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Can Direct Geriatric Unit Admissions through the Use of Virtual Emergency Medicine Tools Shorten Older Inpatients' Stay by at Least One Day?

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Abstract

Introduction: Virtual emergency medicine (VEM) enables video calls with paramedics before emergency department (ED) arrival. This allows streamlining of older patients to the Rapid Assessment and Treatment Unit (RATU), specialised in older adult care, bypassing the ED. **Aim and Method:** This retrospective cross-sectional study with a control group aimed to compare outcomes for older patients admitted to the RATU through the VEM-RATU and non-VEM pathways between January and June 2022. **Results:** This study included 131 patients (64 VEM and 67 non-VEM). The groups were well-matched in terms of comorbidities and demographics. However, the mean age of non-VEM patients (81.7 [7.3]) was lower than that of VEM patients (84.4 [8.0]) by 2.7 years ($p < 0.05$). On average, VEM patients underwent 2.0 fewer interdepartmental bed moves (1.0 [0.0]) than non-VEM patients (3.0 [0.2]; $p < 0.0001$). Inpatient length of stay (LoS) ≤ 80th percentile was generally ≥1 day shorter for VEM than for non-VEM patients ($p < 0.05$). The discharge destination (usual residence or nursing home) and the total number of hospital-acquired complications were similar between groups. **Conclusions:** Our preliminary data show that the VEM-RATU pathway reduces bed moves and might reduce LoS up to the 80th percentile by ≥1 day. Patients admitted through the VEM-

RATU pathway are slightly older than those admitted through the non-VEM pathway. However, the VEM-RATU pathway does not appear to offer additional advantages in terms of discharge destination or reduced hospital-acquired complications. Further research is needed to clarify these preliminary observations.

Keywords

Telemedicine, Older Persons, Emergency Medicine, Ambulance, Paramedics, Virtual Medicine, Length of Stay, Direct Admissions, Geriatric Unit, Geriatrician

1. Introduction

The medical needs of ageing populations impose an escalating burden on healthcare systems [1]. Older adult patients with multiple morbidities face an elevated risk of complications, such as delirium and falls, in an emergency department (ED) [2]. An innovative approach, virtual medicine, is gaining prominence around the world. Virtual medicine can facilitate remote consultations and tailored care to the unique needs of older individuals, thereby enabling faster admission (if required). Hospitals in the UK's National Health Service (NHS) and Canada have already adopted virtual emergency medicine (VEM) in geriatric healthcare to curb hospital admissions and enhance patient outcomes [3] [4]. Further, the University of California, San Francisco has developed a virtual medicine programme designed to provide emergency care to older adult patients in underserved rural regions [5]-[7]. In addition, virtual medicine is used in France to connect nursing homes to general hospitals [8].

1.1. Older-Patient Admissions that Bypass the Emergency Department

Virtual-medicine technologies can potentially provide community-dwelling older patients with an alternative, cost-effective pathway for direct admission to a specialised inpatient geriatric unit that bypasses the traditional emergency department visit. The introduction of the VEM-admission pathway (hereafter, the VEM-RATU pathway) to the Rapid Assessment and Treatment Unit (RATU) of the Geriatric Medicine Department at Fremantle Hospital, Western Australia, was designed to streamline the admission of older patients from the community who require direct inpatient admission to a specialised inpatient geriatric unit (*i.e.*, the RATU), bypassing the busy ED. Although this pathway was not designed as a response to the COVID-19 pandemic, it increased recognition of its utility [9].

The VEM-RATU pathway facilitates the early involvement of geriatricians in patient care, ensuring that older individuals receive specialised attention from the outset. By allowing direct admission of older patients living with frailty from the community to the geriatric ward, the pathway alleviates pressures on the healthcare

system. More specifically, the VEM-RATU pathway reduces ED congestion, minimises ambulance-ramping times, and mitigates bed blockages, thus increasing healthcare system efficiency [10]-[15]. Further, the active participation of geriatricians and a full allied-health team enhances the continuity of patient care, resulting in improved outcomes and a more comprehensive approach to treatment. Patients admitted via the VEM-RATU pathway are likely to stay in the same bed throughout their hospitalisation, which may translate to a better functional status [16]-[18], a reduced risk of falls [19], reduced length of stay (LoS) [17] [19], and reduced occurrence of delirium [2] [19] [20]; something especially beneficial for patients with dementia who are vulnerable to developing delirium. In addition, in older patients, an extended ED stay is associated with an increased probability of adverse events [21]-[24].

