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Research paper

The PhLIP team: Feasibility of a physiotherapy-led intensive prone positioning team initiative during the COVID-19 pandemic

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ABSTRACT

Background: The coronavirus disease 2019 (COVID-19) pandemic resulted in a surge of patients with refractory hypoxaemic respiratory failure being admitted to the intensive care unit (ICU). Prone positioning can improve oxygenation but requires a team of skilled personnel to complete safely. Critical care physiotherapists (PTs) are ideally suited to lead proning teams, due to their expertise in moving critically unwell, invasively ventilated patients.

Objectives: The aim of this study was to describe the feasibility of implementing a physiotherapy-led intensive proning (PhLIP) team to support the critical care team during surges.

Methods: This study involves descriptive evaluation of feasibility and implementation of the PhLIP team, a novel model of care, during the Delta wave of the COVID-19 pandemic, through a retrospective, observational audit of PhLIP team activity, ICU clinical activity, and a description of clinical outcomes.

Results: Between 17 September and 19 November 2021, 93 patients with COVID-19 were admitted to the ICU. Fifty-one patients (55%) were positioned prone, a median [interquartile range] 2 [2, 5] times, for a mean (±standard deviation) duration of 16 (±2) h, across 161 episodes. Twenty-three PTs were upskilled and deployed to the PhLIP team, adding 2.0 equivalent full time to the daily service. Ninety-four percent of prone episodes (154) were led by the PhLIP PTs with a median 4 [interquartile range: 2, 8] turns per day. Potential airway adverse events occurred on three occasions (1.8%) and included an endotracheal tube leak, displacement, and obstruction. Each incident was promptly managed without prolonged impact on the patient. No manual handling injuries were reported.

Conclusion: The implementation of a physiotherapy-led proning team was safe and feasible and can release critical care-trained medical and nursing staff to other duties in the ICU.

1. Background

The coronavirus disease 2019 (COVID-19), declared a pandemic by the World Health Organization (WHO) in March of 2020, resulted in healthcare institutions experiencing surges of patients presenting to hospital with acute respiratory illness.[1] A subset of patients diagnosed with COVID-19 developed severe hypoxaemic respiratory failure, requiring admission to the intensive care unit (ICU), endotracheal intubation, and mechanical ventilation.[2] Prone positioning has been used as a treatment to improve oxygenation for patients with acute respiratory distress syndrome (ARDS) in critical care for nearly five decades.[3] Randomised trials have demonstrated improved oxygenation and mortality with early (within 36 h) application of prolonged (>16 h/day) prone positioning in patients with moderate to severe ARDS.[4,5] Prone

Abbreviations: COVID-19, Coronovirus disease 2019; ARDS, Acute respiratory distress syndrome.

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positioning was widely adopted during the pandemic, with reports of up to a 60% increase in prone utilisation within health services in the United States (US).[6]

Turning a patient with critical illness from the supine to the prone position is a complex manual handling procedure that requires a team of four to six skilled personnel and a coordinated approach to undertake safely.[7] Prone positioning manoeuvres are typically performed by ad hoc teams, traditionally led by intensivists and comprising doctors, critical care nurses, physiotherapists (PTs), and patient assistance staff.

Quarantine and public health measures in Australia fortunately limited the spread of COVID-19 during 2020 and the first half of 2021, allowing health services to plan surge responses.[8] Efforts were undertaken to increase the number of beds, equipment, and staffing capacity with a need to maximise capability of appropriately trained staff.[9] Despite this, increasing the critical care workforce was a significant challenge. Fully trained critical care nursing staff members were not available in sufficient numbers, and alternatives to usual care practice were required. Strategic use of the physiotherapy workforce may reduce the burden on finite critical care nursing resources by taking on tasks and roles historically allocated to the nursing staff. Recent reports suggest variability in allied health capacity across Australian ICUs, with further exploration required to guide preparations for future pandemics or other crises.[10] Intensive care PTs are ideally suited to lead proning teams due to their expertise in respiratory physiology and in moving critically unwell, invasively ventilated patients.

