IMMUNISATION COALITION

Pandemic proofing our future

A/Prof Kirsty Short
School of Chemistry and Molecular Biosciences
The University of Queensland

Prior to COVID-19 many countries thought that they were prepared

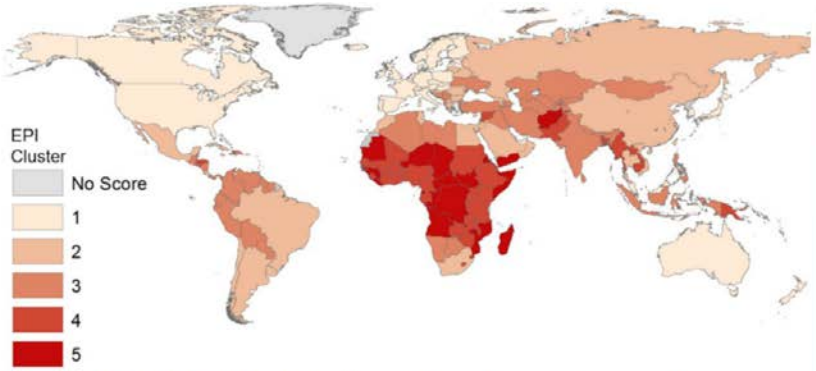
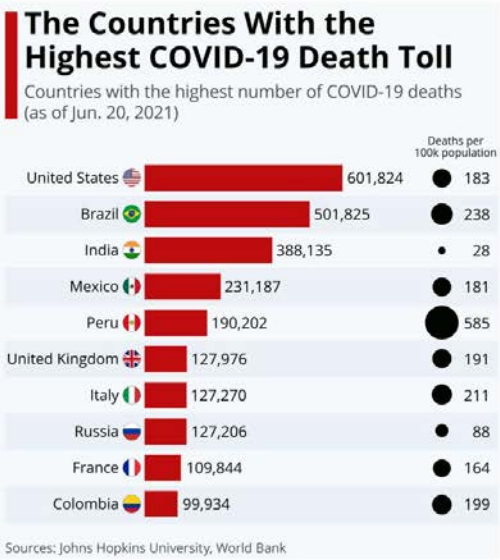


Figure 2 Global distribution of Epidemic Preparedness Index (EPI) scores, with countries binned by k-means clustering (1=most prepared, 5=least prepared).

BMJ Global Health **Assessing global preparedness for the next pandemic: development and application of an Epidemic Preparedness Index**

Ben Oppenheim, Mark Gallivan, Nita K Madhav, Naor Brown, Volodymyr Serhiyenko, Nathan D Wolfe, Patrick Ayscue



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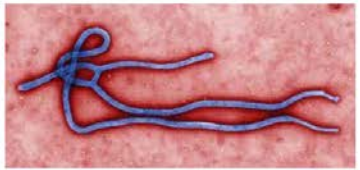
What can we conclude from this disconnect?

- Politics probably disproportionately effects pandemic preparedness
- We need a new approach for pandemic preparedness

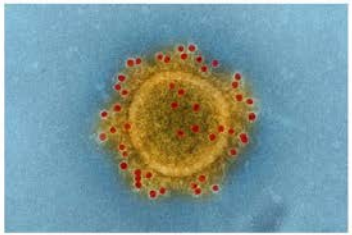
What will be the next pandemic?