1.2. Aims

This study aimed to explore whether LoS for older patients admitted to the RATU who bypassed the ED (*i.e.*, admitted via the VEM-RATU pathway) differed from those of older patients admitted to the RATU through the ED (*i.e.*, admitted via the non-VEM pathway). We hypothesised that a direct admission strategy might be associated with a shorter LoS.

2. Methods

This retrospective cross-sectional study with a control group was conducted over a randomly selected continuous 6-month period from 1 January 2022 to 30 June 2022.

2.1. Power Evaluation

It was initially noted that the LoS of 24 VEM-RATU patients observed in a small in-house quality assurance study [25] was at least 1 day lower on average than that of non-VEM patients after excluding outliers, and this was statistically significant. Therefore, comparing 50 VEM-RATU to 50 well-matched non-VEM patients whose discharges were not significantly delayed was likely adequately powered to demonstrate a lower LoS when older patients access the VEM-RATU pathway. To allow for patients whose discharges got significantly delayed, data for over 60 patients in each arm were collected.

2.2. Cohort Size

A total of 66 patients were referred through the VEM-RATU pathway, 64 of whom were admitted directly to the RATU at Fremantle Hospital and included in the VEM-RATU arm of this study. These patients arrived via ambulance, bypassing the ED, emergency short stay unit (ESSU), and acute medical unit (AMU) at Fiona Stanley Hospital. Two patients were excluded as they were referred through the VEM-RATU pathway and were not admitted to the RATU due to bed unavailability, being subsequently admitted to the general geriatrics ward at Fremantle

Hospital.

During the same 6-month period, approximately 500 patients were admitted to the RATU via the non-VEM pathway. From this group, 80 patients were randomly selected for inclusion in the non-VEM group. All randomly selected patients had to meet the RATU-inclusion criteria upon presentation to the ED and were admitted to the RATU exclusively from the ED, ESSU, or AMU. These patients were not admitted from general medicine, general surgery, or any other medical or surgical specialty, nor did they transition from the ED to the geriatrics ward at Fiona Stanley Hospital before transferring to the RATU.

The average number of comorbidities was higher in the 80 randomly selected non-VEM group compared to the VEM-RATU arm. To ensure comparability, the 80 randomly selected non-VEM patients were excluded one at a time in descending order, starting with the highest number of comorbidities, until both groups were equally matched in terms of average number of comorbidities. Consequently, a total of 67 patients were selected for the non-VEM arm of this study, and 13 patients from the non-VEM group who had the highest number of comorbidities were discarded.

2.3. Data Collection

Data pertaining to VEM patients were systematically retrieved from the electronic medical record system. The dataset encompassed various variables, including demographics, living arrangements (residing at home or at a nursing home), the presence of a caregiver, and the availability of a home-care package. Key clinical information, such as the admission diagnosis (including delirium, common geriatric syndromes like cognitive impairment, incontinence, or immobility, or other conditions leading to hospitalisation), was documented. Additionally, data regarding the discharge destinations (same or a different destination) were collected. To facilitate group comparisons, numerical metrics, including the number of comorbidities, hospital admissions in the previous two years, medications on discharge (including new medications), and complications for patients admitted via both pathways, were computed. This dataset served as the cornerstone of the study's analysis and findings.

2.4. Service Description

A patient in need of emergency care can contact St John's Ambulance, Western Australia, after dialling triple zero (000), and St John's Ambulance paramedics assess the patient upon arriving at the scene. If they determine that the patient could benefit from the streamlined VEM-RATU pathway, they establish contact with command-centre clinicians via telephone or video call. This expedites the patient's access to care because ED staff can conduct a consultation and comprehensive assessment before the patient's arrival at the hospital. A clinical nurse collaborates with a specialist emergency consultant to determine the most suitable course of care for the patient, involving their next of kin, caregiver, or general practitioner,

as needed.

Subsequently, the emergency physician collaborates with the RATU geriatrician at Fremantle Hospital, and if the patient is deemed suitable, direct admission to the RATU ensues, bypassing the ED and traditional admission routes. The ambulance takes the patient directly to Fremantle Hospital instead of the Fiona Stanley Hospital ED. At the RATU, older patients receive a geriatric assessment, often followed by a comprehensive review by an allied-health team on the same day. This expedites patient management and the formulation of a discharge plan shortly after admission.

