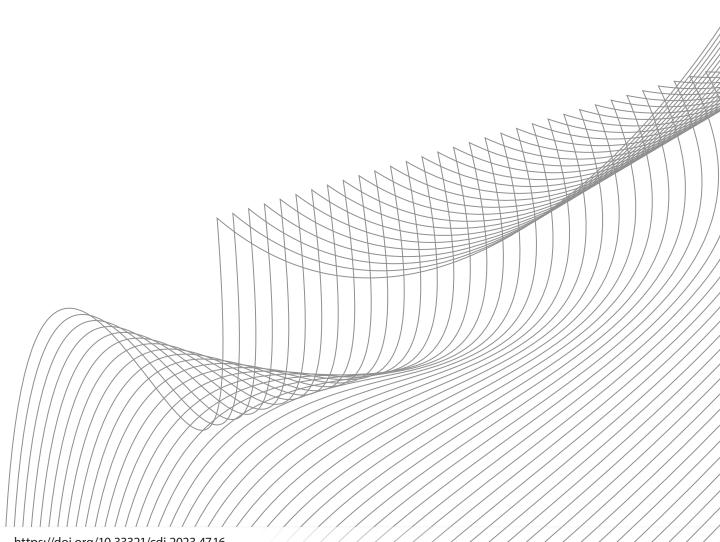# Communicable Diseases Intelligence

Identifying a more severe emergent COVID-19 variant using Emergency Departments' routinely collected clinical measures

Adelaide Nyinawingeri, Michael Staff

Original article

Identifying a more severe emergent COVID-19 variant using Emergency Departments' routinely collected clinical measures

Adelaide Nyinawingeri, Michael Staff

Abstract

Objective

To determine whether a clinical scoring system (the *m*PRIEST score) could be used to identify an emerging coronavirus disease 2019 (COVID-19) variant with increased clinical severity.

Design

Cross sectional study comparing two time periods (Delta and Omicron waves).

Setting

Public Emergency Departments in Northern Sydney Local Health District.

Participants

Patients presenting during August 2021 (Delta wave) and January 2022 (Omicron wave) with confirmed COVID-19. Data on age, gender, temperature, heart rate, systolic blood pressure, respiratory rate, oxygen saturation and mental status were extracted from patients' electronic medical records to assess clinical disease severity at presentation.

Main outcome measures

Modified Pandemic Respiratory Infection Emergency System Triage (*m*PRIEST) score calculated using routinely collected data.

Results

A sample of 262 records of COVID-19 positive patients presenting during the Delta and initial Omicron waves were reviewed with 205 having COVID-19 as their primary diagnosis. During the Delta wave 48.1% had scores above 4 compared to 35.1% for the Omicron wave (p = 0.03). The median score was also significantly higher for the Delta group (4 vs 3; p = 0.01). Hospitalisations, admissions to ICU and deaths during admission were higher among patients presenting during the Delta wave than among those presenting during the Omicron wave.

Conclusion

The *m*PRIEST score was significantly higher for patients for whom the predominant circulating variant was Delta than those for whom the predominant circulating variant was Omicron. This finding is consistent with international reporting of severity measured by hospital admission data and demonstrates the score's possible ability to identify an emergent strain with higher morbidity and mortality.

Keywords: COVID-19; COVID-19 variants; *m*PRIEST score; emergency departments

Introduction

Australia has experienced several waves of coronavirus disease 2019 (COVID-19) infections, with recent population-wide outbreaks caused by the Delta and Omicron variants of concern.[1,2] These variants differ in their transmissibility, ability to escape immunity from vaccination, and disease severity.[3,4] In New South Wales (NSW), the Delta variant was responsible for a wave beginning in July 2021 and was largely replaced by another wave due to the Omicron variant that commenced in December of that year. A report by the World Health Organization in 2022 confirmed that the Delta variant had higher morbidity and mortality than the more recent Omicron variants.[5]

Current COVID-19 surveillance activity in Australia includes notifications based upon laboratory polymerase chain reaction (PCR) testing or patient administered rapid antigen testing, whole genome sequencing, hospital admission data and death data.[2, 6–7] Although whole genome sequencing can confirm the presence of new variants, the public health community still needs to determine whether their detection warrants an intensified public health response.[8] Hospital admission and death data are indicators of disease severity, although they lag behind changes in disease prevalence.[9,10] At an individual level, hospitalisation and death outcomes have been estimated to occur on the order of 8 to 10 days and 18 to 25 days after onset of illness respectively.[9] At a population level, these lags can limit the responsiveness—and hence likely effectiveness—of public health responses, such as calls for increased social distancing and mask wearing and the broadening of the use of antiviral medications should emergence occur of a new variant with increased clinical severity.

