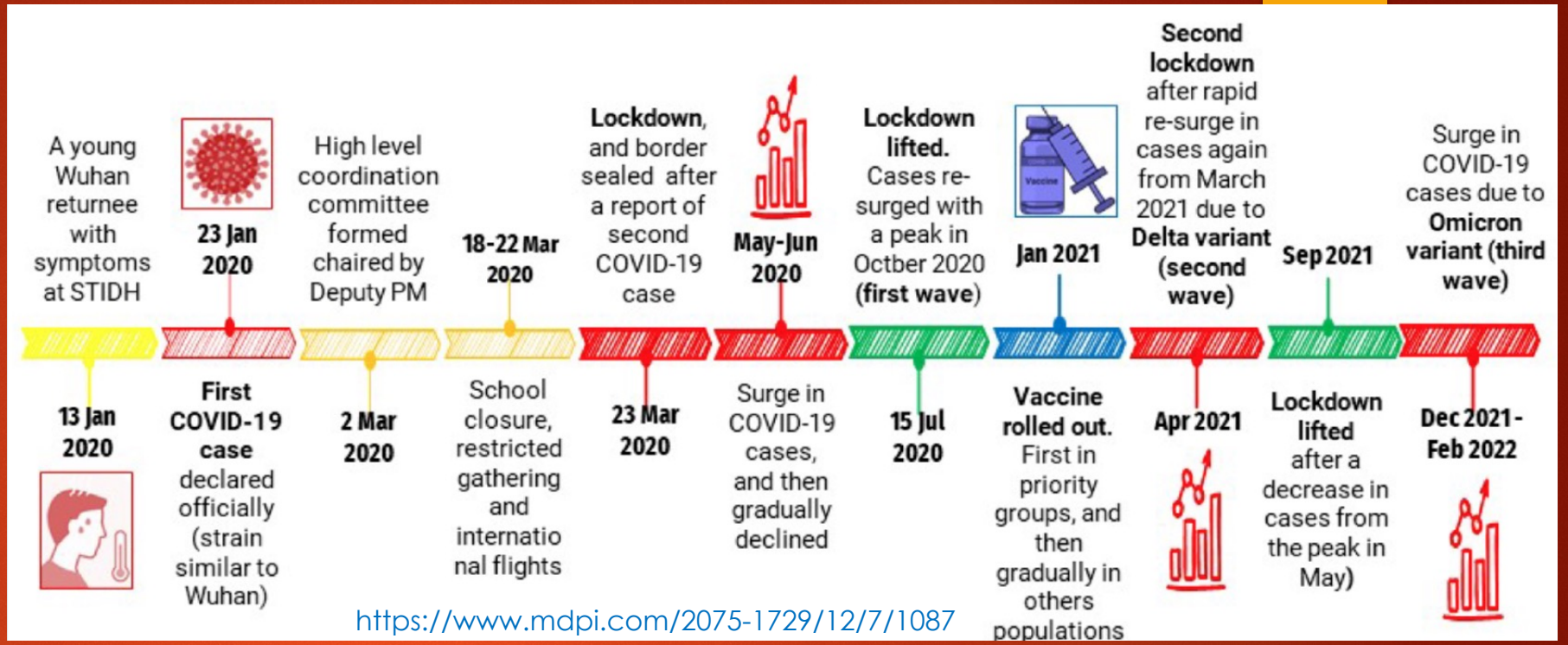
INDIAN BORDER BLOCKADE: SEPTEMBER 2015

..not to forget this

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Group 1	05:00-14:00 18:00-22:00	11:00-19:00	03:00-10:00 14:00-20:00	06:00-15:00 19:00-23:00	10:00-16:00 20:00-24:00	04:00-12:00 16:00-22:00	04:00-11:00 15:00-21:00
Group 2	04:00-11:00 15:00-21:00	05:00-14:00 18:00-22:00	11:00-19:00	03:00-10:00 14:00-20:00	06:00-15:00 19:00-23:00	10:00-16:00 20:00-24:00	04:00-12:00 16:00-22:00
Group 3	04:00-12:00 16:00-22:00	04:00-11:00 15:00-21:00	05:00-14:00 18:00-22:00	11:00-19:00	03:00-10:00 14:00-20:00	06:00-15:00 19:00-23:00	10:00-16:00 20:00-24:00
Group 4	10:00-16:00 20:00-24:00	04:00-12:00 16:00-22:00	04:00-11:00 15:00-21:00	05:00-14:00 18:00-22:00	11:00-19:00	03:00-10:00 14:00-20:00	06:00-15:00 19:00-23:00
Group 5	06:00-15:00 19:00-23:00	10:00-16:00 20:00-24:00	04:00-12:00 16:00-22:00	04:00-11:00 15:00-21:00	05:00-14:00 18:00-22:00	11:00-19:00	03:00-10:00 14:00-20:00
Group 6	03:00-10:00 14:00-20:00	06:00-15:00 19:00-23:00	10:00-16:00 20:00-24:00	04:00-12:00 16:00-22:00	04:00-11:00 15:00-21:00	05:00-14:00 18:00-22:00	11:00-19:00
Group 7	11:00-19:00	03:00-10:00 14:00-20:00	06:00-15:00 19:00-23:00	10:00-16:00 20:00-24:00	04:00-12:00 16:00-22:00	04:00-11:00 15:00-21:00	05:00-14:00 18:00-22:00

14 hours per day on average ! (Jan 2017)

..Lastly (?) COVID-19



https://www.mdpi.com/2075-1729/12/7/1087

HISTORY & CULTURE | CORONAVIRUS COVERAGE

COVID-19 spirals out of control in Nepal: 'Every emergency room is full now'

