


CLINICAL CONCEPTS

Emergency Medical Services

From concept to reality: A comprehensive exploration into the development and evolution of a virtual emergency department

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Abstract

Emergency department (ED) overcrowding remains a persistent challenge in global public health, leading to detrimental outcomes for patients and healthcare professionals. Traditional approaches to improve this issue have been insufficient, prompting exploration of novel strategies such as virtual care interventions. Our team developed the first comprehensive statewide virtual ED in Australia, the Victorian Virtual Emergency Department, offering an alternative to in-person care for non-life-threatening emergencies. Here, we present the development and ongoing refinement of this pioneering virtual care service, aiming to provide insights for hospital administrators and policymakers seeking to implement patient-centric care solutions worldwide. By sharing our model of care, we hope to guide further work toward addressing the global problem of over crowded EDs.

KEYWORDS

crowding, digital health, emergency medicine, telemedicine, triage

1 | INTRODUCTION

Emergency department (ED) overcrowding has continuously been a global public health problem over the last few decades.¹ Crowded EDs lead to severe consequences, such as extended triage times, patients

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leaving the ED without receiving a full assessment, inability to transfer patients to inpatient beds, and heightened stress levels among ED staff.^{2,3} These challenges collectively contribute to a greater risk of adverse patient outcomes.⁴ Emergency providers, hospital administrators, and policymakers continue to propose and implement strategies to alleviate the issue of ED overcrowding, which have varied,⁵ with one

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being the utilization of virtual care interventions to provide remote health care.

Virtual care, in the form of telemedicine, emerged in the early 1900s with the telephone being used for health consultations and advice. Over time, the evolution of telecommunications coupled with the emergence of the internet and digital technologies has revolutionized telemedicine.⁶ The advent of video conferencing, secure messaging platforms, and remote monitoring devices has vastly expanded the scope and capabilities of virtual care, especially in scenarios demanding immediate specialist advice when distances or schedules separate patients from healthcare professionals.⁷ Furthermore, the COVID-19 pandemic served as a catalyst for the widespread adoption of virtual care and highlighted its significant value in delivering health care, including increased accessibility, improved convenience and environmental impacts, and increased staff efficiency for identifying and treating illnesses and injuries.⁸ Yet, criticisms of telemedicine persist, such as depersonalizing care, limitations around diagnosis and treatment due to lack of physical touch, apprehensions about care quality, and concerns around digital health literacy and adoption by clinicians and patients.^{8,9-12} Despite these criticisms, the rise of virtual health care is imminent, and we must examine how emergency care can be administered in the context of the entire healthcare system to overcome ED overcrowding.

Together with our health service (Northern Health), we developed the first comprehensive, multidisciplinary statewide virtual ED in Australia to provide patients with an alternative to in-person care for non-life-threatening emergencies. This platform re-imagined emergency care, offering a comprehensive solution that goes beyond traditional models of care. By leveraging telemedicine technology, patients can be virtually triaged, treated, and discharged appropriately by a clinician. The virtual ED is part of the public healthcare system in Victoria, funded by the government, and patients who are eligible for Medicare (Australia's universal health insurance scheme) can access the service at no direct cost and without incurring any out-of-pocket expenses. In this paper, we present the development and ongoing advancement of this innovative virtual model of care to help hospital administrators and policymakers understand our learnings as we work to imbed safe, effective, and patient-centric care models in Australia and globally.

2 | INITIAL MODEL

The initial virtual ED service was established at The Northern Hospital (Melbourne, Australia) in October 2020 with the main goal of diverting low-acuity patients from the hospital's ED during the COVID-19 pandemic. The service utilized a telehealth model to provide online audio-visual consultations to assess and facilitate either complete or streamlined ongoing care to patients within the Northern Health catchment in Victoria, Australia. Northern Health is the primary provider of acute and subacute services in the northern metropolitan region of Victoria and is one of Australia's fastest growing areas, with the population projected to grow from 350,000 in 2016 to more than 570,000 by 2031. Patients requiring less urgent specialist care were referred to their general practitioner (GP) or an outpatient specialist

clinic, and those requiring urgent emergency care were referred to The Northern Hospital ED. The initial virtual ED model has been described elsewhere¹³; therefore, a brief overview is provided below.