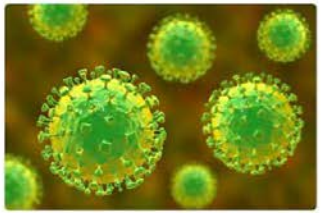
Ebola

Marburg

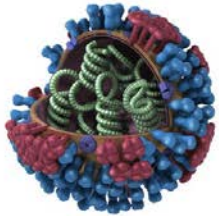
Lassa



MERS-CoV



Nipah



Influenza

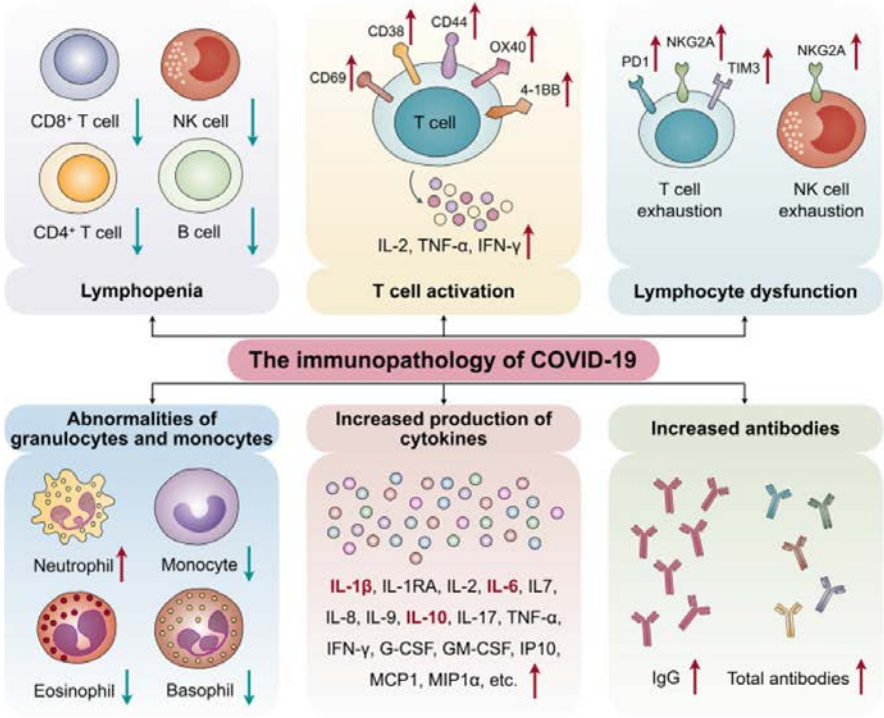
We cannot afford to depend on a virus-specific approach to pandemic preparedness

We need pan viral:

- Vaccines (Universal influenza vaccine; Pan-coronavirus vaccine)
- Therapeutics (vs. traditional anti-virals like Oseltamivir)
- Prognostics (facilitate patient triage)
- Diagnostics

This ensures that we are prepared no matter what virus causes the next pandemic

Therapeutics: targeting the immune system (a pan viral response)

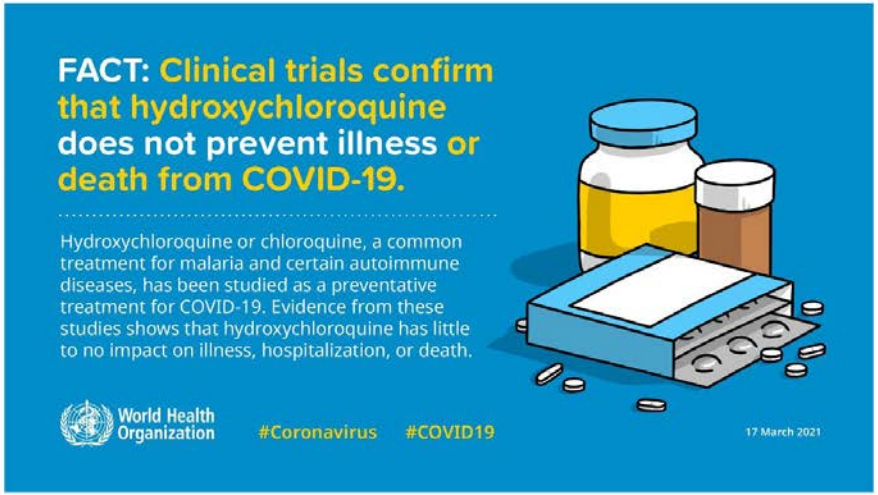


Use the right cell type!

Donald J. Trump
@realDonaldTrump

HYDROXYCHLOROQUINE & AZITHROMYCIN, taken together, have a real chance to be one of the biggest game changers in the history of medicine. The FDA has moved mountains - Thank You! Hopefully they will BOTH (H works better with A, International Journal of Antimicrobial Agents).....