https://www.nationalgeographic.com/culture/article/a-pandemic-surge-threatens-livelihoods-in-nepal

Surging caseloads, spiking mortality rates, and supply shortages threaten one of India's neighboring nations.

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VIRUS TABLE

VIRAL FAMILY	VIRUS	SPECIES	SAMPLING LOCATION	# OF POSITIVE INDIVIDUALS TOTAL	WET SEASON	DRY SEASON
Coronavirus	Alphacoronavirus NL63	Human	Makwanpur District	2	2	0
	Coronavirus 229E (Human strain)	Human	Kathmandu Valley	2	0	2
	Murine coronavirus	Black Rat	Kathmandu Valley	3	0	3
	Duck coronavirus	Mallard	Kathmandu Valley	16	0	16
	Infectious bronchitis virus	Mallard	Kathmandu Valley	3	0	3
Paramyxovirus	Human parainfluenzavirus 3	Human	Makwanpur District	1	0	1
	PREDICT_PMV-83	Asian House Shrew	Kathmandu Valley	3	0	3
	Newcastle disease virus	Mallard	Kathmandu Valley	8	0	8
Influenza virus	Influenza A	Human, Mallard	Kathmandu Valley, Clinic (Kathmandu), Makwanpur District	21	4	17
Flavivirus	Dengue virus serotype 2	Human	Clinic (Chitwan)	1	0	1
Total				**60**	**6**	**54**

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PANDEMIC PREPAREDNESS FOR GLOBAL HEALTH SECURITY

PREDICT

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Status of S&T funding in Nepal

- Nepal budget '22-'23 -> USD 14 Billion Dollars → 1.6 B to MoEST
- S&T allocation → 0.45%
- India → 0.7%; China → 2%; USA→ 2.7%
- Global Innovation Index:
- Nepal → 95 position; China, India, and Korea → 4th , 10th and 48th

Epidemic Intelligence

BNMT NEPAL
Serving the People of Nepal

Epidemic Intelligence:

