Witness Name: Kathryn Rowan
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UK COVID-19 INQUIRY

WITNESS STATEMENT OF PROFESSOR KATHRYN ROWAN

I, Kathryn Rowan, will say as follows: -

1. Introduction to ICNARC

1.1 The Intensive Care National Audit & Research Centre (ICNARC) is an independent, scientific, not-for-profit organisation (registered charity number: 1039417). We work to ensure the best possible critical care by facilitating improvements in the structure, process, outcomes and experiences of care – for patients and for those who care for them. We achieve this by developing and sharing information about the quality of critical care with those who finance, commission, manage, deliver and experience critical care (both within and outside the NHS) through our national clinical audit and through our national and international research.

1.2 I am the founder of ICNARC and was Director from its inception until September 2023. I am currently employed by ICNARC as a Scientific Advisor. ICNARC's current Senior Leadership Team comprises: Professor David Harrison and Paul Mouncey (Co-Directors), Peter Hyde (Chief Operating Officer) and Lindsay Hannigan (Chief Information Officer). As a registered charity, ICNARC's activities are overseen by a Board of Management made up of the eleven Trustees of the charity, comprising a mix of clinical, scientific, business and lay members. The Chair of the Board is Sue James.

2. Introduction to the Case Mix Programme

2.1 Launched in 1994, the Case Mix Programme is the national clinical audit for patient outcomes from adult critical care units (intensive care and high dependency units) in England, Wales and Northern Ireland. All NHS adult general critical care units providing Level 3 (intensive) care participate in the Case Mix Programme. Other

specialist units, including neurosciences and cardiothoracic critical care units, and standalone Level 2 (high dependency) units also participate. The Case Mix Programme does not include critical care units in Scotland, which coordinates its own national audit. Although the Case Mix Programme was established as a voluntary audit, participation is required by the NHS England Service Specification for Adult Critical Care. A list of participating units is provided as an exhibit [KR/01 – INQ000473873].

2.2 Critical care units participating in the Case Mix Programme capture/collect data, according to the ICNARC Case Mix Programme Dataset Specification, using local software on all admissions (including readmitted patients) to their unit. Securely, they submit these data to ICNARC, usually either monthly or quarterly, and a series of over 600 data validation checks are run, identifying errors and any missing information. Dedicated, trained (by ICNARC) staff at units then have a chance to correct and complete the data prior to analysis.

2.3 At the end of each quarter, critical care units receive a report which indicates how the unit compares both with other units identified as having a similar profile of admissions and with all units participating in the Case Mix Programme. The report focuses on a defined set of key potential quality indicators, and identify trends in these over time, helping the unit to understand more about the care they deliver and outcomes they achieve. The aim is to assist the unit in decision-making and resource allocation around service delivery and organisation and to promote and prompt local quality improvement.

3. Response to the pandemic

3.1 On 22 January 2020, in response to the WHO 'Novel Coronavirus (2019-nCoV) Situation Report - 1', ICNARC convened an internal working group to prepare for the arrival/likely arrival of SARS-CoV-2 in the UK and to be ready to monitor the impact on adult critical care.

3.2 On 11 February 2020, Professor Keith Willett, the Strategic Incident Director at NHS England and NHS Improvement, contacted me by email asking for a teleconference, which took place on Sunday 16 February 2020. We discussed the potential contributions that ICNARC could make to informing NHS capacity for delivery of critical care for critically ill patients with COVID-19 and identified a number of reports to be

produced using existing data from the Case Mix Programme, which were sent over the following weeks.

3.3 On 4 March 2020, I emailed all critical care units participating in the Case Mix Programme to request that they:

- notify ICNARC immediately of any patient with confirmed or clinically suspected COVID-19 admitted to their unit;
- export all available data on these patients after the first 24 hours; and
- re-export data on these patients immediately after critical care discharge.

3.4 To facilitate this request, we "unlocked for use" codes that had been introduced into the ICNARC Case Mix Programme Dataset Specification, following the H1N1 pandemic, for 'Pandemic influenza, suspected' and 'Pandemic influenza, confirmed', repurposing these to record suspected and confirmed COVID-19.

3.5 ICNARC received the first notifications from participating critical care units in response to this request the same day (4 March 2020). Subsequent data submissions indicated that the first critical care admission with confirmed COVID-19 occurred on 5 February 2020.

