# ORIGINAL RESEARCH

# Structured evaluation of a virtual emergency department triage model of care: A study protocol

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## Abstract

*Objective*: A new virtual ED service was introduced into a hospital network in the northern suburbs of Melbourne in response to changing needs during the COVID-19 pandemic. The 'virtual ED' utilises a telehealth model as a means of assessment for appropriately selected patients to facilitate either complete care or navigation into streamlined pathways for ongoing care, in some cases bypassing the ED entirely where appropriate. The proposed study aims to evaluate the implementation of the model and identify future improvement opportunities, assess the impact on traditional health service delivery processes and patient experience, and determine the acceptability of the 'virtual ED' model of care.
*Methods*: The present study will consist of a pre-post- implementation evaluation using the RE-AIM framework. Routine health service data will be collected for 6 months post-implementation of the virtual ED model and compared to 24 months prior to implementation. Prospective data will be collected using routinely collected and survey data. Interviews and focus groups will be conducted to understand consumer and clinician perspectives on barriers and enablers to implementation and adoption of the virtual ED.
*Results*: Descriptive statistics will be used to describe the study population and key outcomes, including changes in ED presentations and length of stay. Thematic analysis will be conducted on transcribed interviews and focus group data. This will be triangulated with data collected from patient feedback surveys.
*Conclusion*: This project will support the delivery of care to ED patients by evaluating the 'virtual ED' model of care.

**Key words**: *COVID-19, digital health, emergency department, telehealth, triage.*

## Introduction

ED crowding is a public health issue that impacts healthcare systems worldwide.[1] ED demand in Australia over the past 20 years has exceeded population growth. It is a complicated issue impacted by an ageing population and growth in chronic and complex diseases; however, specific factors behind the rise remain poorly understood.[2]

High ED demand presents challenges to the provision of timely and appropriate care. Overcrowding leads to diversion of resources away from life-threatening situations, long waiting times, adverse health outcomes, increased workload stress for ED staff, bed blockages and patient and staff dissatisfaction.[3–5] It is a problem that requires hospital administrators and policymakers to understand the complexity of hospital services and the impact congestion has on a patient's journey.

There has been a large amount of work over the past 20 years that aimed to improve ED waiting times, patient flow and reduce crowding. These have included streaming and rapid assessment teams,[6] alternative urgent care centres to provide treatment for minor injury and illness,[7] integration of general practitioners into EDs,[8] extended scope of practice for paramedics to provide assessment and treatment in the home rather than traditional response and transport roles,[9] waiting room nurses,[10] short stay units (SSUs)[11] and care coordination programmes.[11,12]

The COVID-19 pandemic and control measures such as social distancing increased the complexity of managing ED waiting room congestion. Concern for personal exposure to COVID-19 and adherence to strict lockdown measures became barriers to patients accessing timely emergency care. These constraints have created a catalyst for the adoption of digital technologies that enable new methods for patient interactions and the

development of innovative virtual healthcare models. These virtual and telehealth services allow us to reimagine how patient care can be delivered. Prior to the COVID-19 pandemic, virtual models of care involving telehealth in emergency medicine in Australia have focused on remote support for clinicians.[13] These virtual care models allow rural hospitals and health clinics to connect virtually with larger EDs and specialised services, potentially reducing the need for transfer.

A new virtual ED service providing direct care to patients was introduced into a hospital network based in the northern suburbs of Melbourne. The service was established in response to changing needs during the COVID-19 pandemic. The virtual ED model was designed to:

1. Virtually manage and discharge appropriate patients, preventing ED attendances.
2. Direct patients needing urgent emergency care to the ED and, where possible, streamline their ED journey, for example, direct admission to the SSU.
3. Redirect patients needing less urgent specialist care to outpatient specialist clinics bypassing the ED.
4. Redistribute patient time of arrival by scheduling their ED care to less busy times.

The aims of the virtual triage ED model evaluation are to:

1. Evaluate the virtual triage and telehealth model implementation.
2. Assess the impact virtual triage and telehealth have on traditional health service delivery processes.
3. Assess the acceptability to ED clinicians and patients.
4. Identify opportunities to continue to improve the quality and impact of the virtual ED model.

## Methods

### Design

The present study will be a pre-post-implementation evaluation using the RE-AIM framework.[14] RE-AIM is a framework that uses a mixed-methods approach that incorporates both impact and implementation evaluation. The proposed evaluation of this service has been reviewed by the Northern Health Research Ethics Committee and has been approved for evaluation as a 'quality improvement and innovation project' (ALR 08.2021).