The virtual ED included a clerk, a triage nurse, and a specialist emergency physician, and was open every day between 1:00 pm and 9:30 pm, aligning with peak ED presentation times. It included two distinct access pathways:

1. Patient self-referral: Patients referred themselves to the virtual ED using a QR code or link accessible on Northern Health's ED internet page. Once routine ED triage information was collected, the patient received a link to the virtual ED waiting room. The nurse conducted a video triage consultation using the Odyssey telehealth triage assessment tool,¹⁴ which generated one of four virtual triage categories: category 1 (attend ED urgently); category 2 (attend ED semi-urgently); category 3 (await video consultation with an emergency physician); or category 4 (referral to GP or outpatient clinic for follow-up). If the emergency physician decided a patient required further in-person assessment, they recommended the patient attend the hospital.
2. Health care provider (HCP) referral: HCPs (GPs and urgent care center staff) registered their patients through a separate pathway that directly connected them to the emergency physician's waiting room, bypassing the triage nurse.

Patients completed online registration using a survey on the Research Electronic Data Capture (REDCap) platform and data was captured by the existing Emergency Department Information Systems (EDIS) for Australia.

3 | COVID-19-POSITIVE PATHWAYS PROGRAM

In April 2021, the virtual ED expanded to a 24-h model to manage COVID-19-positive patients appropriately at home. Patients within the Northern Health catchment that enrolled in the COVID-19-Positive Pathways program¹⁵ were sent a link to the initial medical history and a symptom check survey, upon receiving a positive polymerase chain reaction (PCR) test. When a patient registered a concerning symptom, the service provided the patient with registration information for the virtual ED, and simultaneously alerted the virtual ED nurse the patient had input a symptom or physiological parameter of concern. In addition to this, COVID-19-Positive Pathways staff who were monitoring patients could initiate the virtual ED call on behalf of the patient (and were included in the call) using the HCP pathway. This process resulted in the early identification of patients who required urgent review and allowed virtual assessment to determine if these patients could be safely managed at home or required in hospital care.

4 | COLLABORATION WITH AMBULANCE VICTORIA

The virtual ED's management of COVID-19 patients successfully diverted a large proportion of individuals from presenting to the



The VVED is a FREE, state-wide service. If you are contacted for payment, please do not disclose your personal details and refer the matter to vved@nh.org.au

Welcome to the Victorian Virtual Emergency Department (VVED), a public health service to treat non-life-threatening emergencies.

If your situation is life-threatening, please call Triple Zero (000)

Please enter the VVED according to the category which best represents you.



FIGURE 1 Victorian Virtual Emergency Department (VVED) registration screen (www.vved.org.au).

Northern Hospital ED. This initiated a partnership with Ambulance Victoria to co-develop and pilot a new clinical pathway where paramedics caring for COVID-19 patients could seek a virtual ED consult if their patient was triaged as not requiring transfer to an ED. This clinical care pathway was launched in June 2021, still only within the Northern Health catchment, but has since expanded statewide and was made available to all paramedics in metropolitan Melbourne in March 2022, followed by regional and rural Victoria in September 2022 (further details below).

5 | VICTORIAN VIRTUAL EMERGENCY DEPARTMENT—STATEWIDE EXPANSION

In February 2022, we secured government funding to begin the expansion of the virtual ED statewide. The current model, now known as the Victorian Virtual Emergency Department (VVED), is a free-to-access service available 24 h a day, 7 days a week, and has been open to all residents of Victoria, Australia (current population of 6.81 million) since March 2022. The VVED has a clinical footprint in every local government area across the state and, as of April 2024, is the largest virtual model of care in the Southern Hemisphere staffed with 11 ward clerks, 78 registered nurses, 138 GPs, 75 emergency physicians, 44 pediatric emergency physicians/pediatricians, and 14 specialist nurse practitioners. The service is accessed via the VVED website (Figure 1) from any

personal device with a camera (mobile phone, PC, tablet), although a device that can receive SMS text messages is required. The VVED has expanded to include several additional access pathways in addition to self- and ambulance-referral, including residential aged care facilities (RACFs), urgent care centers, and other HCP practices (such as GPs, bush nurses, community nurses, and disability centers) (Figure 2). The VVED now manages a broad range of health conditions (not COVID-19 related) but does not provide non-urgent services such as routine prescriptions, medical certificates, or mental health, drug and alcohol care.