10:13 AM · Mar 21, 2020 · Twitter for iPhone

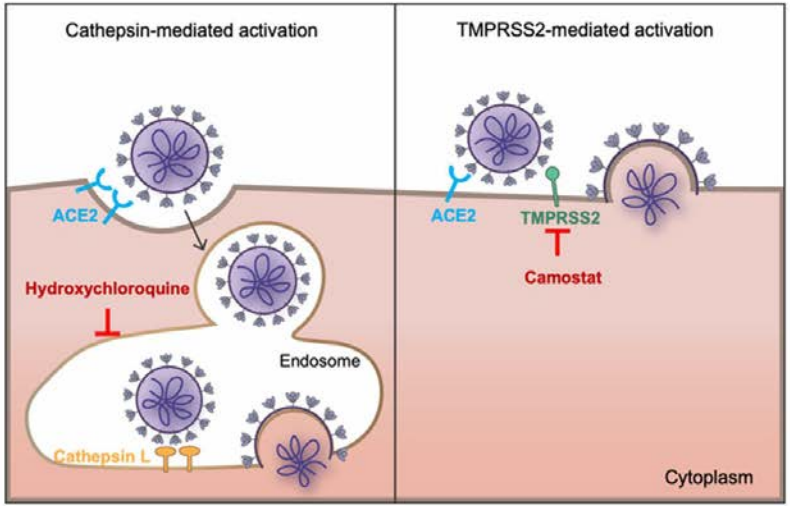


Use the right cell type!

Hydroxychloroquine-mediated inhibition of SARS-CoV-2 entry is attenuated by TMPRSS2

Tianling Ou, Huihui Mou, Lizhou Zhang, Amrita Ojha, Hyeryun Choe, Michael Farzan

Version 2 Published: January 19, 2021 • https://doi.org/10.1371/journal.ppat.1009212



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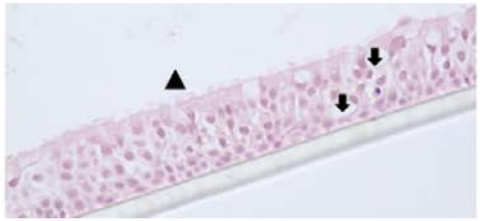
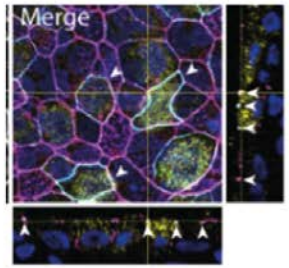
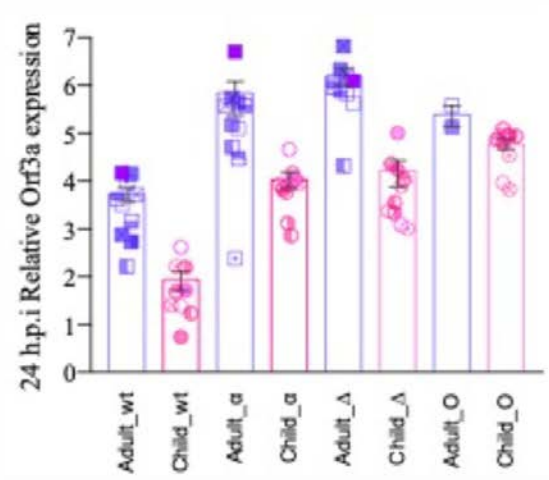
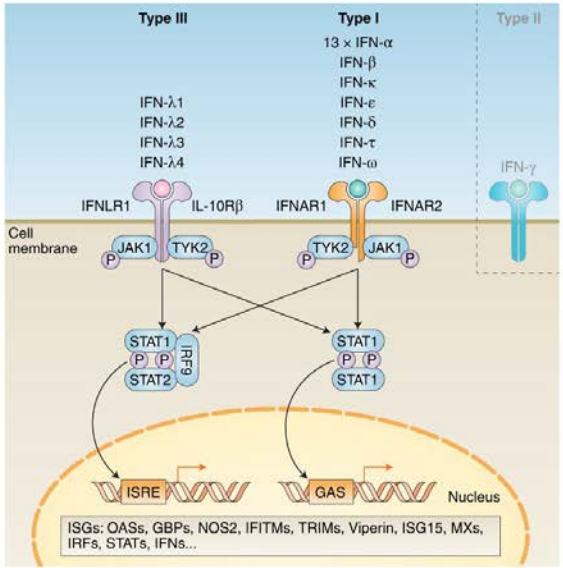
Primary cells, organoids, chips are the way to go







A pan viral prognostic marker



ELSEVIER

Virus Research

Volume 289, November 2020, 198149

IFI27 as a potential indicator for severe Enterovirus 71-infected hand foot and mouth disease