### Setting

Northern Health (NH) is the major provider of acute, subacute and ambulatory specialist services in Melbourne's north and provides a comprehensive range of primary, secondary and tertiary healthcare services. The NH catchment is located in 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. Residents originate from more than 184 countries and speak more than 106 languages, with the top five languages spoken after English being Arabic, Italian, Assyrian, Turkish and Greek. Residents in the NH catchment have lower income, educational attainment, health literacy and higher unemployment rates than state averages.[15]

### Population

Participants will be sourced from self-referral and healthcare professional (HCP) referrals to NH's Virtual Emergency Department. HCP referrals include general practitioners, residential aged care and urgent care centres. The online registration will be completed using a survey on the Research Electronic Data Capture (REDCap©) platform (Appendix S1. Full xml template will be provided upon registration in this link https://redcap.nh.org.au/surveys/?s=N4FFXF7HNT). The online registration ensures patient data is captured as part of the existing Emergency Department Information Systems (EDIS) for Australia. Completing the registration will indicate implied consent to the data collected being used for research purposes, and this is explicitly stated in the registration pre-amble, where participants are offered the opportunity to decline participation by notifying study investigators, without it affecting their registration eligibility.

The study population includes eligible self-referred and HCP referred patients entering the virtual triage process between October 2020 and June 2021.

To be eligible for the self-referral pathway, the patient must meet all the following criteria:

1. The patient has access to a device that can support a video telehealth consult.
2. The patient has a valid Medicare card.
3. The patient can read and respond to screening and registration questions in written English.
4. The patient is currently located in the catchment area for the Northern Hospital or is a NH patient.

Patients who do not fulfil the eligibility criteria are directed to contact their primary healthcare service or attend their closest ED. Patients are advised prior to registration that the service is for non-life-threatening emergencies.

As this model was established in under 12 weeks, patients requiring interpreter services were initially excluded from accessing the service. As of 12 January 2021, interpreter services were integrated into the model to allow those with low English proficiency or who communicate in Australian Sign Language (AUSLAN) to access the virtual ED.

Eligibility for the HCP pathway includes:

1. The HCP has gained consent from the patient to participate in a telehealth consult.
2. The HCP has a device that can support a telehealth consult.
3. The patient currently resides in the catchment area of the Northern Hospital or is an NH patient.

There are notably no patient age exclusions for either pathway.

### Intervention

This virtual emergency care model offers real-time online audio-visual consultations for patients and HCPs. This service is a substitution model, aiming to decrease onsite ED attendances and, therefore, manage

demand more efficiently for both the provider and the consumer.

The virtual ED service is staffed by a dedicated team, including one clerk, a triage nurse and a specialist emergency physician. The triage nurses have a post-graduate certificate in emergency care and have at least 1 year of triage experience. All clinical staff received training and credentialling in telehealth. The service is offered from 13.00 to 21.30 +hours, aligning with peak presentation times.

There are two pathways to access the virtual ED service. The first is through the patient self-referral pathway, and the second is through the healthcare referral pathway, which is available to HCPs (Fig. 1):

### Patient self-referral pathway

Eligible patients can register remotely using a QR code or a link accessible on Northern's Emergency Department internet page. Participants are directed to the registration survey (REDCap© administered by NH), which initially screens participants for eligibility (Appendix S1). Eligible patients are then directed to the registration page, entering routine information collected for standard emergency presentations. This includes demographics such as age, sex and marital status; health insurance status; general practitioner details and emergency contacts. Patients who do not fulfil the eligibility criteria are directed to contact their primary healthcare service or attend their closest ED.

Completion of the registration page triggers an email notification to clerical staff who enter the patients' data into existing ED and hospital systems (EDIS and Patient Administration System (iPM)). The patient is simultaneously linked directly into the virtual ED waiting room (Healthdirect). Whereas in the virtual waiting room, the patient receives automated messages at regular intervals to contact '000' if their condition deteriorates.

The triage nurse conducts a video triage consultation using a videoconference platform (Healthdirect) and a telehealth triage assessment tool (Odyssey). The triage generates four categories:

1. Virtual category 1: attend ED urgently (Note: patients requiring time-critical care are advised to call an ambulance. If they are unable, the triage nurse will contact 000 on their behalf).
2. Virtual category 2: attend ED semi urgently (For patients advised to attend the ED, where possible, their care is streamlined to avoid repetitive steps such as repeat registration).
3. Virtual category 3: video consultation with the emergency physician (Patients suitable for a telehealth consult are transferred to the physicians' virtual waiting room. The ED physician is notified that a patient is waiting. A telehealth consult is then conducted).
4. Virtual category 4: advise GP follow-up.