In New South Wales, a near real-time monitoring system that analyses electronic medical record data (the Public Health Rapid Emergency Disease Syndromic Surveillance)[11] reports the number of hospital Emergency Department (ED) presentations by patients with COVID-19. By including more clinical data into this system it could be used to monitor the illness severity of patients presenting with COVID-19 and enhance our current surveillance system.

United Kingdom (UK) Emergency clinicians and researchers have developed an ED triage tool, based on clinical assessment alone, to predict the outcome of patients presenting with COVID-19 infection (the Pandemic Respiratory Infection Emergency System Triage [PRIEST] score).[12] The score has subsequently been validated in settings outside the UK[13] and its use has been further promoted as a decision-making support tool in emergency care.[14]

There is the potential to utilise clinical scoring systems such as the PRIEST score to not only assist in clinical decision making at a patient level, but to also provide an early warning of a population-level change in clinical severity of COVID-19 patients that warrants an increased public health response. The objective of our study was to determine whether the PRIEST score, which utilises routinely collected emergency department data recorded in existing electronic medical records, could be used to identify an emerging COVID-19 variant with increased clinical severity in a near real-time manner.

Method

Participants

Emergency Department (ED) attendance lists for one tertiary referral and two district hospitals in the Northern Sydney Local Health District (NSLHD) were cross-referenced with notifications received by NSW Health and recorded in the Notifiable Conditions Information Management System (NCIMS) to identify patients with a confirmed COVID-19 diagnosis within seven days before or after the date of ED presentation. A total of 131 patients that presented to NSLHD EDs in August 2021 (presumed to be part of the Delta wave) and a random sample of 131 patients drawn from 1,043 attendances in January 2022 (presumed to be part of an Omicron wave) were included in the study. The sample of January 2022 cases was randomly selected using the STATA package.

Data collection

The electronic medical records of patients were manually reviewed to collect basic demographic data; clinical observations; whether they were admitted (either to the general ward or the intensive care unit); and whether they had died whilst in hospital. As part of this review it was determined whether COVID-19 was the primary cause for their presentation or an incidental finding.

The clinical observations collected were those recorded on initial presentation to the ED prior to the commencement of treatment (e.g. supplementary oxygen). These observations consisted of those necessary to calculate the PRIEST score (see Appendix A, Table A.1), with the exception of 'performance status'. This variable was excluded from the score due to concerns about the accuracy and reliability of recording in ED records and resulted in the calculation of a modified PRIEST (mPRIEST) score. This approach was similar to that adopted by others who have validated the ability of this modified score to predict clinical outcomes.[12]

Analysis

Data were analysed both as a single group and as a subgroup of participants where COVID-19 was the primary cause for presentation. mPRIEST scores were dichotomised into lower probability (score less than or equal to 4) and higher probability (score greater than 4) of adverse outcome.[11] This threshold was chosen as previous validation of the score demonstrated a clear threshold for increased probability of adverse outcomes above a score of 4.[11,12] Chi-square tests were performed to compare the two time periods. Raw mPRIEST scores were also compared between time periods using a log rank test. Although not a primary objective of the study, hospital admission and death whilst in hospital were compared across scores and study periods.

As the mPRIEST score includes age and sex as inputs, no adjustment was attempted for these variables. However, it is possible that patients presenting to a tertiary hospital may have a higher level of clinical severity so adjustment was made using a logistic regression model. All analyses were done in STATA.[15]

Ethics

Ethics approval was gained from the Northern Sydney Local Health District Human Research Ethics Committee to conduct this research, approval reference number 2022/ETH00732.

Results

A total of 262 medical records were reviewed, with 205 (78%) patients presenting as a result of COVID-19. There was a higher proportion of males and younger patients in the Delta wave group. Looking at the study group as a whole, both the median score and the proportion of patients with a score greater than four were statistically significantly higher for the Delta wave group (one point and 13% respectively). When restricted to patients presenting primarily due to COVID-19, a similar pattern was observed (Table 1).