Alternatively, in the standard (the non-VEM) pathway, patients present to the ED either through ambulance services or using their own transport. Subsequently, these patients undergo an assessment in the ED, which occasionally necessitates an overnight stay in the ESSU and subsequent admission to the AMU. The identification of patients suitable for the non-VEM-RATU pathway can occur at various stages, including in the ED, ESSU, or AMU, and is followed by a transfer to the RATU at Fremantle Hospital. Moreover, patients can be transferred to the RATU from various medical and surgical specialties at Fiona Stanley Hospital.

A summary of inclusion and exclusion criteria is shown in Table 1.

Table 1. Rapid assessment and treatment unit—patient inclusion and exclusion criteria.

Inclusion criteria
Age ≥ 65 years
Infections—cellulitis, pneumonia, urinary tract infection (UTI), etc. (excluding septic shock)
Mobility issues—falls, functional decline (clinical frailty score > 4)
Cognitive issues—delirium, dementia (excluding patients needing a locked unit)
Heart failure (if hemodynamically stable)
Fractures (for conservative management)
Parkinson's disease and syndromes
Other issues (identified in discussion with the RATU geriatrician)
Exclusion criteria
Patients who require surgery or are immediately postoperative
Bariatric patients (weight > 230 kg, shoulder width > 60 cm, or pelvic width > 55 cm)
Patients who are haemodynamically unstable (Adult Deterioration Detection System score > 3), need telemetry, or require tertiary care
Patients who require non-invasive ventilation (unless the patient can self-manage their own CPAP machine)
Patients with femur fractures, unstable pelvic fractures, or those who need spinal precautions
Patients who require complex disposition planning

2.5. Data Analysis

Categorical data were analysed using Fisher's exact test, whereas continuous data were analysed using Student's *t*-test. A two-tailed *p*-value < 0.05 was considered statistically significant. Because LoS is not normally distributed, the Wilcoxon signed-rank test was used for analysis. *T*-tests were applied to age, comorbidities, drugs, and the number of admissions.

The 80th percentile of LoS was selected to focus on patients who required primarily acute and/or subacute care while excluding older inpatients who needed extended maintenance care as they awaited suitable accommodation for discharge. The study juxtaposed the mean, median, and every 5 percentile intervals of LoS observed in the VEM-RATU pathway with data from non-VEM admissions to the RATU over a 6-month period. Subsequently, the cohort's data were compared with those of the broader Australian older inpatient population in the same year, utilising data from the Australian Institute of Health and Welfare (AIHW) for 2021-2022 [26].

2.6. Ethics Approval

This quality activity (No. 50491) was approved by the South Metropolitan Health Service Human Research Ethics Committee. As this study is a retrospective study, and all participants were de-identified, informed consent to participate was not required.

3. Results

The groups were well matched; that is, they did not exhibit differences in gender distribution, demographics, number of comorbidities, hospital admissions in the previous two years, predominant admission issues, number of new medications, number of medications on discharge, average LoS, discharge destination, or total number of hospital-acquired complications (Table 2).

Table 2. Comparison of the VEM-RATU and matched Non-VEM cohorts.

	VEM-RATU Patients (n = 64)	**Non-VEM Patients** (n = 67)	***p*-value**
Age (years)	84.4 (8.0)	81.7 (7.3)	<0.05
Gender	38 females 26 males	35 females 32 males	ns
Demographics	53 homes 11 nursing homes 33 have a carer 34 have a home package	44 homes 19 nursing homes 32 have a carer 41 have a home package	ns
Comorbidities	9.0 (4.2)	8.9 (3.8)	ns
Hospital admissions two years prior	3.8 (3.1)	4.1 (3.0)	ns