Min, Zhu [a, b, 1], Ye, Zhu [a, b, 1], Gang, Li [c], Boyu, Du [a, d], Xueyan, Xi [a, b, c]

Research | Open Access | Published: 02 January 2021

IFI27 may predict and evaluate the severity of respiratory syncytial virus infection in preterm infants

Junyan Gao, Xueping Zhu, Mingfu Wu, Lijun Jiang, Fudong Wang & Shan He

Hereditas **158**, Article number: 3 (2021) | Cite this article

A novel immune biomarker *IFI27* discriminates between influenza and bacteria in patients with suspected respiratory infection

Benjamin M. Tang, Maryam Shojaei, Grant P. Parnell, Stephen Huang, Marek Nalos, Sally Teoh, Kate O'Connor, Stephen Schibeci, Amy L. Phu, Anand Kumar, John Ho, Adrienne F. A. Meyers, Yoav Keynan, Terry Ball, Amarnath Pisipati, Aseem Kumar, Elizabeth Moore, Damon Eisen, Kevin Lai, Mark Gillett, Robert Geffers, Hao Luo, Fahad Gul, Jens Schreiber, Sandra Riedel, David Booth, Anthony McLean, Klaus Schughart

European Respiratory Journal 2017 49: 1602098; DOI: 10.1183/13993003.02098-2016

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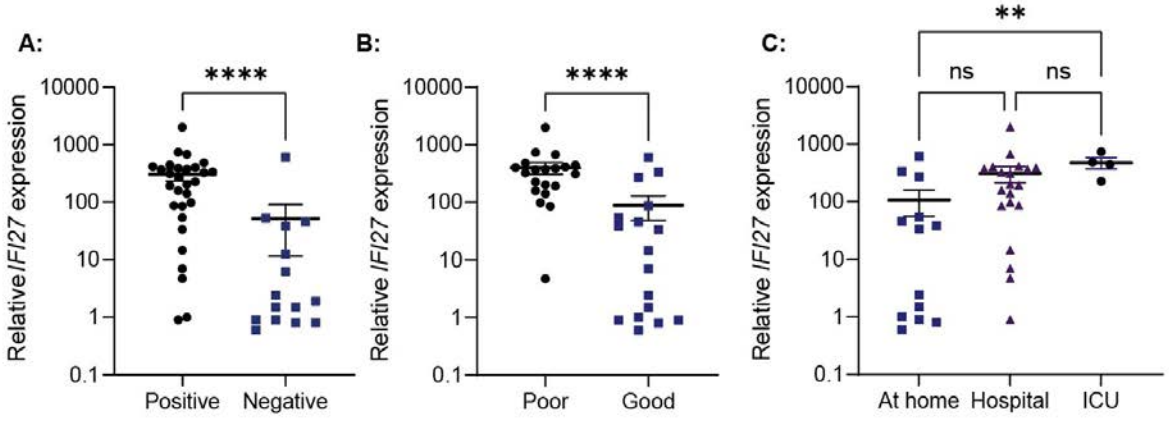
A pan viral prognostic marker



- Patients recruited from Westmead Hospital and Nepean Hospital, New South Wales, Australia (February, 2020)

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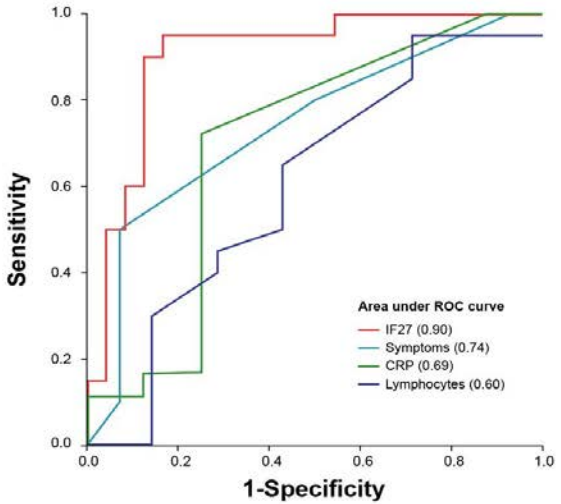
A pan viral prognostic marker