Table 1: Gender, age and *m*PRIEST Score by time period (August 2021 Delta wave; January 2022 Omicron wave)

Category[a]	August 2021	January 2022	*p* value
All presentations (N = 262)	**N = 131**	**N = 131**	
Male (%)	66 (50.4)	59 (45.0)	0.39
Median age in years (IQR)	42 (29–57)	49 (32–71)	< 0.01
Median score (IQR)	4 (2–7)	3 (1–6)	0.01
Score > 4 (%)	63 (48.1)	46 (35.1)	0.03
Tertiary hospital (%)	51 (38.9)	55 (42.0)	0.62
COVID-19 primary cause (N = 205)	**N = 109**	**N = 96**	
Male (%)	53 (48.6)	39 (40.6)	0.25
Median age in years (IQR)	42 (30–57)	51.7 (33.5–71)	< 0.01
Median score (IQR)	5 (3–8)	3 (1–6.5)	0.01
Score > 4 (%)	57 (52.3)	37 (38.5)	0.049
Tertiary hospital (%)	43 (39.5)	35 (36.5)	0.66

a   IQR: interquartile range.

Admission and death data are reported in Table 2. These data confirmed that patients with higher scores were more likely to be admitted to hospital; to be admitted to an intensive care unit (ICU); and to die in hospital. A similar pattern of increased severity was demonstrated for patients who presented during the Delta wave and to the tertiary hospital. The logistic regression modelling showed that both Delta wave and tertiary hospital attendance were significantly associated with increased odds of having a score greater than four, with adjusted odds ratios of 1.8 (95% confidence interval [95% CI]: 1.1–3.0; $p = 0.02$) and 2.3 (95% CI: 1.4–3.8; $p < 0.01$) respectively.

Discussion

This study demonstrated that a clinical scoring system (the *m*PRIEST score) could have detected a higher level of clinical severity among patients presenting to emergency departments during the Delta COVID-19 wave compared to the Omicron wave. Although already validated by others,[11] a higher score was also demonstrated to be associated with both hospital admission and admission to ICU.

One of the major advantages of using the system described as a surveillance tool is its potential to be 'near real-time'. This is made possible by its use of routinely collected clinical data that is likely to be recorded in electronic medical records. Current ED surveillance systems in Australia have the ability to interrogate electronic medical records but have not as yet fully utilised clinical observations.[10] A key requirement to pursue this strategy is the ability to interpret the significance of these data, and the *m*PRIEST score shows promise in this regard.

Being a novel system, a new quantitative method to identify an emerging strain with increased severity will need to be established. As an example, given that at least 100 COVID-19 cases have presented to emergency departments per day during recent waves,[16] one potential predetermined measure indicating the arrival of a new strain could be developed by comparing

Table 2: Admissions and deaths by *m*PRIEST score, time period and hospital type

Category	Admitted	*p* value	Admitted to ICU	*p* value	Died	*p* value
mPRIEST score						
≤ 4	66/153 (43.1%)	< 0.01[a]	1/153 (0.7%)	< 0.01[b]	1/153 (0.7%)	< 0.01[b]
> 4	90/109 (82.6%)		19/109 (17.4%)		13/109 (11.9%)	
Variant (time period)[c]						
August 2021	105/131 (80.1%)	< 0.01[a]	18/131 (13.7%)	< 0.01[b]	9/131 (6.9%)	0.27[b]
January 2022	51/131 (38.9%)		2/131 (1.5%)		5/131 (3.8%)	
Hospital type						
Tertiary	94/106 (88.7%)	< 0.01[a]	10/106 (9.4%)	0.37[a]	8/106 (7.5%)	0.19[b]
District	62/156 (39.7%)		10/156 (6.4%)		6/156 (3.8%	

a   Chi² test.

b   Fisher's exact test.

c   Inferred principal responsible SARS-CoV-2 variant: Delta (August 2021), Omicron (January 2022).

the proportions of cases with *m*PRIEST scores above 4 for the current week with the proportion calculated for the previous four weeks.