Continued

Admission issues	38 geriatric syndromes 26 other issues	31 geriatric syndromes 36 other issues	ns
Bed moves between departments	1.0 (0.0)	3.0 (0.2)	<0.0001
New medications	2.6 (2.2)	2.6 (1.9)	ns
Medications on discharge	11.0 (4.7)	11.6 (5.7)	ns
Length of inpatient stay (days)	9.9 (8.1) Median 6 80th percentile 12	9.8 (11.0) Median 6.5 80th percentile 14	ns
Hospital-acquired complications	7 hypertension/postural hypotension 4 falls 5 UTI 3 delirium 2 constipation/diarrhoea 2 AKI 2 COVID 1 *Candida* infection	9 constipation/diarrhoea 6 *Candida* infection 6 delirium 4 hypertension/postural hypotension 4 COVID 2 UTI 1 fall	ns
Discharge destination	47 home or usual residence 13 nursing homes 3 tertiary hospitals 1 private rehabilitation unit	57 home or usual residence 9 nursing homes 0 tertiary hospitals	ns

However, non-VEM patients were 2.7 years on average younger than VEM-RATU patients. Compared to non-VEM patients, VEM-RATU patients underwent an average of 2.0 fewer interdepartmental bed moves. At the ≤80th percentile, VEM-RATU patients generally had ≥1 fewer inpatient day than non-VEM patients (**Figure 1**).

More than half of the cohort admitted to RATU through both pathways had geriatric syndromes as one of their predominant admission reasons, *i.e.*, issues related to cognition, continence, and mobility. Additionally, various other medical conditions, such as cellulitis, heart failure, pneumonia, etc, played significant roles in the health of these older patients living with frailty.

The VEM-RATU pathway exhibited a mean, median, and 80th-percentile LoS of 9.9 days (standard deviation 8.1 days), 6 days, and 12 days, respectively. The matched data for patients admitted to the RATU via the non-VEM pathway had a mean LoS of 9.8 days (standard deviation 11.0 days), a median LoS of 6.5 days, and an 80th-percentile LoS of 14 days. For Australian inpatients 80 years of age and older, the mean, median, and 80th-percentile LoS were 7.8 days (standard deviation 8.7 days), 6 days, and 11 days, respectively, according to data from the AIHW for the 2021-2022 study period.