5.1 | Patient self-referral pathway

Individuals experiencing non-emergent, yet still urgent clinical symptoms can self-refer to the VVED via the patient pathway on the website (Figure 1; 'Are you sick/unwell?'). After entering their name, date of birth and phone number, patients are asked a set of pre-screening questions (gender; home address; presenting problem; Medicare details). The registration form is available in over 20 languages and patients can request an interpreter if required. They are then placed in a virtual triage queue and assessed by an emergency care nurse who conducts a video triage consultation (as described for the initial model). Nurses provide self-care advice or referral to GPs/priority primary care centers for low-acuity patients and recommend immediate transfer to a

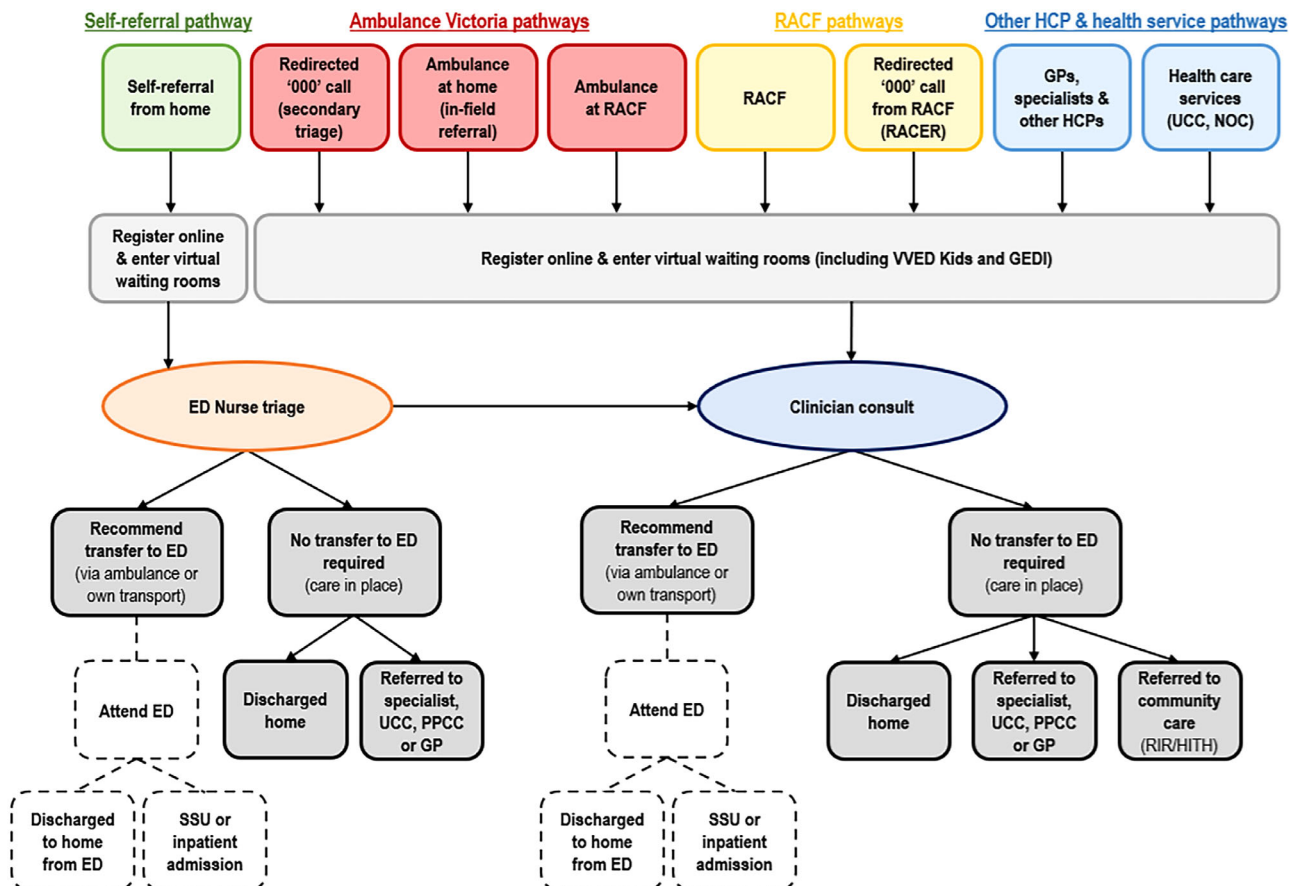


FIGURE 2 Victorian Virtual Emergency Department (VVED) model of care. ED, emergency department; GEDI, geriatric emergency department intervention; GP, general practitioner; HCP, health care provider; HITH, hospital in the home (including palliative care services); NOC, nurse on call; PPCC, priority primary care center; RACER, residential aged care enhanced response; RACF, residential aged care facility; RIR, residential in-reach team; SSU, short stay unit; UCC, urgent care center.

physical ED for high-acuity patients. The remaining patients are placed in the doctor's virtual waiting room to be assessed by a clinician or specialist nurse practitioner. Since inception, the self-referral pathway has represented over 50% of total VVED presentations.

5.2 | Health care provider pathways

All health professionals (including paramedics, GPs, Urgent Care Center staff, RACF nurses, and other outpatient/community services) referring their patients to the VVED can register through three dedicated HCP pathway links on the VVED website (Figure 1; 'Are you from Ambulance Victoria?', 'Are you an Aged Care Service?' or 'Are you a Healthcare Provider?') that enable nurse triage to be bypassed so the patient directly enters the clinician consult waiting room.

5.2.1 | Ambulance Victoria pathways

The VVED Ambulance Victoria pathways were established to allow paramedics to determine if their patients are suitable for a VVED consultation instead of transporting them to an ED. This pathway can be