Guidelines for physiotherapy and intensive care staff recommended implementing processes to facilitate prone positioning.[11,12] The implementation of mobile prone teams to increase capacity to provide prone positioning during periods of surge has been published from international settings.[13–15] However, there are no published reports from an Australian setting describing the practical and logistical considerations of developing additional surge clinical teams, despite their inclusion in pandemic response guidelines. Our unit developed a physiotherapy-led intensive prone positioning (PhLIP) team. The aim of the PhLIP team was to support and educate the ICU workforce to meet the increased demand for prone positioning. This article describes how the PhLIP team was developed and operationalised in our hospital to address these increased demands of the critical care workforces during the COVID-19 pandemic.

2. Method

2.1. Study design

We describe the development and implementation of a dedicated physiotherapy-led prone positioning team during the Delta wave of the COVID-19 pandemic and evaluate the feasibility of this novel model of care delivery through a retrospective, observational audit of PhLIP team activity, ICU clinical activity, and a description of clinical outcomes.

2.2. Setting

The Austin Hospital is a 560-bed major academic teaching hospital in Melbourne, Australia. The Austin Hospital's ICU is a quaternary-level unit and a referral centre with advanced capabilities including extracorporeal membranous oxygenation (ECMO). The ICU provides specialised care for patients requiring liver and intestinal transplantation, patients with spinal cord injuries, and patients requiring prolonged ventilator weaning. Before the pandemic, the ICU treated 2200 patients per year and had 29 physical bedspaces (24 funded ICU equivalent beds) per day available for patient care.

The unit is routinely staffed with 6.75 equivalent full time ICU PTs 7 days a week, from 08:00 to 18:30. PTs provide a respiratory and rehabilitation service. During surge periods, additional, ICU-trained PTs working across the health service were redeployed to the PhLIP team in the ICU. During this time, elective surgery was reduced or suspended entirely to facilitate resource allocation to the COVID-19 response. Medical and nursing staff members were redeployed from non–critical care areas to bolster staffing with oversight from critical care–trained staff.

2.3. ICU Activity Index

During the pandemic, the ICU Activity Index was developed and validated in Australia as a measure of ICU strain.[16] A higher ICU Activity Index indicated more critical care transfers, higher levels of ICU occupancy, greater numbers of patients requiring 1:1 nurse-to-patient ratios, and crucially, fewer critical care nursing staff members available. An ICU Activity Index score of 1.6 is considered 'high'.[16] We retrospectively reviewed the ICU Activity Index for the unit during PhLIP activation as a measure of ICU strain.

2.4. Study procedures

2.4.1. Protocol development

Prior to the commencement of PhLIP, the hospital protocol for prone positioning was updated and endorsed by senior leadership from the intensive care and physiotherapy departments. An iterative approach to adapt this protocol was done in response to evaluation of the service.

2.4.2. Education and training

A multimodal education program on prone positioning was delivered to ICU medical and nursing staff by experienced ICU PTs. This education program was based on a just-in-time training model, frequently adopted in disaster management and planning, consisting of curriculum covering both theoretical and practical domains of prone positioning.[17,18] Approximately one hour of theoretical education including rationale, indications, contraindications, and patient selection was delivered via videoconference and sharing of relevant research articles and online resources. This content was included in the hospital prone positioning protocol and the newly developed training video outlining the manoeuvre. Interprofessional simulations of 1 hour duration were used to rehearse the process of positioning patients with critical illness secondary to COVID-19 in prone. Bedsides, education and coaching in prone positioning were provided prior to, during, and after the manoeuvres. These learning activities were reviewed and updated accordingly as clinical practice and updated versions of the protocol were released.

2.4.3. Team composition

The PhLIP team comprised a PT as a team leader, airway doctor (non–critical care but airway management trained), and nursing, physiotherapy, and other staff. A comparison of the PhLIP team composition relative to traditional ad hoc prone teams is illustrated in Fig. 1. Roles are outlined as follows:

Team leader: PhLIP PTs were allocated to the team leader role with responsibilities including bedside consultation with the treating intensivist regarding clinical decision-making of proning. This consultation comprised patient selection, timing, and dose. They were responsible for assembling personnel, gathering equipment, briefing the team, coordinating the manoeuvre, and completing documentation. The PTs identified for the PhLIP team leader role had a minimum of 4 months' clinical ICU experience.