3.6 Hospitals increased their critical care capacity in response to the pandemic – termed 'surge capacity'. We encouraged critical care units to provide data to the Case Mix Programme for patients admitted to surge areas where it was possible to do so. In some hospitals, the surge areas operated as additional temporary units in the Case Mix Programme. For some other hospitals, patients admitted to surge areas were included within the Case Mix Programme data submissions for the main existing unit. In other hospitals, there was not the capacity to provide data for surge areas. We do not know the exact extent of the coverage of surge areas within our data.

3.7 On 10 March 2020, we produced our first report on patients with confirmed COVID-19 admitted to critical care units in the UK, based on data we had received for 13 patients with confirmed COVID-19, out of 20 patients that had been notified to us by that date. I emailed this report to Keith Willett. Due to the small number of patients included, we did not make this report available publicly. We subsequently updated the report on 17 March 2020, including data for 83 patients.

3.8 On 20 March 2020, we produced a more detailed report including data on 196 patients. This report was circulated to all critical care units participating in the Case Mix Programme, to Keith Willett, and to representatives of the Intensive Care Society, the

Faculty of Intensive Care Medicine and the Adult Critical Care Clinical Reference Group of NHS England. The report received attention from the national media, and we decided to make the report, and all our subsequent similar reports, available to all via our ICNARC website.

3.9 On 23 March 2020, I forwarded the report to Stephen Powis (National Medical Director, NHS England) and Simon Stevens (Chief Executive, NHS England) [KR/02 – INQ000473874]. I included in the email, the daily and cumulative numbers of new cases of which we had been notified. I did not receive any direct response to the email, other than a read receipt. I, or one of my senior colleagues, continued to send daily updates on the numbers of new cases to Stephen Powis and to Simon Stevens (then Alison Pritchard) throughout the pandemic.

3.10 We continued to produce reports weekly throughout the waves/peaks of the pandemic, reducing frequency to monthly when critical care admissions were lower and subsequently to quarterly in 2022. These reports were circulated to senior NHS and Department of Health and Social Care (DHSC) colleagues (including Keith Willett, Stephen Powis, Simon Stevens (then Alison Pritchard), Jonathan Van Tam, NR NR Chris Moran, Celia Ingham Clark and Adam Roberts) before being posted on our website with a link circulated to participating critical care units and to the media. Jonathan Van Tam indicated that he routinely forwarded our reports on to the UK Chief Medical Officer's Senior Clinicians Group. Once sufficiently large numbers of patients were available, we expanded our public reporting to produce specific reports for Northern Ireland (from April 2020) and Wales (from May 2020). Copies of all public reports produced have been shared with the Inquiry as a general disclosure.

3.11 In producing these reports, our aim was to provide accurate and timely data to aid in the planning and delivery of critical care for patients critically ill with confirmed COVID-19. We made an active decision to limit the interpretation of the data analyses presented to providing definitions and highlighting any appropriate caveats. We engaged with those receiving our reports to help explain the content of the reports and in responding to queries but we avoided making any recommendations on consequent actions.

3.12 As well as these regular reports, we responded to specific requests to provide additional focussed reports to groups including NHS England, the Cabinet Office, JCVI and others.

3.13 To assist critical care units in learning from each other's experiences, and following rapid development and validation of a risk prediction model for COVID-19, in September 2020 we produced a comparative report showing risk-adjusted mortality for patients with confirmed COVID-19 in each critical care unit in the form of funnel plots [KR/03 – INQ000099537]. In a funnel plot, the result for each healthcare provider is plotted against the number of patients contributing to the calculation. Control lines (which take the form of funnel shapes) allow you to identify whether the variation between providers is greater than would be expected by chance. Each critical care unit was given access to the report through our online file sharing system, together with information on the results for their unit. Individual critical care units were not identified in the report.

3.14 In addition to our reporting, we sought to make our data available to all relevant bodies, subject to appropriate governance approvals. Daily data flows to NHSX for patients in England commenced on 25 March 2020. Weekly data flows to SAIL for patients in Wales commenced on 13 May 2020. We also provided and linked data for many research studies.