In the future, we would intend patients in virtual category 4 to be referred for GP follow-up. For the purposes of our initial implementation, both virtual categories 3 and 4 patients are scheduled for a consultation with an emergency physician. This increases the safety profile of the project, ensuring all patients are seen by a virtual nurse and doctor (either a hospital doctor on arrival to ED or the virtual doctor at the time of the virtual presentation). This is also an acknowledgement that some patients report having already seen a GP or have difficulty accessing timely GP appointments. Patients can receive a higher category at the nurse's discretion but can only be downgraded in discussion with the emergency physician. Virtual category 2 patients meeting the criteria for existing SSU care plans are also transferred to the virtual emergency physician. The emergency physician can facilitate a direct admission to SSU and initiate early investigations and management on the patient's arrival to ED.

At the end of the triage, Odyssey generates a summary of the answered questions and the recommended category outcome. The triage nurse can add additional free notes regarding any further discussions with the patient. The summary notes generated by Odyssey are printed and provided to the virtual emergency physician and uploaded as part of the patient's medical record.

### Healthcare referral pathway

HCPs can connect directly to the emergency physician's telehealth waiting room, bypassing the triage nurse. This pathway aims to work with HCPs to provide optimal care for their patients, avoiding ED attendances. Existing
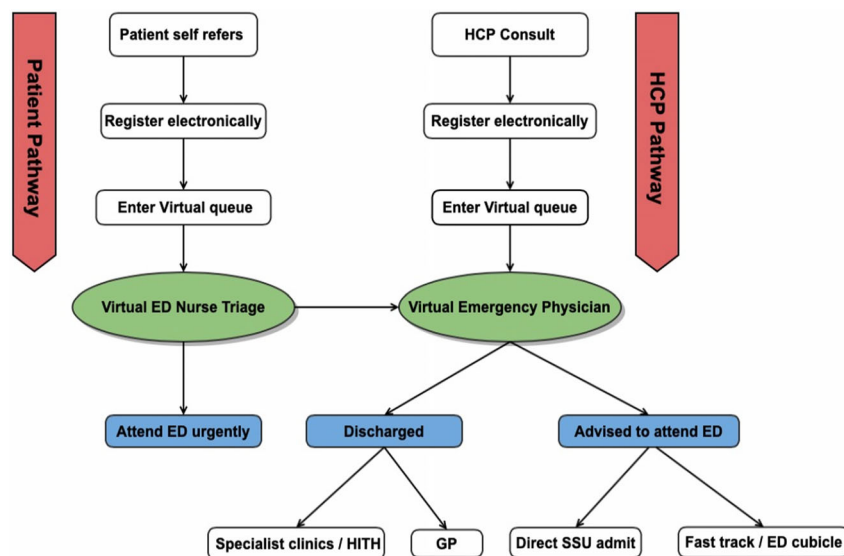


**Figure 1.** *Virtual ED care pathways.*

virtual care pathways allow direct access to outpatient appointments, hospital in the home services and residential aged care reviews. If a patient requires emergency investigation and care, where possible, this is streamlined to the SSU.

To maximise HCP engagement in the service, local GP practices and urgent care centres have been invited to online forums during the development phase of this model. Specific promotional pamphlets are regularly distributed by our GP liaison officer, with updated communications regarding the service.

## Triage software

Odyssey TeleAssess is designed to safely assess undifferentiated symptoms, that is, symptoms presenting prior to any form of clinical diagnostic process. It employs a unique approach designed to support person-centred clinical assessment, decision-making and advice-giving based on evidence-based frameworks. Assessment screens include drop-down menus that provide regularly updated referenced information on differential diagnoses and rationales for lines of enquiry for each type of presentation.[16] The Odyssey Clinical Database comprises content enabling assessment of several hundred symptoms, each linked to