There are several limitations of the current study that need to be acknowledged. Firstly, there was an assumption that the presentation period was a good proxy for distinguishing between the Delta and Omicron variants. However, based upon whole genome sequencing, this is likely to be the case at a population level.[17] Using time period comparisons could have also introduced a further limitation, as COVID-19 vaccination levels in the community were lower in August 2021 than in January 2022. Although vaccination likely lessened the impact of COVID-19 in the Omicron wave,[18] the objective of the study was to determine the severity of illness at a particular point given community vaccination rates at the time.

Secondly, although the *m*PRIEST score (which does not include a measure of activity/self-care) has been validated in an emergency department

setting, it does not consider the prevalence of comorbidities specifically. Including the collection of these data on an ongoing basis is likely to be resource intensive and problematic in an ED setting, thereby making implementation of the system more difficult. Furthermore, it could be argued that a surveillance system only needs to measure the overall severity of illness in the population as a whole rather than at an individual level, and hence collection of individual patient comorbidities is unnecessary.

The *m*PRIEST score is an example of a clinical scoring system that could be incorporated into existing emergency department surveillance to monitor changes in COVID-19 severity that may occur with the emergence of a new variant. Its use would supplement current measures of changes in severity, such as hospital admissions and deaths, by detecting a 'near real-time' signal. Arming public health decision-makers with this additional information may support

the making of timely decisions around the need to introduce additional measures to control the impact of an emerging COVID-19 variant.

Author details

Adelaide Nyinawingeri[1]
Dr Michael Staff[1]

1. Public Health Unit, Northern Sydney Local Health District, NSW Health.

Corresponding author

Adelaide Nyinawingeri

Address: Public Health Unit - Northern Sydney Local Health District

Royal North Shore Hospital, Reserve Rd, St Leonard's NSW 2065

Phone: +61 (02) 9485 6972

Email: Adelaide.Nyinawingeri@health.nsw. gov.au

References

1. Australian Institute of Health and Welfare (AIHW). *The first year of COVID-19 in Australia: direct and indirect health effects.* Canberra: Australian Government, AIHW; 2021. [Accessed in August 2022.] Available from: https://www.aihw.gov.au/getmedia/a69ee08a-857f-412b-b617-a29acb66a475/aihw-phe-287.pdf.

2. COVID-19 National Incident Room Surveillance Team. Technical supplement. COVID-19 Australia: Epidemiology Report. *Commun Dis Intell (2018).* 2021;45. doi: https://doi.org/10.33321/cdi.2021.45.2.

3. World Health Organization (WHO). Tracking SARS-CoV-2 variants. [Internet.] Geneva: WHO; 2022. [Accessed in August 2022.] Available from: https://www.who.int/activities/tracking-SARS-CoV-2-variants.

4. Ong SWX, Chiew CJ, Ang LW, Mak TM, Cui L, Toh MPHS et al. Clinical and virological features of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) variants of concern: a retrospective cohort study comparing B.1.1.7 (Alpha), B.1.351 (Beta), and B.1.617.2 (Delta). *Clin Infect Dis.* 2022;75(1):e1128–36. doi: https://doi.org/10.1093/cid/ciab721.

5. WHO Health Emergencies Programme. *Severity of disease associated with Omicron variant as compared with Delta variant in hospitalized patients with suspected or confirmed SARS-CoV-2 infection.* Geneva: WHO; 7 June 2022. [Accessed in August 2022.] Available from: https://www.who.int/publications/i/item/9789240051829.

6. Australian Government Department of Health and Aged Care. Coronavirus (COVID-19) case numbers and statistics. [Internet.] Canberra: Australian Government Department of Health and Aged Care; 2022. [Accessed in August 2022.] Available from: https://www.health.gov.au/health-alerts/covid-19/case-numbers-and-statistics.

7. Hoang T, Da Silva AG, Jennison AV, Williamson DA, Howden BP, Seemann T. AusTrakka: fast-tracking nationalized genomics surveillance in response to the COVID-19 pandemic. *Nat Commun.* 2022;13(1):865. doi: https://doi.org/10.1038/s41467-022-28529-9.

8. Ward T, Johnsen A. Understanding an evolving pandemic: an analysis of the clinical time delay distributions of COVID-19 in the United Kingdom. *PLoS One.* 2021;16(10):e0257978. doi: https://doi.org/10.1371/journal.pone.0257978.

9. New South Wales Government Department of Health (NSW Health). *In focus: COVID-19 Hospitalisations in NSW. Reporting period: 1 January to 19 April 2020.* Sydney: New South Wales Government, NSW Health; 2020. [Accessed in August 2022.] Available from: https://www.health.nsw.gov.au/Infectious/covid-19/Documents/in-focus/hospitalisations.pdf.