	Sensitivity	Specificity	Positive predictive value	Negative predictive value	AUROC
IFI27	0.95	0.83	0.83	0.95	0.90*
Lymphopenia	0.40	0.71	0.48	0.64	0.60
CRP	0.72	0.75	0.66	0.80	0.69
Age	0.50	0.54	0.42	0.62	0.57
Comorbidity	0.70	0.64	0.57	0.76	0.77*
Symptom score	0.80	0.50	0.52	0.79	0.74*
Heart rate	0.65	0.73	0.61	0.76	0.71*
Respiratory rate	0.45	0.91	0.77	0.71	0.59
PaO_2	0.42	0.64	0.43	0.62	0.53

- Patients recruited from Westmead Hospital and Nepean Hospital, New South Wales, Australia (February, 2020)

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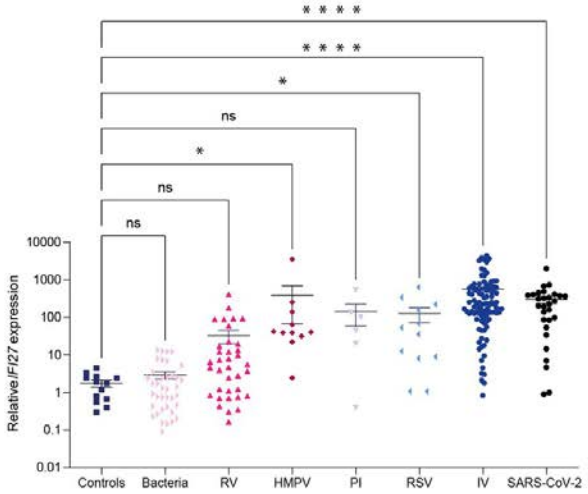
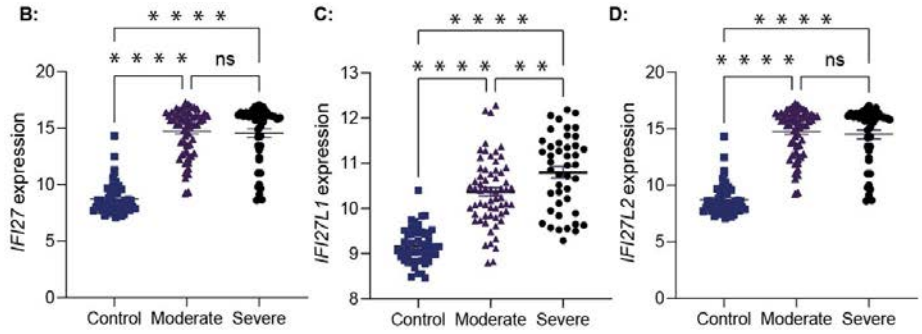


A pan viral prognostic marker



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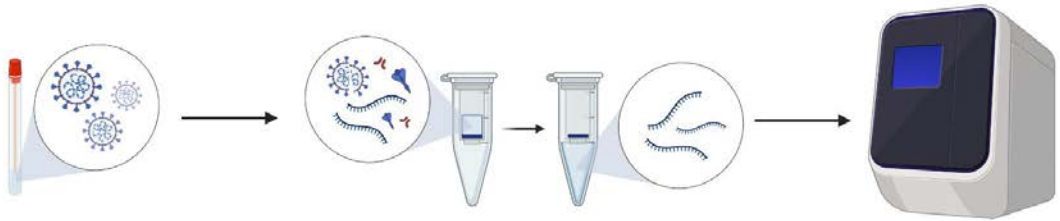
A pan viral diagnostic

- **Detection** of cases is also paramount to quarantine efficacy
- Current gold standard – real-time reverse transcriptase polymerase chain reaction (RT-PCR) for viral RNA
- **+ highly sensitivity and specific**
- **- Highly time dependent (there is a period early in infection that you will test negative to the pathogen even if you are infected; this can delay treatment and affect quarantine and isolation procedures)**
- **- Specific to viral pathogen in question (harder to stockpile for a pandemic; not useful against a novel virus)**



Extract the viral RNA

A pan viral diagnostic: the host transcriptome

Lancet Microbe. 2021 Oct; 2(10): e508–e517.
Published online 2021 Oct. doi: 10.1016/S2666-5247(21)00146-4
PMCID: PMC8260104
PMID: 34250515

Blood transcriptional biomarkers of acute viral infection for detection of pre-symptomatic SARS-CoV-2 infection: a nested, case-control diagnostic accuracy study