3.15 In December 2020, ICNARC was approached by NR (National Clinical Director for Critical and Peri-operative Care, NHS England) with a suggestion to collect additional data on treatments received by patients critically ill with COVID-19. We worked this suggestion into a proposal for a process audit, to evaluate whether patients were receiving the interventions that had been established to be effective through clinical trials such as RECOVERY and REMAP-CAP and to explore variability in use of other treatments where the evidence base had not yet been established. The COVID-19 Process Audit went live on 3 March 2021, with units requested to enter data retrospectively for patients admitted from 1 January 2021 onwards, where possible. In June 2021, individual critical care units were provided with reports showing their results compared with other units. Summary results across all units were produced and shared in July 2021 [KR/04 – INQ000099527], October 2021 [KR/05 – INQ000473876] and April 2022 [KR/06 – INQ000473877].

4. Overview of key statistics

4.1 In response to the request from the Inquiry, my colleagues at ICNARC have produced a bespoke report (*Overview of key statistics gathered by the Intensive Care National Audit & Research Centre*) to address the areas of specific interest [KR/07 – INQ000480138].

4.2 During the relevant period (1 March 2020 to 30 June 2022), there were almost 400,000 patients admitted to critical care units in England participating in the Case Mix Programme, 19,000 in Wales, and 8,000 in Northern Ireland. Of these, 12% of patients in England, 9% in Wales and 13% in Northern Ireland were admitted primarily for COVID-19. The report provides breakdowns of the numbers of patients admitted to critical care, patients in critical care, and deaths in critical care for requested patient subgroups, and a comparison of the delivery of critical care services, patient characteristics, and organ support, length of stay and mortality over time covering both the pre-pandemic period (1 April 2018 to 29 February 2020) and the relevant period.

5. Information unable to be included in the overview of key statistics

5.1 ICNARC do not collate real-time data on the number of critical care beds available, and therefore we were not able to include information on bed occupancy within the report. We do record data on the numbers of routinely staffed beds in units participating in the Case Mix Programme. On 28 February 2020, I sent a report based on pre-pandemic bed numbers, 'Available and potential critical care capacity' [KR/08 – INQ000099519], to Professor Keith Willet at NHS England. This report detailed the available critical care beds in adult general critical care units in England, Wales and Northern Ireland and the percentage of bed days occupied by patients admitted following elective or scheduled surgery and those with a lower requirement for organ support.

5.2 ICNARC do not record any routine data on the staffing of critical care units, and therefore we were not able to include this in the report.

5.3 We were asked to provide "a summary of any data gathered by ICNARC which may indicate a notable correlation between likelihood of dying with COVID-19 in ICU and specific treatment administered". Such correlations are notoriously hard to interpret from observational data. Patients who are more severely ill are likely to receive more, and more invasive, treatments and therefore it is inevitable that receipt of such treatments will be correlated with worse outcomes (termed 'treatment indication bias' or 'confounding by indication'). We therefore do not believe it is possible to determine any meaningful causal associations between treatment and outcome from our data, at least without conducting much more complex analyses to attempt to adjust for this confounding using advanced statistical techniques.

5.4 Data on receipt of ECMO was only incorporated into the routine dataset for the Case Mix Programme after the relevant period, and therefore we were not able to include this within the report. During the pandemic, we conducted a data linkage with data held by the national ECMO service and produced a number of outputs from this: a report describing the characteristics and outcomes of patients with confirmed COVID-19 transferred for ECMO at each of the ECMO centres (14 October 2020) [KR/09 – INQ000099524]; a report on risk-adjusted outcomes for patients with confirmed COVID-19 transferred for ECMO (26 November 2020, subsequently updated on 4 February 2021 and 21 April 2021) [KR/10 – INQ000099534]; and a presentation on the characteristics of patients referred and accepted for ECMO at each of the ECMO centres (22 October 2021) [KR/11 – INQ000099523].

6. ICU capacity strain

6.1 Prior to the pandemic, we reported that how busy an intensive care unit (ICU) is on a given day (termed 'ICU capacity strain') impacts on patient outcomes with higher strain associated with higher acute hospital mortality. ICU capacity strain can be seen as a mismatch between supply and demand with availability of beds, staff and/or other resources (as supply) and the need to admit and provide care for critically ill patients (as demand). The COVID-19 pandemic created a huge demand in the number of patients requiring critical care worldwide. Meeting this demand placed an unprecedented capacity strain on health care systems, and particularly on ICUs, with hospitals having to rapidly expand their critical care capacity. We sought to determine whether patients admitted to an ICU during times of unprecedented strain during the pandemic experienced a higher risk of death and published this in the scientific manuscript "Does Unprecedented ICU Capacity Strain, As Experienced During the Covid-19 Pandemic, Impact Patient Outcome?" in *Critical Care Medicine* in June 2022 [KR/12 – INQ000250242].