Coronavirus sequencing surveillance in Nepal

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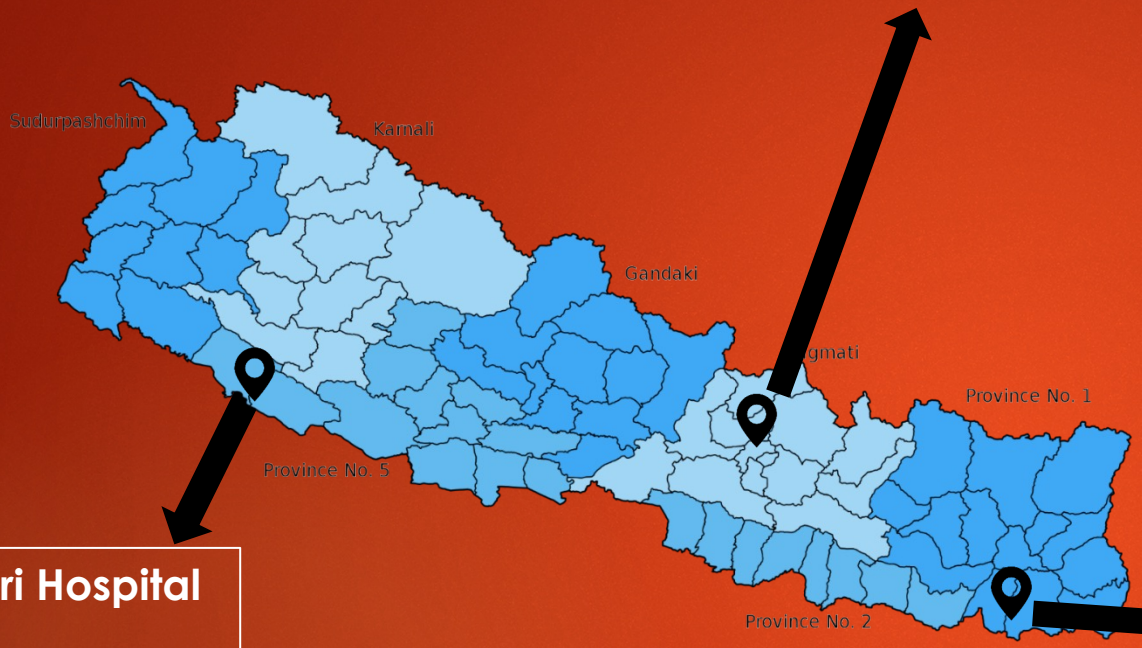
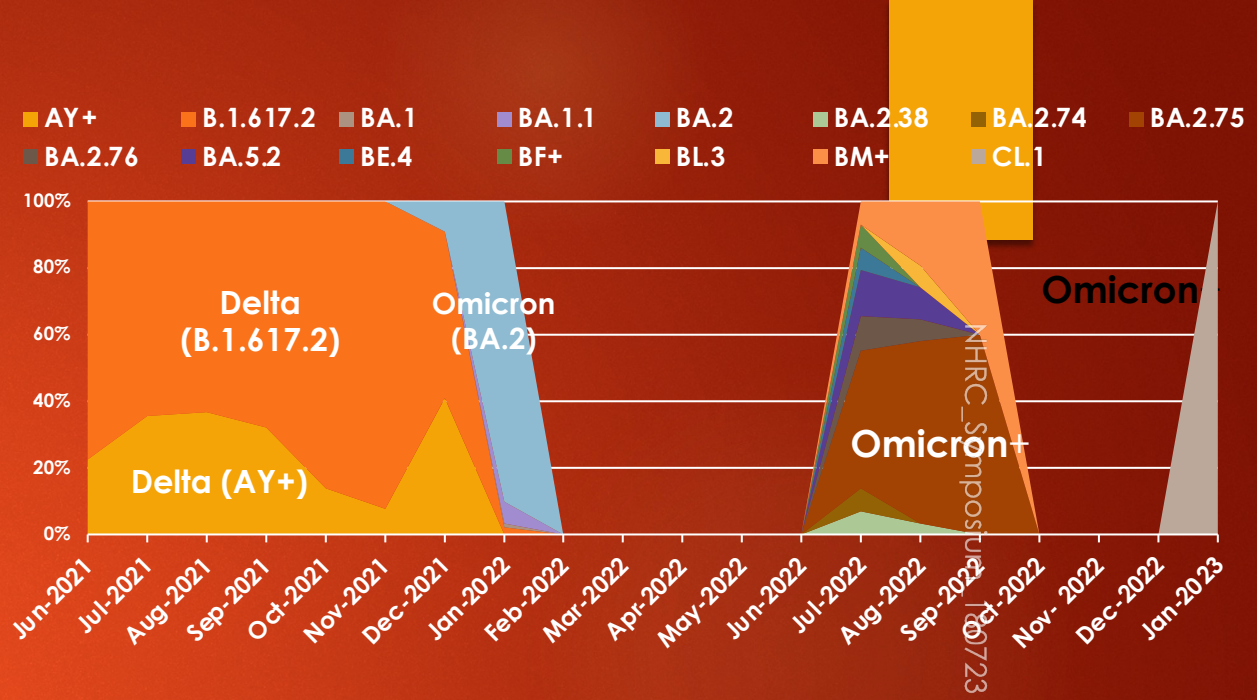
LIVERPOOL SCHOOL OF TROPICAL MEDICINE