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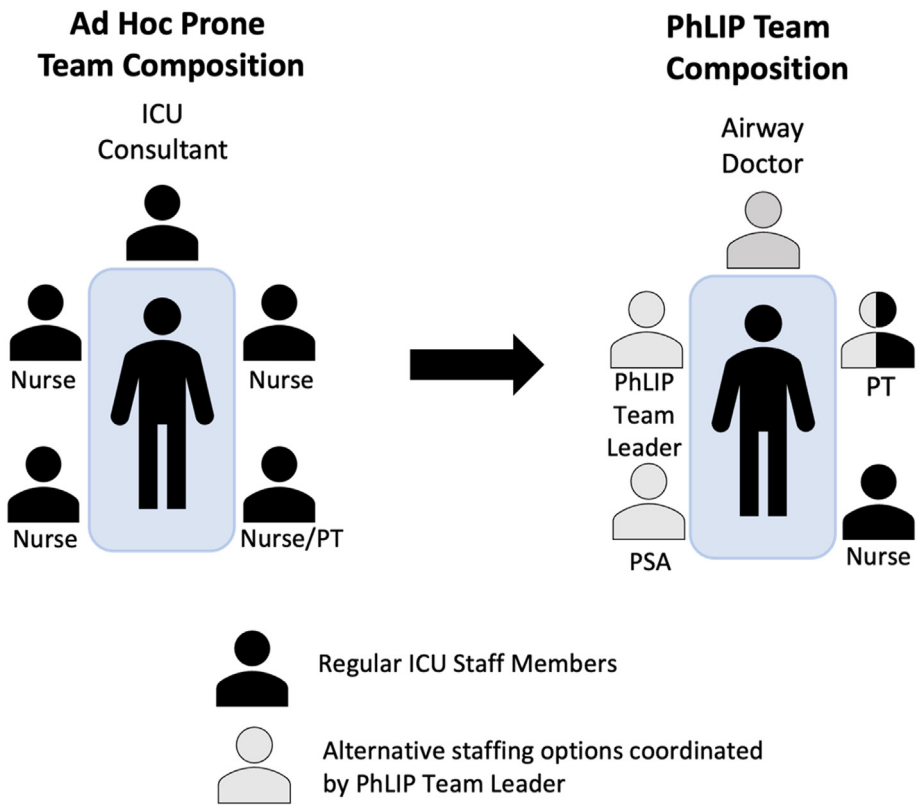

Fig. 1. Prone team composition before and after implementation of PhLIP team. ICU, intensive care unit; PhLIP, physiotherapy-led intensive care proning; PT, physiotherapist; PSA, patient service assistant.

Airway doctor: Medical staff members with airway management skills (i.e., intensive care or anaesthesia training) were responsible for ensuring security of the endotracheal tube. Experience with prone positioning was not required. Each stage of the manoeuvre was carried out on the airway doctor's direction.
Nurse: The primary nurse caring for the patient being proned was responsible for preparing the patient for the turn, including application of prophylactic pressure relieving dressings.[19] They also contributed to the turn.
Other: The remainder of the team was formed by available physiotherapy, medical, nursing, and patient assistance staff.

2.4.4. Roster

The unit planned to expand from a 24-bed mixed medical/surgical ICU to 112 beds including use of general hospital ward beds usually allocated to day surgery procedures.

The brief for PhLIP was to provide up to a 24-h dedicated prone positioning service while maintaining appropriate clinical care to patients in the non-COVID ICU during periods of high ICU strain.

We developed a two-tier scalable roster to provide an additional, extended daytime service in the first instance that could progress to 24 h according to clinical need. PhLIP roster structures followed a pattern of 4 days on and 4 days off. Once activated, teams of four PhLIP PTs would either be rostered in the day shift or evening shift or rostered off. The 24-h service would add on a night shift to the same rostering pattern with a senior PhLIP PT. The roster would overlap to allow for double staffing between 14:00 and 17:00 which was anticipated to be the peak prone positioning time. Details on the roster structure are available in Supplementary Material 1.

2.5. Data collection

Data on COVID admissions, deployed staff, patient turns, ICU Activity Index, and complications associated with the procedure were collected. A prone positioning episode was defined as a prone-and-return-to-supine cycle. A turn was defined as either a prone or return to supine manoeuvre. Data were managed on a Microsoft Excel[20] database. Standard epidemiological descriptions of studied activity were performed by expressing medians, interquartile ranges (IQRs), means, and standard deviations.