Rishi K Gupta, MRCP,[a,b,*] Joshua Rosenheim, MSc,[b,*] Lucy C Bell, PhD,[b,*] Aneesh Chandran, PhD,[b] Jose A Guerra-Assuncao, PhD,[b] Gabriele Pollara, PhD,[b] Matthew Whelan, PhD,[b] Jessica Artico, MBBS,[d] George Joy, MBBS,[d] Hibba Kurdi, MBBS,[d] Daniel M Altmann, Prof, PhD,[g] Rosemary J Boyton, Prof, PhD,[h] Mala K Maini, Prof, PhD,[b] Aine McKnight, Prof, PhD,[i] Jonathan Lambourne, PhD,[e] Teresa Cutino-Moguel, PhD,[f] Charlotte Manisty, PhD,[c,d] Thomas A Treibel, PhD,[c,d] James C Moon, Prof, PhD,[c,d] Benjamin M Chain, Prof, PhD,[b] Mahdad Noursadeghi, Prof, PhD,[b,*] and COVIDsortium Investigators, on behalf of the

ARTICLES | VOLUME 21, ISSUE 3, P396-404, MARCH 01, 2021

A blood-based host gene expression assay for early detection of respiratory viral infection: an index-cluster prospective cohort study

Micah T McClain, MD • Florica J Constantine, MS • Bradly P Nicholson, PhD • Marshall Nichols, MS • Thomas W Burke, PhD • Ricardo Henao, PhD • et al. Show all authors

Published: September 24, 2020 • DOI: https://doi.org/10.1016/S1473-3099(20)30486-2 • Check for updates

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A pan viral diagnostic: the host transcriptome

	AUROC	Sensitivity	Specificity	Adjusted p value
IFI27	0·95 (0·91–0·99)	0·84 (0·70–0·93)	0·95 (0·85–0·98)	..
Sweeney7	0·95 (0·91–0·99)	0·82 (0·67–0·91)	0·95 (0·85–0·98)	0·85
Zaas48	0·93 (0·88–0·98)	0·61 (0·45–0·74)	0·95 (0·85–0·98)	0·088
Pennisi2	0·91 (0·86–0·96)	0·58 (0·42–0·72)	0·95 (0·85–0·98)	0·088
IFI44L	0·90 (0·84–0·96)	0·55 (0·40–0·70)	0·95 (0·85–0·98)	0·039
AndresTerre11	0·89 (0·83–0·95)	0·55 (0·40–0·70)	0·95 (0·85–0·98)	0·021
Henrickson16	0·89 (0·82–0·96)	0·55 (0·40–0·70)	0·93 (0·83–0·97)	0·0093
TrouilletAssant6	0·87 (0·80–0·94)	0·53 (0·37–0·68)	0·93 (0·83–0·97)	0·008
Lydon15	0·86 (0·79–0·94)	0·58 (0·42–0·72)	0·95 (0·85–0·98)	0·0046
Herberg2	0·84 (0·76–0·92)	0·5 (0·35–0·65)	0·93 (0·83–0·97)	0·0034
Sampson4	0·84 (0·76–0·92)	0·5 (0·35–0·65)	0·93 (0·83–0·97)	0·0027
Sampson10	0·83 (0·74–0·92)	0·5 (0·35–0·65)	0·95 (0·85–0·98)	0·0021
RSAD2	0·83 (0·74–0·91)	0·47 (0·32–0·63)	0·93 (0·83–0·97)	0·0021
MX1	0·82 (0·74–0·91)	0·45 (0·30–0·60)	0·95 (0·85–0·98)	0·0017
Tsalik33	0·79 (0·70–0·89)	0·39 (0·26–0·55)	0·98 (0·9–1·0)	0·0011
Lopez7	0·79 (0·69–0·88)	0·37 (0·23–0·53)	0·98 (0·9–1·0)	0·00080
IFIT3	0·75 (0·64–0·86)	0·45 (0·30–0·60)	0·93 (0·83–0·97)	0·00027
OLFM4	0·62 (0·51–0·74)	0·03 (0·0–0·13)	0·98 (0·9–1·0)	<0·0001
Sweeney11	0·60 (0·48–0·73)	0·16 (0·07–0·30)	0·96 (0·88–0·99)	<0·0001
Yu3	0·59 (0·47–0·71)	0·05 (0·01–0·17)	1 (0·93–1·0)	<0·0001

Data are point estimates (95% CIs). Includes 38 contemporaneous SARS-CoV-2-positive samples and 55 SARS-CoV-2-negative samples. Discrimination is shown as AUROC. Sensitivity and specificity are shown using predefined thresholds of 2 SDs above the mean of the uninfected control population (Z2). p values show pairwise comparisons to best performing signature with Benjamini-Hochberg adjustment (false discovery rate 0·05). Equivalent data for discrimination between test-negative controls and participants with SARS-CoV-2 infection 1 week before positive PCR test are in appendix 1 (p 7). AUROC=area under the receiver operating characteristic curve.