6.2 We used pooled data on patient case mix and outcomes from each adult general ICU participating in the Case Mix Programme to identify two cohorts of patients: (1) patients admitted to ICU immediately prior to the COVID-19 pandemic between 1 March 2019 and 29 February 2020 (Reference cohort); and (2) patients admitted to ICU during the first two waves of the COVID-19 pandemic in the UK between 1 March 2020 and 28 February 2021 (Analysis cohort). We used the "ICU bed census" (the number of patients in the ICU at any time during the day) on the day of ICU admission to calculate ICU capacity strain. "Typical" ICU capacity strain was defined with respect to the range observed in the pre-pandemic Reference period, with "typical high" and

"typical low" ICU capacity strain defined as more than 10% above or below the median bed census observed for each ICU. For the COVID-19 pandemic Analysis period, we defined "pandemic high" ICU capacity strain as up to 50% greater than the pre-pandemic maximum and "pandemic extreme" as more than 50% greater than the pre-pandemic maximum. Multilevel, mixed effects, logistic regression models (statistical techniques that take into account potential differences in important patient factors) were then used to examine the relationship between levels of ICU capacity strain on the day of admission with risk-adjusted hospital mortality.

6.3 We included 130,689 patients admitted to 210 adult general ICUs in 207 hospitals in England, Wales, and Northern Ireland in the analyses. We found that ICU capacity strain fluctuated over the time periods included in the analyses. During the pre-pandemic Reference period, the mean ICU bed census (the number of patients in the ICU at any time during the day) across all ICUs was 17 and varied from 14 to 20 over the year. During the Analysis period, immediately prior to the first wave, as elective surgery was cancelled, the mean bed census decreased to 13 (21 March 2020) and then rose to a maximum of 28 (15 April 2020) during the first wave. Between the first and second waves, the mean bed census dropped to a minimum of 12 (21 June 2021) and then rose again to a maximum of 35 (25 January 2021) in the second wave. During the peaks of both pandemic waves, most patients were exposed to ICU capacity strain exceeding the range previously experienced by the admitting ICU (i.e. "pandemic high" or "pandemic extreme"). Immediately prior to the first wave and during the period between the waves, most patients were exposed to "typical low" ICU capacity strain. A total of 177 out of 211 ICUs (84%) experienced periods of "pandemic high" or "pandemic extreme" strain, with one in five patients (21%) admitted during such periods.

6.4 When adjusting for potential differences in important patient factors, compared to "typical" ICU capacity strain, we found a significant association between exposure to higher ICU capacity strain and higher acute hospital mortality, both overall and for patients with COVID-19 and non-COVID-19, with increasing levels of ICU capacity strain associated with increasing mortality. This pattern differed between patients with and without COVID-19 and across the waves of the pandemic. For COVID-19 patients admitted during periods of "pandemic high" or "pandemic extreme" ICU capacity strain during the first wave, we found no difference in hospital mortality, whereas for those admitted during "pandemic high" or "pandemic extreme" ICU capacity strain in the second wave, we found a 17% (odds ratio 1.17; 95% confidence interval 1.05 to 1.30)

and 15% (odds ratio 1.15; 95% confidence interval 1.00 to 1.31) higher odds of hospital mortality, respectively, compared with those admitted during "typical" ICU capacity strain. For non-COVID-19 patients, there was little difference in trend between waves, with those admitted during periods of "pandemic high" and "pandemic extreme" ICU capacity strain having 16% (odds ratio 1.16; 95% confidence interval 1.08 to 1.25) and 30% (odds ratio 1.30; 95% confidence interval 1.14 to 1.48) higher overall odds of acute hospital mortality, respectively, compared with those admitted during "typical" ICU capacity strain.

6.5 In summary, for patients admitted to ICU during periods of unprecedented levels of ICU capacity strain, higher strain was significantly associated with higher acute hospital mortality, after accounting for differences in baseline characteristics. The effects of ICU capacity strain were strongest for non-COVID-19 patients.

7. Summary of key messages

7.1 Critical care units responded rapidly to simultaneously manage numbers of critically ill patients far in excess of usual capacity. The largest peak of the pandemic for critical care occurred in January 2021; during this month, the average number of patients in critical care was almost double that seen prior to the pandemic, and indeed this averaging to both monthly level and across the entire country masks even greater peaks at a shorter-term and more localised level.