accessed from "in-field"—all emergency ambulances are staffed with at least two paramedics that arrive on the scene in locations such as private homes and RACFs—and from "secondary triage"—referrals that occur from emergency services staff (via 000 call) that deem patients appropriate for VVED assessment rather than dispatching an ambulance. For "in-field" referrals, paramedics complete the registration form and initiate the virtual ED call on behalf of their patient, provide verbal handover to the virtual ED physician, and assist with the consultation including history taking, physical examinations, and liaison with the patient and/or family. It is expected that the attending paramedics will remain on scene until the VVED clinician has advised they are no longer required to be there. The VVED and Ambulance Victoria are frequently modifying and creating new clinical practice guidelines as we evaluate the quality and safety of this collaboration. These pathways are the second largest referral source for patients, representing 25% of total VVED presentations.

5.2.2 | RACF pathways

RACF nursing staff can access the VVED either directly or through the residential aged care enhanced response (RACER) pathway. The

RACER pathway is an alternative care pathway developed following extensive consultation with clinicians, consumers, and aged care partners that allows some 000 calls to instead be connected to the VVED. This pathway allows RACF residents to receive virtual clinical assessments, medical advice, treatment, and specialist referrals to provide better access to care for residents and avoid unnecessary transfers to the hospital. The development of this pathway was motivated by the need to minimize unnecessary ambulance dispatches and reduce the frequency of 000 calls from RACFs that result in ambulance responses and subsequent resident transportation to the ED (currently over 90% as identified by Ambulance Victoria annual reports). A specialist waiting room—Geriatric Emergency Department Intervention (GEDI)—comprising clinicians with expertise in aged care was developed in January 2024 to help streamline the management of this patient cohort.