oucru

Epidemic Intelligence

Sukraraj (Teku) Hospital





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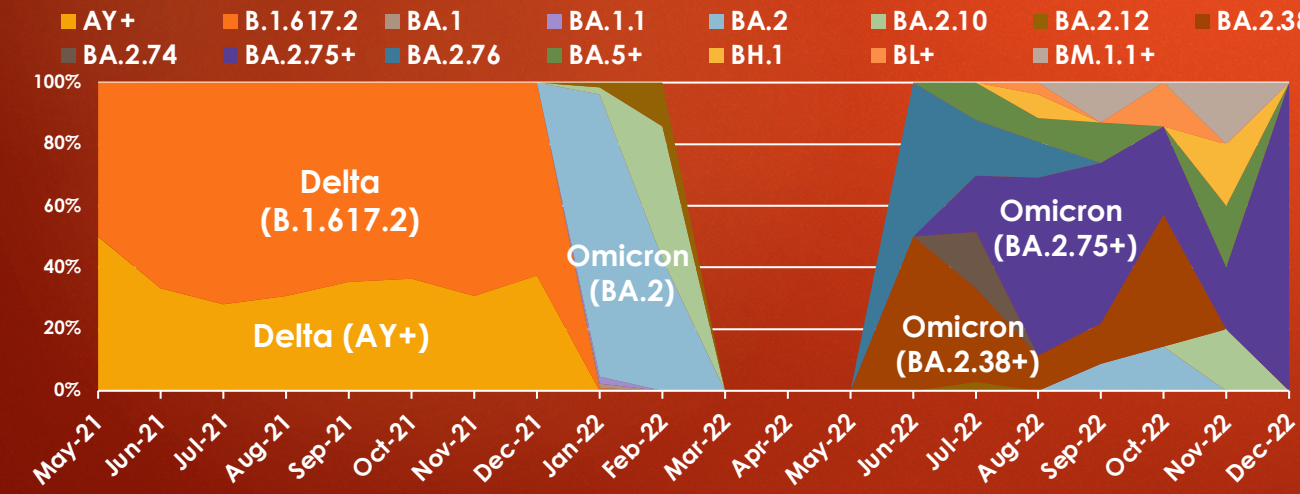
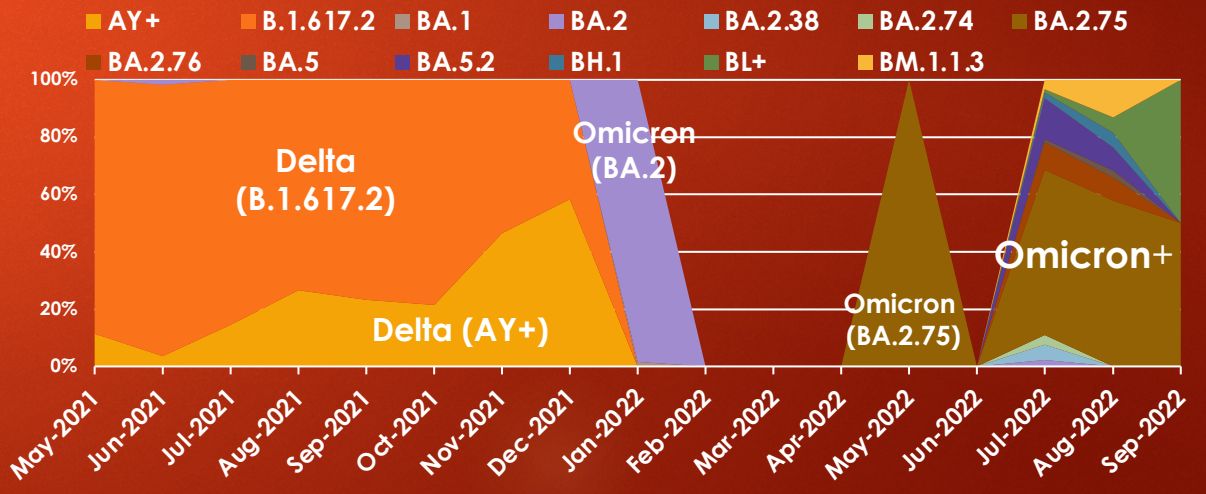
Bheri Hospital