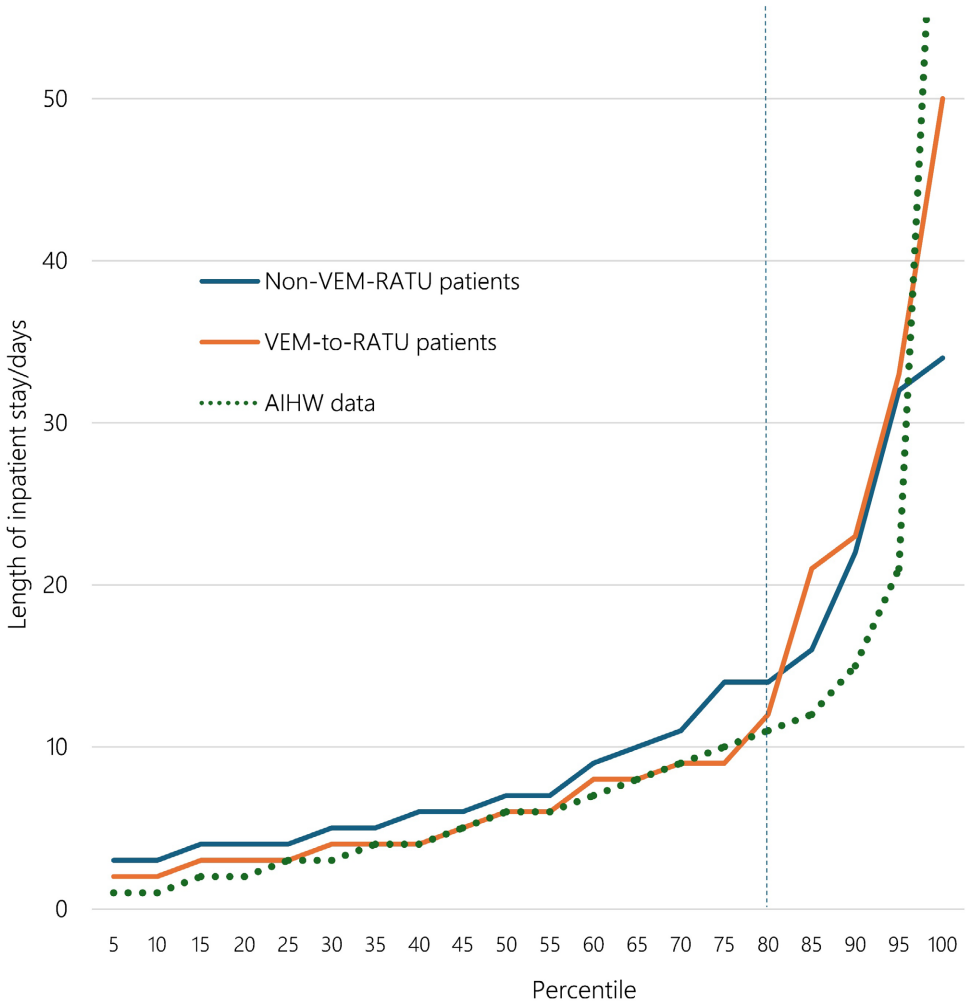

Figure 1. Comparison of the length of inpatient stay.

Figure 1 shows a comparison of LoS data to the AIHW's LoS data at 5 percentile intervals. The LoS up to the 80th percentile was consistently lower for VEM patients than for non-VEM patients ($p < 0.05$) and coincided with the AIHW's LoS data up to the 80th percentile. These observations support using the 80th percentile to dichotomise the data to exclude LoS outliers. LoS for non-VEM patients was slightly but consistently higher than that indicated by the AIHW data up to the 95th percentile.

4. Discussion

In the VEM-RATU pathway, virtual medicine is seamlessly integrated into ambulance services, with an additional phone-call link established between the ED and geriatric consultants at the RATU. Consequently, this pathway transcends pure telehealth by introducing an additional step into the process. The pathway's objective is not solely to manage patients through telehealth but to establish a comprehensive pathway that facilitates patient admission and treatment. This paper delved into a unique dimension of the application of virtual-medicine technology.

4.1. Age Disparities

In this study, patients admitted via the VEM-RATU pathway were slightly but significantly older than those admitted through the non-VEM pathway. We speculate that the older patients admitted via the VEM-RATU pathway were more quickly identified by emergency physicians as suitable for RATU admission. Moreover, slightly younger non-VEM patients may have been more mobile and consequently less likely to call an ambulance. Furthermore, the older patients admitted through the VEM-RATU pathway may have had more multi-organ issues, which are common among older patients living with frailty, than single-organ issues.

4.2. Length of Stay Comparisons

The lowered LoS by at least one day per patient when older patients access the VEM-RATU pathway instead of the non-VEM pathway has important implications for healthcare cost and bed flow. Despite the potential superiority of the VEM-RATU to the non-VEM pathway in terms of minimising bed moves and shorter LoS, the LoS in general and the LoS ≥ 80th percentile for the VEM-RATU and the non-VEM pathways appear to show no clear advantage over the AIHW data. This discrepancy may be attributed to factors such as COVID-19 outbreaks in nursing homes, challenges in discharging patients to nursing homes [27] [28], and the reduced availability of medical and allied-health staff in hospitals and nursing homes due to COVID-19-related illnesses during certain months.

For comparison with other reports, a 2007 Australian study reported a median LoS of approximately 6 days for patients aged 84.4 years, with a 90th-percentile LoS of approximately 22.5 days [29]. A 2019 UK study indicated a mean LoS of 10 - 12 days for NHS inpatients in an age group similar to that of our cohort [30]. A 2022 French study from 2013 to 2018 with 6583 patients had a median hospital LoS of 11.8 days for patients who were directly admitted to an acute geriatric unit and 13.0 days for patients seen first in the emergency department [31]. However, recent Australian data indicate a declining trend in hospital LoS for Australians ≥ 75 years of age over the past two to three decades [32]. This decline has been attributed to various innovations, including the implementation of earlier geriatric assessments and the use of multidisciplinary healthcare teams [2]. Despite the significant decline in LoS in recent years, the LoS reductions for this demographic may be reaching or have reached a plateau [32], as indicated by our VEM-RATU pathway LoS data up to the 80th percentile.

The French study that demonstrated a shorter median hospital LoS (11.8 days vs 13.0 days) differed from our study [31]. In this study, direct admission was defined as patients being admitted directly from their usual residence after a telephonic clinical assessment conducted between the outpatient physician or the patient's own general practitioner and an acute geriatric unit physician, without the involvement of an emergency physician.

4.3. Bed Moves

Compared to the VEM-RATU pathway, the non-VEM pathway exhibited two more bed moves on average. The initial bed move involves transport via ambulance to the ED; the second move to the AMU, and the third to the RATU. Although our study focused on bed moves across rather than within units, it is improbable that this distinction affected the interpretation of the results.