10. NSW Health. Rapid surveillance using PHREDSS. [Internet.] Sydney: New South Wales Government, NSW Health; 13 April 2022. Available from: https://www.health.nsw.gov.au/epidemiology/Pages/rapid-surveillance-using-PHREDSS.aspx.

11. Goodacre S, Thomas B, Sutton L, Burnsall M, Lee E, Bradburn M et al. Derivation and validation of a clinical severity score for acutely ill adults with suspected COVID-19: the PRIEST

observational cohort study. *PLoS One*. 2021;16(1):e0245840. doi: https://doi.org/10.1371/journal.pone.0245840.

12. Suh EH, Lang KJ, Zerihun LM. Modified PRIEST score for identification of very low-risk COVID patients. *Am J Emerg Med*. 2021;47:213–6. doi: https://doi.org/10.1016/j.ajem.2021.04.063.

13. American College of Emergency Physicians (ACEP). COVID-19 ED Management Tool Now Available, Updated. [Internet.] Irving: ACEP; 7 June 2022. [Accessed in August 2022.] Available from: https://www.acep.org/corona/COVID-19-alert/covid-19-articles/covid-19-ED-management-tool-now-available/.

14. The University of Sheffield School of Health and Related Research (ScHARR). The PRIEST COVID-19 clinical severity score. [Webpage.] Sheffield: ScHARR. [Accessed in August 2022.] Available from: https://www.sheffield.ac.uk/scharr/research/centres/cure/priest/priest-covid-19.

15. StataCorp LLC. STATA. [Software.] College Station: StataCorp LLC; 2022. Available from: https://www.stata.com/company/.

16. NSW Health. *COVID-19 weekly surveillance in NSW. Epidemiological week 49, ending 10 December 2022*. Sydney: New South Wales Government, NSW Health; 15 December 2022. [Accessed in December 2022.] Available from: https://www.health.nsw.gov.au/Infectious/covid-19/Documents/covid-19-surveillance-report-20220214.pdf.

17. NSW Health. *COVID-19 weekly surveillance in NSW. Epidemiological week 04 ending 29 January 2022*. Sydney: New South Wales Government, NSW Health; 14 February 2022. [Accessed in August 2022.] Available from: https://www.health.nsw.gov.au/Infectious/covid-19/Documents/covid-19-surveillance-report-20220214.pdf.

18. Liu B, Gidding H, Stepien S, Cretikos M, Macartney K. Relative effectiveness of COVID-19 vaccination with 3 compared to 2 doses against SARS-CoV-2 B. 1.1. 529 (Omicron) among an Australian population with low prior rates of SARS-CoV-2 infection. *Vaccine*. 2022;40(43):6288–94. doi: https://doi.org/10.1016/j.vaccine.2022.09.029.

Appendix A: Supplementary material

Table A.1: Pandemic Respiratory Infection Emergency System Triage (PRIEST) score components used in this study[a,b]

Variable	Range	Score
Respiratory rate (per minute)	12–20	0
	9–11	1
	21–24	2
	< 9 or > 24	3
Oxygen saturation (%)	> 95	0
	94–95	1
	92–93	2
	< 92	3
Heart rate (per minute)	51–90	0
	41–50 or 91–110	1
	111–130	2
	< 41 or > 130	3
Systolic blood pressure (mm Hg)	111–219	0
	101–110	1
	91–100	2
	< 91 or > 219	3
Temperature (° C)	36.1–38.0	0
	35.1–36.0 or 38.1–39.0	1
	> 39.0	2
	< 35.1	3
Alertness	Alert	0
	Confused or not alert	3
Inspired oxygen	Air	0
	Supplemental oxygen	2
Sex	Female	0
	Male	1
Age (years)	16–49	0
	50–65	2
	66–80	3
	> 80	4
Performance status[b]	*Unrestricted normal activity*	*0*
	Limited strenuous activity, can do light activity	*1*
	Limited activity, can self-care	*2*
	Limited self-care	*3*
	Bed/chair bound, no self-care	*4*

a   As detailed in reference 14.

b   The modified PRIEST (*m*PRIEST) score used in this study does not include the 'performance status' component.