Koshi Hospital



Genomic surveillance of SARS-COV-2 in sewage

PLOS ONE

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Rapid genomic surveillance of SARS-CoV-2 in a dense urban community of Kathmandu Valley using sewage samples

Rajindra Napit, Prajwol Manandhar, Ashok Chaudhary, Bishwo Shrestha, Ajit Poudel, Roji Raut, Saman Pradhan, Samita Raut, Pragun G. Rajbhandari, Anupama Gurung, Rajesh M. Rajbhandari, Sameer M. Dixit, Jessica S. Schwind, [...], Dibesh B. Karmacharya [view all]

Published: March 30, 2023 • https://doi.org/10.1371/journal.pone.0283664

Abstract

Understanding disease burden and transmission dynamics in resource-limited, low-income countries like Nepal are often challenging due to inadequate surveillance systems. These issues are exacerbated by limited access to diagnostic and research facilities throughout the country. Nepal has one of the highest COVID-19 case rates (915 cases per 100,000 people) in South Asia, with densely-populated Kathmandu experiencing the highest number of cases. Swiftly identifying case clusters (hotspots) and introducing effective intervention programs is crucial to mounting an effective containment strategy. The rapid identification of circulating SARS-CoV-2 variants can also provide important information on viral evolution and epidemiology. Genomic-based environmental surveillance can help in the early detection of outbreaks before clinical cases are recognized and identify viral micro-diversity that can be used for designing real-time risk-based interventions. This research aimed to develop a genomic-based environmental surveillance system by detecting and characterizing SARS-CoV-2 in sewage samples of Kathmandu using portable next-generation DNA sequencing devices. Out of 22 sites in the Kathmandu Valley from June to August 2020, sewage samples from 16 (80%) sites had detectable SARS-CoV-2. A heatmap was created to visualize the presence of SARS-CoV-2 infection in the community based on viral load intensity and corresponding geospatial data. Further, 47 mutations were observed in the SARS-CoV-2 genome. Some detected mutations (n = 9, 22%) were novel at the time of data analysis and yet to be reported in the global database, with one indicating a frameshift deletion in the spike gene. SNP analysis revealed possibility of assessing circulating major/minor variant diversity on environmental samples based on key mutations. Our study demonstrated the feasibility of rapidly obtaining vital information on community transmission and disease dynamics of SARS-CoV-2 using genomic-based environmental surveillance.

Main challenges to lab based research

- Erratic power supply
- Cost of consumables (TAXES !): It's expensive in Nepal !!
- Reliance on suppliers (not always efficient)
- Nepal Rastra Bank limitations on dollar payments (in installments)
- Service support in-country
- Access to latest technology extremely limited
- Brain Drain at expert level
- Media/Social Media understanding extremely limited
- NHRC costs, SWC costs, Provincial government, local government hassles
- Tendency of trying to conduct laboratory investigations overseas

Opportunities

- COVID pandemic opened avenues !
- Infectious diseases research !
- Cancer research !
- Human genomics !

Thank you !!

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