Although patients may spend only a brief period in the ED, there were still two bed moves, from the ambulance to the ED and to the RATU. Likewise, a significant proportion of patients underwent three bed moves: from the ambulance to the ED, from there to the ESSU, and finally to the RATU (or a comparable sequence, such as ambulance to ED, ED to AMU, and AMU to RATU). In contrast, all the VEM-RATU patients underwent only one bed move, namely from the ambulance directly to the RATU.

Our data (see **Figure 1**) suggest that the VEM-RATU pathway results in 1 to 5 (average 1.5) bed days reduction up to the 80th LoS percentile. These findings indicate that the VEM-RATU pathway is efficient and streamlined in terms of minimising bed moves and optimising resource utilisation.

4.4. Discharge Destinations

The fact that no patients from the non-VEM group were transferred back to a tertiary care hospital from RATU may indicate that the patients had been appropriately screened and selected by the medical staff at Fiona Stanley Hospital as suitable for care at RATU in Fremantle Hospital (secondary care hospital). If, upon screening, any patients were deemed to require admission at a tertiary care hospital, they remained at Fiona Stanley Hospital until their tertiary hospital needs were appropriately met. Although three VEM group patients were transferred to a tertiary care hospital, this result was not statistically significant when compared with the non-VEM group. This non-significant result indicates that screening of suitable patients for the VEM-RATU admission pathway was effectively done as well. Most study participants were discharged to their homes or to nursing homes, without significant difference between groups.

4.5. Limitations

The data analysed in this study were collected from a single medical centre, limiting the generalisability of the findings to a broader population, as the characteristics of patients and their outcomes may have been influenced by centre-specific factors. Also, the AIHW cohort was not matched to our cohort, thus limiting comparisons.

This study was based on a relatively short data-collection period of six months. During this time, there may have been fluctuations in patient numbers and variations in service delivery due to COVID-19 guidelines and restrictions, which could have influenced the results. The sample size (131 patients) was relatively small, which likely reduced the statistical power and reliability of the comparisons.

The VEM-RATU pathway was in the early stages of its implementation during the study period. As a result, patient selection may have been limited by the exclusion criteria, which prevented the inclusion of severely ill patients or those requiring tertiary care.

Matching the non-VEM arm to the VEM-RATU arm by excluding non-VEM patients with higher numbers of comorbidities seems practical for this small, preliminary exploratory study with a limited data set. However, no consideration of the functional status of each patient or other potential confounders might attenuate the true LoS differences and make this approach less robust. Multivariate analyses to control for the possible effects of confounding to allow for a more accurate estimate of the effect of confounding were not carried out.

Despite all these limitations above, which should be taken into consideration when interpreting these results, this preliminary exploratory study raises the plausibility that shortening older inpatient stays is achievable. The pathway's effectiveness may improve with maturing implementation. Additional data collection post-COVID pandemic, with a larger sample size, a longer observation period, a more comprehensive study design that includes propensity score matching, and inclusion of other centres, is required to validate the findings of our study. Further studies may substantiate our speculation that non-VEM patients may be younger and therefore more mobile, consequently less likely to call an ambulance. They should also evaluate the ambulance call-to-geriatrician time and ED return visits within six months. Such research may provide more robust evidence of the strengths and benefits of the VEM-RATU pathway.

5. Conclusions

1) The VEM-RATU pathway reduces bed moves and might reduce LoS up to the 80th percentile by ≥1 day.

2) Based on our findings, patients admitted through the VEM-RATU pathway are slightly older than those admitted through the non-VEM pathway.

3) The VEM-RATU pathway does not appear to offer additional advantages in terms of discharge destination, medications used, or reduced hospital-acquired complications.

4) Further research is needed to clarify these preliminary observations.

Authors' Contributions

Dr Imran Riaz conceived the study, collected the data, performed the literature search, data analyses, and drafted the entire manuscript. A/Prof Roger Clarnette provided comments on the paper and assisted with proofreading and copyediting. Dr Janet O'Brien provided comments on the paper and assisted with the development of the study concept. Prof Bhaskar Mandal provided comments on the paper. Dr Kevin T Ong contributed to the development of the study concept, data analyses, literature search, manuscript organisation, proofreading, and copyediting. He is the senior author on this paper.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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