2.6. Ethical approval

Human ethics research approval for the data collected for this feasibility study was provided by Austin Health (Approval HREC/82018/Austin-2021).

3. Results

Case numbers attributed to the Delta COVID-19 variant rapidly increased from the 13th of September and continued until the 19th of November 2021. During this time, 93 patients with COVID-19 were admitted to the ICU. Fifty-one (55%) were positioned prone across 161 episodes (362 turns) with a median [IQR] of 2 [2, 5] prone episodes per patient. Median [IQR] duration that patients were positioned in prone per episode was 16.2 [14.4, 17.1] h. Prone positioning primarily occurred between 14:00 and 22:00 (Fig. 2). Return to supine turns mainly occurred between 08:00 and 12:00.

Twenty-three PTs were upskilled and deployed to the PhLIP team, adding 2.0 equivalent full time to the daily service. Ninety-four percent (154/161) of proning episodes were conducted by the PhLIP team with a median [IQR] 4 [2, 8] turns per day. During the

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surge, up to six patients required prone positioning and return to supine per day, which reflected up to a quarter of all patients in the ICU (Fig. 3a). The ICU Activity Index exceeded the threshold for high strain (>1.6) on all but 3 days of the PhLIP service (Fig. 3b).

Approximately 300 medical, nursing, and support staff members were trained by the PhLIP team using the multimodal training program. There was no additional cost with the PhLIP team as all personnel were already employed at the organisation but were redeployed in the setting of reduced services elsewhere in the organisation.

Potential airway adverse events occurred on three occasions (1.8%). These incidents included two episodes of increased endotracheal tube leak requiring repositioning of the tube and one airway obstruction secondary to the body habitus of the patient, managed with repositioning. There were no hypoxia-related complications or other adverse outcome for the patients from these incidents, and no escalations of care were required as determined by the treating intensivist. There were no accidental extubations. Importantly, there were no prone-related neuromuscular injuries reported from any patient followed up to ICU discharge. There were no reports of manual handling injuries or staff exposures to COVID-19. Only one patient (1%) admitted to the unit was placed onto veno-venous extracorporeal membranous oxygenation (VV-ECMO). ICU survival rate for COVID-19 patients in the third wave at our site was 88% (n = 82/93).

4. Discussion

The PhLIP team was key to managing the surge in severe COVID-19 patients in our ICU. This approach liberated valuable critical care—trained medical and nursing staff to other duties. Over a 2-month period, the PhLIP team completed over 150 prone positioning manoeuvres with minimal adverse events. Each day, up to a quarter of the patients in the ICU required prone positioning. This is of particular importance as the PhLIP team operated during the period of peak ICU strain, as measured using the ICU Activity Index (Fig. 3). We observed a low rate of airway adverse events (1.8%) compared with published reports of 11–13% in patients with ARDS[4,21] and up to 17% for patients with COVID-19–related respiratory failure.[22] We found that a physiotherapy-led approach was a safe and feasible method to provide a scalable prone positioning team during periods of surge.

Prior to the pandemic, there were limited published reports on the composition of prone positioning teams. Our experience was similar, albeit on a smaller scale to that of Short et al., where a mobile multidisciplinary prone team was successfully established to facilitate prone positioning across a large health network in New York, USA.[13] In France, non–critical care–trained volunteer medical staff formed a dedicated prone team that avoided major adverse events and relieved intensive care staff.[15] Although there were anecdotal reports of prone positioning teams planned and utilised locally, this is the first report on the establishment of this model of care in Australia.