5.2.3 | Other HCP and health service pathways

As with the pilot virtual ED model, GPs and other HCPs can refer their patients to the VVED through a separate pathway that directly connects them to the clinician consult waiting room. There has been significant engagement with Urgent Care Centers across the state, initially starting in the Northern Health region. A steering committee was established to assist the VVED with the rollout of this distinct referral pathway. In August 2023, a partnership between VVED and “Nurse on Call” was established that offered VVED consultations to pediatric patients that would have ordinarily been advised to attend an ED. “Nurse on Call” is state-funded, nurse-led telephone health advice line run by HealthDirect that uses algorithms and nursing triage tools to make care decisions, and has been a key care pathway for Victorians over the last three decades to receive immediate after-hours health-care advice. Prior to the establishment of this pathway, a dedicated pediatric waiting room (VVED Kids) with dedicated pediatric staff was set up to streamline access to expertise care. Based on the success of the pediatric pathway, an adult “Nurse on Call” pathway was launched in November 2023.

6 | CHALLENGES, LEARNINGS, AND KEY FACTORS FOR IMPLEMENTATION

The ongoing implementation of the VVED can be attributed to a combination of key facilitators. First and foremost is the strong stakeholder collaboration among hospitals, Ambulance Victoria, health services, and government bodies. This ensured a unified approach to the design and development of this model of care, including developing an organizational governance structure to act as a template for the expansion into regional and rural areas. The financial investments from Government agencies play a pivotal role in our work, including investments into critical infrastructure such as the construction of robust and reliable telehealth networks. This investment also included iterative reporting and feedback to relevant government organizations (eg, the Victorian Department of Health) that has ultimately informed pol-

icy, further investment and scaling-up of the service. Clear guidelines, in-depth orientation, and continued education for VVED staff in the unique practice of telemedicine played a crucial role in the service's implementation. This has equipped staff with the specialized skills required for navigating the nuances of telemedicine, thereby ensuring the delivery of high-quality care in accordance with the Australasian College for Emergency Medicine clinical standards. Lastly, public awareness and willingness to embrace telehealth services were vital in driving patient engagement and uptake. The VVED initially gained traction through word of mouth, with patients and healthcare professionals sharing their positive experiences. To maximize awareness and utilization of the VVED, the VVED leadership team began actively promoting the service through in-person presentations and online forums. We collaborated with Ambulance Victoria and various hospitals across Victoria to promote the use of the VVED for low-acuity health problems, including displaying VVED posters in ED waiting rooms and distributing VVED pamphlets and fridge magnets to patients. Additionally, the VVED has been featured in social media campaigns (eg, Facebook, LinkedIn) and promoted via radio and TV interviews, helping to inform the public about this innovative healthcare service.

However, with the rapid growth of any health service comes a number of challenges. Employment of a new workforce to a novel format of emergency care while maintaining quality and providing specialized care to high-risk groups presented significant challenges in the successful implementation of the VVED. Central to overcoming this was the recruitment of a multidisciplinary team of clinicians under the guidance of emergency physicians. Supplementing emergency physicians with general practitioners and nurse practitioners helped facilitate the service, allowing for more patients to be seen without prolonged delays. Additionally, the creation of in-depth orientation processes involving co-consults and creation of a searchable knowledge database allowed all clinicians access to the latest clinical, referral, and governance information. To maintain the quality of the VVED, new clinical procedures/projects adhered to a consistent approach: piloting, establishing transparent governance structures, real-time evaluation, iterative refinement, expansion, and repetition until integration into standard practice. This systematic process was reinforced by a robust quality governance framework, safeguarding the integrity and efficacy of the VVED. As the VVED began to grow exponentially in both the number and complexity of patient presentations, it mirrored the need to follow practices of traditional EDs by addressing the unique needs of high-risk populations. A notable example was the establishment of VVED Kids, a dedicated pediatric waiting room overseen by pediatric emergency physicians and supported by a diverse team of pediatricians, general practitioners, and specialized nurse practitioners. With VVED Kids now managing a daily caseload exceeding 200 patients, the VVED extended its services to include a dedicated geriatric waiting room (VVED GEDI), catering to patients referred from collaborating partners such as aged care facilities. By recruiting a diverse group of clinicians with subspecialty expertise, the VVED was able to expand rapidly and leverage time efficiencies from this model. To ensure the effectiveness of these described strategies, a formal data-driven evaluation of the VVED implementation strategy (including efficacy) is currently underway.¹³