7.2 It may be surprising therefore that the mean daily number of patients admitted to critical care was, on average, lower during the relevant period than pre-pandemic, and did not exceed pre-pandemic levels even during the peaks of pandemic activity. This seemingly contradictory finding was caused by a combination of: reduced numbers of elective patients admitted to critical care (with typically short stays, a mean of 4 days in critical care); and a substantially longer length of stay for patients admitted for COVID-19 (a mean of 16 days in critical care compared with 7 days for non-elective patients admitted for other reasons).

7.3 Overall, approximately 24% fewer patients were admitted to critical care for reasons other than COVID-19 across England, Wales and Northern Ireland than would have been expected based on pre-pandemic rates of admission. It is impossible to determine from the data we hold the extent to which this shortfall is due to any combination of: cancellation or postponement of elective activity; fewer patients becoming critically ill (for example, reductions in trauma during lockdowns); fewer

patients presenting to hospital or patients presenting to hospital later; and/or patients being managed elsewhere in the hospital (including specialist and surge critical care capacity not covered by the Case Mix Programme data collection).

7.4 The interventions received by patients admitted to critical care for COVID-19 changed rapidly over the first few months of the pandemic (to the limited extent that we are able to assess this using Case Mix Programme data). The percentage of patients receiving advanced respiratory support (invasive ventilation) reduced from over 80% in March 2020 to around 45% by June 2020, and percentages receiving other advanced organ supports also reduced, although not by such a great extent. Such changes in management are likely indicative of a 'learning curve' as clinicians became more familiar with a new disease and shared learning on how best to manage it. The presence of a learning curve effect is also supported by the reduction in risk-adjusted mortality seen over the first few months of the pandemic. Using a statistical model calibrated to data from 2022, observed in-hospital mortality during the early months of the pandemic was significantly higher than predicted by the model, reducing rapidly to be consistent with the model predictions by early summer.

7.5 Early in the pandemic, we published an analysis of prognostic factors for 30-day in-hospital mortality among the first approximately 10,000 patients admitted with COVID-19 ("Prognostic Factors for 30-Day Mortality in Critically Ill Patients With Coronavirus Disease 2019: An Observational Cohort Study", published in *Critical Care Medicine* in January 2021) [KR/13 – INQ000473878]. Relationships between potential prognostic factors and mortality are illustrated in eFigure 2 from this publication [KR/14 – INQ000473879]. This showed a very strong association between increasing age and higher mortality. There were also smaller associations for higher mortality with: Asian ethnicity; greater deprivation; increasing body mass index; presence of any prior dependency; and immunocompromise. Among potential physiological prognostic factors, the strongest relationship was found for the ratio of PaO_2 to FiO_2 (a measure of the amount of oxygen in the blood), with lower blood oxygen being associated with higher mortality. Smaller associations were also found for low systolic blood pressure, increasing heart rate, increasing respiratory rate, increasing blood lactate, raised creatinine and urea, and decreasing platelet count.

7.6 While it is impossible to determine from data only on those patients admitted to critical care whether "rationing of care" was taking place, there is evidence that there were some changes in the characteristics, management and outcome of patients admitted to critical care during the peaks of the pandemic waves when capacity strain was at its

greatest. Firstly, the proportion of patients receiving advanced respiratory support (invasive ventilation) and multi-organ support increased during the peaks of the waves. This suggests that triage decisions were being made to prioritise admission of those patients deemed to require advanced organ support, with patients with lower requirements for organ support (who may have been admitted to critical care during times of less demand) being managed elsewhere in the hospital. This also corresponded with increases in predicted mortality (as well as observed mortality) among patients admitted for reasons other than COVID-19. These increases were of similar magnitude to the usual seasonal increases in predicted mortality associated with winter pressure on critical care (e.g. in January 2019 and in December 2019). The peaks of the first two waves of the pandemic were also associated with decreases in the proportions of patients admitted for reasons other than COVID-19 that were: aged 75 years or older; or (for non-elective admissions) had any prior dependency or any advanced chronic condition. Such changes in patient characteristics were not seen during periods of winter pressure in the pre-pandemic period.

Statement of Truth

I believe that the facts stated in this witness statement are true. I understand that proceedings may be brought against anyone who makes, or causes to be made, a false statement in a document verified by a statement of truth without an honest belief of its truth.

Signed: **PD** Date: 24 May 2024

Professor Kathryn M Rowan