We report a novel approach to task-based rather than discipline-based care where we allocated staff to specific duties in the COVID-ICU without restricting individual clinicians to their traditional discipline-specific roles. A physiotherapy-led model increases capability of the critical care multidisciplinary team without adding additional strain to an already scarce ICU nursing and medical workforce. In the first 4 months of the pandemic, 27% of mechanically ventilated patients in Australian ICUs received prone positioning.[2] In the third wave, prone positioning of invasively

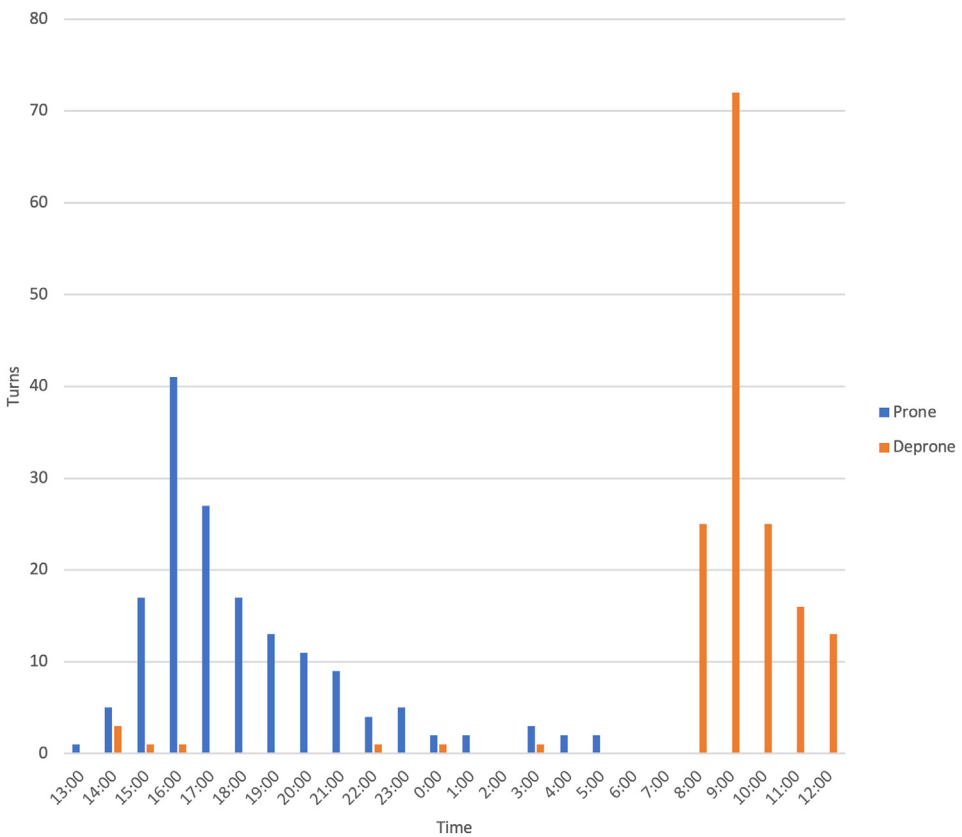

Fig. 2. Turning times for turning prone and returning supine. Proning rounds commenced at approximately 14:00. Rounds to return patients to supine commenced following handover at 08:00.

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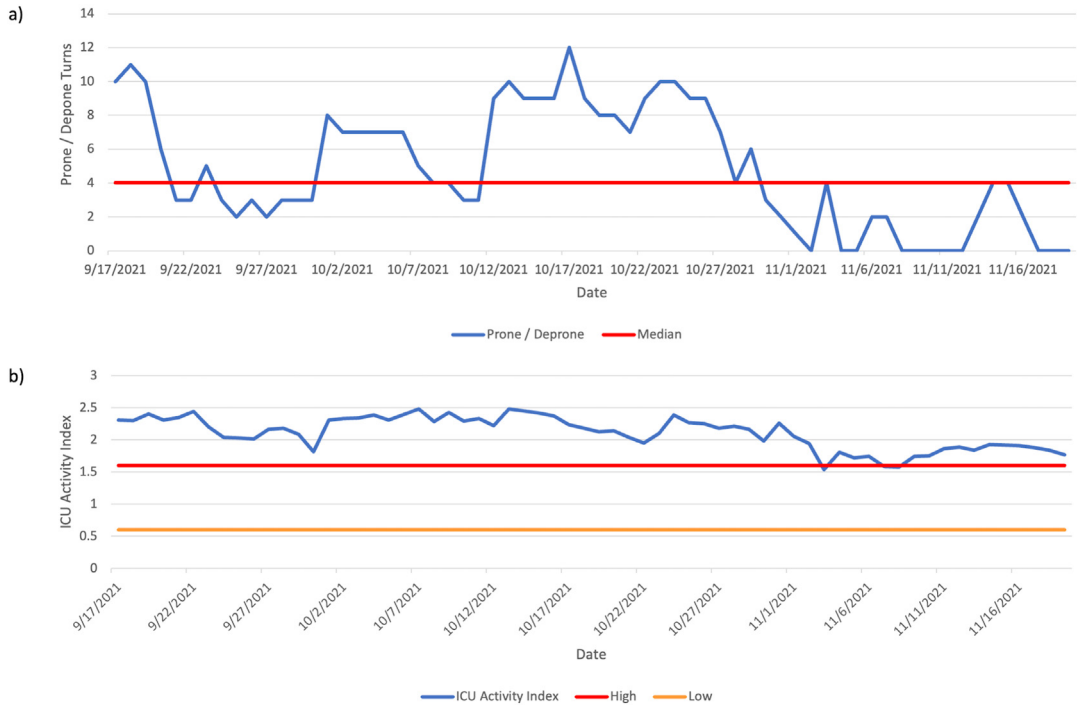