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PMCID: PMC8260104
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Blood transcriptional biomarkers of acute viral infection for detection of pre-symptomatic SARS-CoV-2 infection: a nested, case-control diagnostic accuracy study

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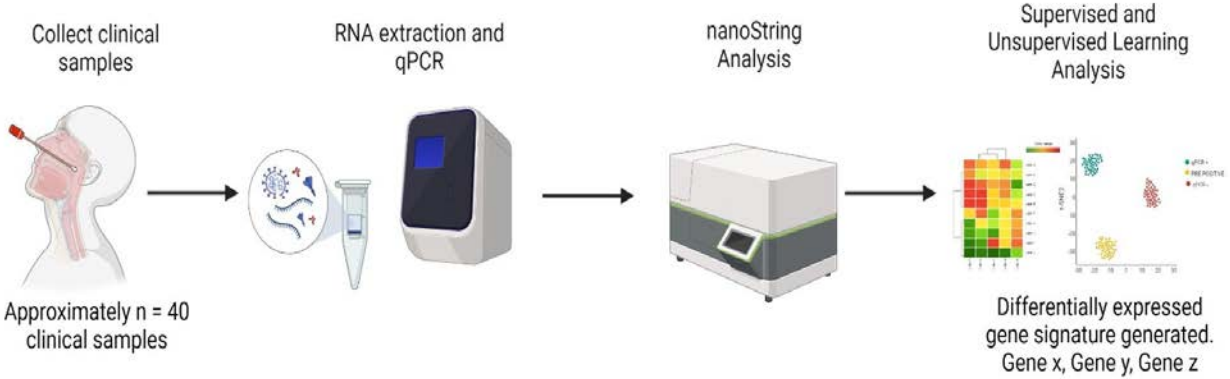

Watch this space!!!

When will the next pandemic be?
What will it be?
Will we have learnt from COVID-19?

Acknowledgements

Australian Government
National Health and Medical Research Council
NHMRC

Maryam Shojaei[1,2#], Amir Shamshirian[3], James Monkman[4,5], Laura Grice[6], Minh Tran[6], Chin Wee Tan[7,8], Gustavo Rodrigues Rossi[5], Timothy R. McCulloch[5], Marek Nalos[1], Keng Yih Chew[9], Yanshan Zhu[9], Yao Xia[10], Timothy J. Wells[5], Alexandra Cristina Senegaglia[11,12], Carmen Lúcia Kuniyoshi Rebelatto[11,12], Claudio Luciano Franck[11], Anna Flavia Ribeiro dos Santos[11], Lucia de Noronha[11], Sepideh Motamen[13], Reza Valadan[14,15], Omolbanin Amjadi[3], Rajan Gogna[16,17], Esha Madan[18], Reza Alizadeh-Navaei[3], Liliana Lamperti[19], Felipe Zuñiga[19], Estefania Nova-Lamperti[20], Gonzalo Labarca[19,20], Ben Knippenberg[21], Velma Herwanto[22], Ya Wang[1,2] Amy Phu[1,23], Tracy Chew[24], Timothy Kwan[1], Karan Kim[2], Sally Teoh[1], Tiana M Pelaia[1], Win Sen Kuan[25, 26], Yvette Jee[25], Jon Iredell [27,28,29], Ken O'Byrne[4], John F. Fraser[30], Melissa J. Davis[7,8,31], Gabrielle T. Belz[5], Majid E. Warkiani[32], Carlos Salomon Gallo[19,33], Fernando Souza-Fonseca-Guimaraes[5], Quan Nguyen[6], Anthony Mclean[1] Arutha Kulasinghe[5*#], Kirsty R. Short[9*#], Benjamin Tang[1,2*]

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