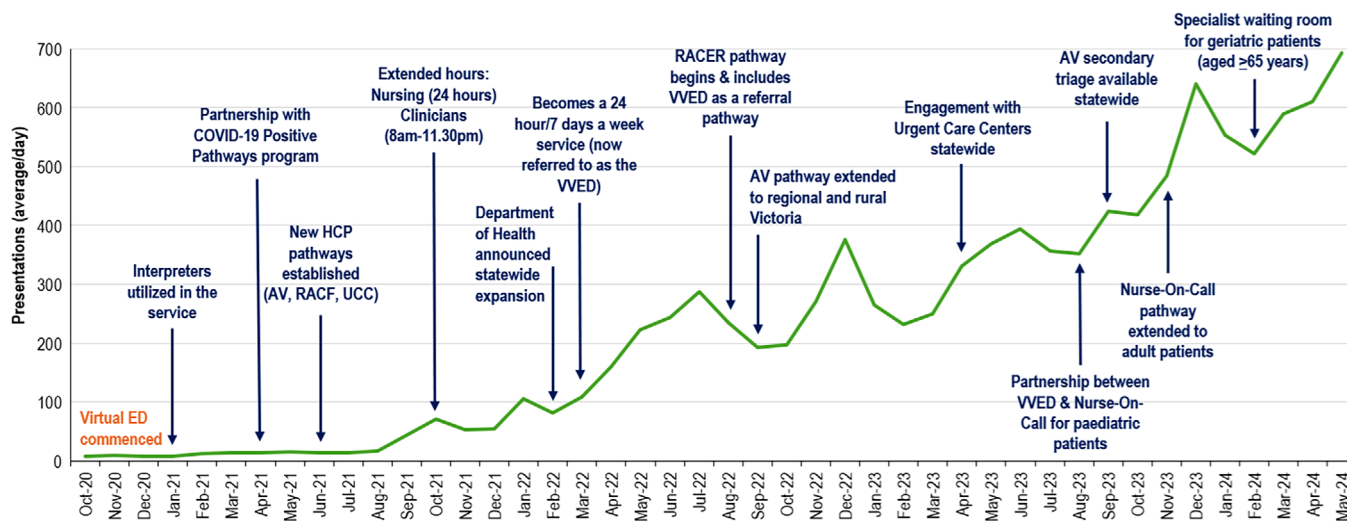


FIGURE 3 Key Victorian Virtual Emergency Department (VVED) milestones and monthly patient presentations from October 2020 to May 2024 (average/day). AV, ambulance Victoria; ED, emergency department; HCP, health care provider; RACER, residential aged care enhanced response; RACF, residential aged care facility.