Fig. 3. Proning activity and ICU Activity Index during PhLIP activation. (a) Proning activity. (b) ICU Activity Index (high strain defined as ≥1.6, low strain defined as ≤0.6).

ventilated patients in Australia was used 29% of the time and VV-ECMO in 5% of cases.[8] Our data show over half (55%) of the mechanically ventilated patients admitted with severe COVID-19 in our unit received prone positioning, with only one patient (1%) proceeding to VV-ECMO. The survival rate was similar to nationally reported outcomes from the third wave in Australian ICUs (88% vs 86%).[8] We hypothesise that access to a dedicated service for prone positioning in our unit encouraged intensivists to utilise this evidence-based therapy. A dedicated staff member responsible for coordinating the procedure with the treating intensivist enabled an efficient approach to workflow during peak periods. Challenges encountered included providing education en masse during periods of restrictions on face-to-face education and training. The use of cloud-based protocols, videoconferencing, and instructional videos were vital to safely provide education on prone positioning. Due to evolving restrictions on face-to-face teaching, the PhLIP team incorporated education of clinical staff in the COVID pod at each proning round.

One of the main limitations of the PhLIP team was the inability of the model to liberate medical staff entirely from prone positioning procedures. Inadvertent extubation in critically hypoxaemic patients with COVID-19 is a serious adverse event; therefore, having medical staff with airway management skills present was critical to the safety of our approach. Due to the reduction in surgical activity, we were able to allocate anaesthetic staff with airway management skills to the PhLIP team to fulfil this role without drawing on ICU medical staff. Future studies could consider expanding the scope of practice of disciplines such as physiotherapy in tasks such as airway management to further increase the capability of the multidisciplinary team. This report is limited to the feasibility and fidelity of the model but would benefit from further evaluation with regards to its acceptability by the ICU team to guide future pandemic preparations.

In conclusion, the PhLIP team supported the ICU multidisciplinary workforce at our institution through safe, high-volume prone positioning for patients with critical illness secondary to COVID-19. This model released scarce critical care—trained medical and nursing staff to other duties in the ICU and should be considered in future crises. Engaging the capability of all members of the multidisciplinary team is paramount during a pandemic, and we have demonstrated the feasibility of a physiotherapy-led model in the ICU.

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CRediT authorship contribution statement

Thomas C. Rollinson: Conceptualisation, Methodology, Investigation, Writing – Original draft. **Joleen Rose**: Conceptualisation, Methodology, Investigation, Writing. **Luke A. McDonald**: Conceptualisation, Methodology, Investigation, Writing. **Cara Green**: Conceptualisation. **Michelle Topple**: Conceptualisation, Review and Editing. **Stephen Warrillow**: Conceptualisation, Review and Editing. **Lucy Modra**: Conceptualisation, Methodology, Review and Editing. **Rahul Costa-Pinto**: Conceptualisation, Methodology, Review and Editing. **Sue Berney**: Conceptualisation, Methodology, Review and Editing.

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Data availability statement

Deidentified data used in this publication may be made available by the corresponding author upon reasonable request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.aucc.2023.02.001.

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