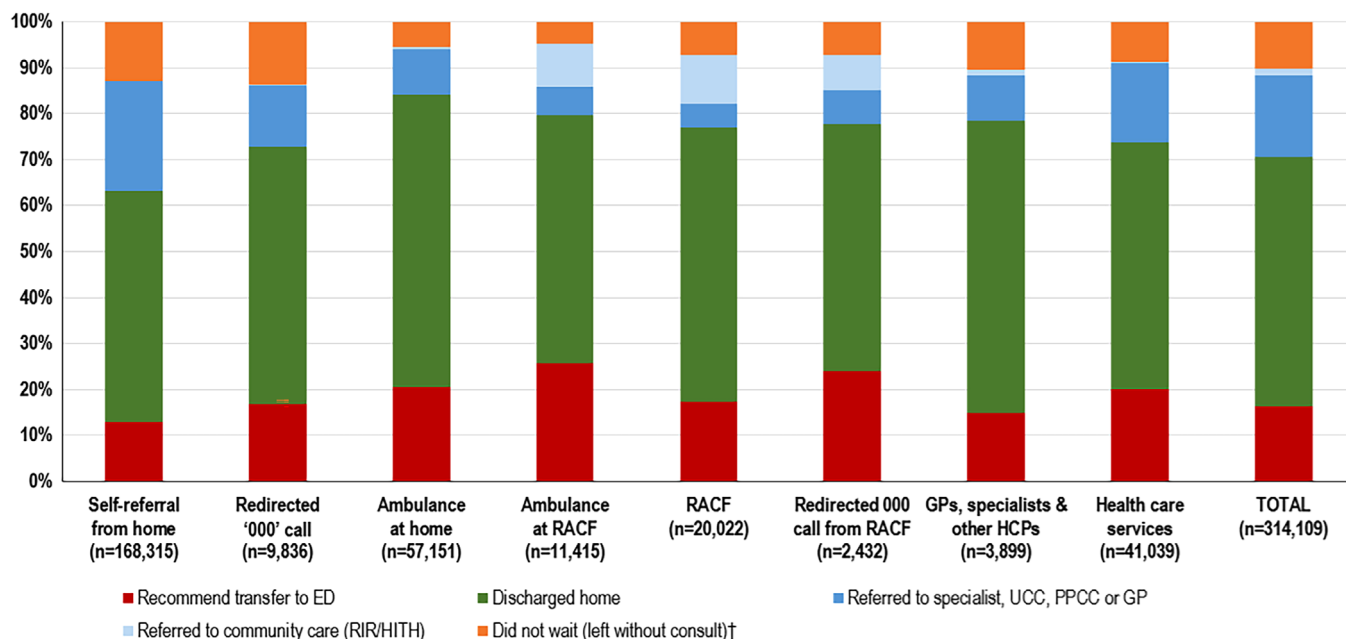


FIGURE 4 Victorian Virtual Emergency Department (VVED) discharge outcomes by referral pathway (October 2020 to May 2024). ED, emergency department; GP, general practitioner; HCP, health care provider; HITH, hospital in the home (including palliative care services); PPCC, priority primary care center; RACF, residential aged care facility; RIR, residential in-reach team; UCC, urgent care center. † Included patients who had a change in their condition while waiting (i.e., no longer required a consult) and those unable to complete the consult (e.g., technical issues).

7 | PROGRESS AND NEXT STEPS

The VVED has reformed healthcare delivery in Australia by offering a secure, efficient, and convenient alternative to physical emergency care. Since its inception, the VVED has consulted with more than 300,000 patients across the entire state of Victoria, currently averaging over 600 presentations each day (Figure 3). Preliminary assess-

ments suggest that the service is highly effective. Ad hoc audits indicate that referrals to physical EDs are low (Figure 4) and that there has been a positive response from patients about the service based on responses in a voluntary post-discharge survey. However, a formal evaluation is currently in progress¹³ that will provide valuable insights into the efficacy of the service, including assessing the rate of ED presentations and hospital admissions, evaluating the cost-effectiveness of

the service, understanding the environmental impacts, assessment of condition-specific presentations to inform future practice, and identifying opportunities to improve the operations and quality of the service (from both the patient and clinician perspective).

As digital technologies continue to advance, so will the potential of the VVED to increase the number of patients seen on a daily basis without the need to present to a physical ED. This may reduce the strain on the healthcare system as a whole. Furthermore, the multidisciplinary workforce currently employed by the VVED must also be reassessed if the service is to expand. The incorporation of other HCP staff (e.g., physiotherapists, geriatricians, etc) will likely be necessary to facilitate a more complete and complex service.¹⁶

8 | CONCLUSION

The VVED model of care is a pioneering virtual emergency care service that spotlights the feasibility of digital health solutions in alleviating barriers to emergency care access. While the service was born out of the COVID-19 pandemic, we expect it will persist long into the future and become a usual model of care. Patients, families, and HCPs support the use of virtual care, and optimization of virtual care now aligns with Australian national healthcare priorities.¹⁷ Thus, the question we ask now about the ongoing integration of digital health interventions into current healthcare systems is not a matter of why, but how. By sharing our model of care, we hope to guide a vision of how to embed virtual care within the emergency setting and to inspire policymakers across the world as they work toward addressing the global problem of ED overcrowding.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest regarding the publication of this manuscript.

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