**TABLE 1.** *Outcomes according to RE-AIM framework*[1]

| RE-AIM item | Who | Study population | Data source | Pre | Post |
|---|---|---|---|---|---|
| **Reach**<br>Patient and clinician participation | NH staff | Demographic and professional breakdown of participating staff | Survey | x | x |
| | Patients | Descriptive analysis of registration data | Survey | | x |
| | | Demographic and clinical characteristics of participants who chose virtual presentations *vs* face-to-face presentations. In particular: | EDIS | | |
| | | 1) Age categories | | | |
| | | a. paediatric patients (<18) | | | |
| | | b. working age (18–65) | | | |
| | | c. Over 65 | | | |
| | | 2) Location | | | |
| | | a. Within the catchment area | | | |
| | | b. Out of catchment | | | |
| | | c. Rural/regional | | | |
| | | 3) Preferred language | | | |
| | | 4) Country of origin | | | |
| | | 5) Presenting complaint(s) | | | |
| | | 6) Triage category | | | |
| **Effectiveness**<br>Negative and positive consequences | Patients | Health service utilisation: the trajectory of weekly ED presentations will be described for the 12 months prior to implementation. The effect of any lockdown will be timestamped and accounted for in analyses. | EDIS | | x |
| | | Referrals leading to non-presentations | | | |
| | | 6-month review of hospital utilisation: re-admission or presentation rates | | | |
| **Adoption**<br>Current and future potential | Staff | Technology readiness scale | Survey | x | x |
| | | Acceptability | Interviews | | |
| | Patients | Acceptability | Survey | | x |
| | | | Interviews | | |
| **Implementation**<br>Barriers and enablers | Staff | IT service interruptions | Survey | | x |
| | | Resources used, for example, patient telehealth instructions | | | |
| **Maintenance**<br>Medium- to long-term effects | | Description of the service at 12 and 24 months | Survey | | x |
| | | Review patient satisfaction data | EDIS | | |
| | | Review presentations number to service | | | |

urgency assessment, patient self-care advice, management advice for the user, differential diagnoses, patient information and education.[16] Odyssey has been evaluated in several randomised controlled trials, and its clinical effectiveness and cost-effectiveness are already established.[16]

## Data collection

### Reach and effectiveness

Data to be collected are described in Table 1. Routinely collected health service utilisation data for the 6 months following implementation of the model will be compared to 24 months prior to implementation. Data will be accessed from the NH data warehouse. Surveys distributed on REDCap© will be used to collect prospective data, including administrative demographics, patient experience and acceptability of the service.

### Adoption and implementation

Interviews and focus groups will be conducted to understand the perspectives of consumers and clinicians on the barriers and enablers to implementation and adoption of the virtual ED triage.

### Maintenance

The sustained utility of this service over time will be assessed descriptively over 2 years. This includes patient satisfaction, acceptability and service utilisation.

## Data analysis

### Reach, effectiveness and maintenance

Descriptive statistics will be used to describe the study population. This includes demographic information such as sex, age, language spoken at home and Socio-Economic Indexes for Areas category.

Descriptive statistics for virtual and face-to-face presentations will be compared for the 6 months post-implementation using $X^2$ tests or $t$-tests (or relevant non-parametric equivalent). Interrupted time-series analyses will be used to describe the trajectory of weekly ED presentations before (24 months) and after (up to 24 months) implementation.[17] All analyses will be performed with a level of significance of $P = 0.05$.

### Adoption and implementation

A thematic analysis will be conducted on the transcribed interviews and focus group data. This will be triangulated with data collected from patient feedback surveys. The data will be coded across seven theoretical themes using Sekhon, Cartwright and Francis' evidence-based review of the acceptability of healthcare interventions.[18] The framework's seven theoretical themes are:
1. Affective attitude (how participants felt about ED triage).
2. Burden (perceived effort required to participate in virtual ED triage and how this compares to standard ED triage).
3. Perceived effectiveness (do participants believe that they received the same quality treatment as they would have received if attending face to face).
4. Ethicality (does ED triage fit with an individual's value system).
5. Intervention coherence (the extent to which individuals understand virtual ED triage and how it works).
6. Opportunity costs (issues affecting adherence).
7. Self-efficacy (participant's confidence that they can comfortably and actively participate in an online version of ED triage).

Thematic analysis is an iterative and reflective process. To ensure the conclusions accurately reflect the content of the workshops, two study investigators will separately code all the interview and focus group data. Two cross-checks to compare emerging themes will be performed to assess the accuracy of inferences at each stage. Where a difference is found, the study investigator will be asked to demonstrate from the raw data how their interpretation was reached until an agreement is found. Where consensus is not found, a third study investigator will be consulted. A pragmatic approach will be adopted when drawing final inferences from the present study, focusing on developing useful knowledge directly related to the acceptability and feasibility of the virtual ED triage model.

Participants will receive a copy of the final report, which we will send individually via email or post.

## Competing interests

None declared.

## Data availability statement

Data sharing not applicable to this article as no datasets were generated or analysed.

## References

1. Hoot NR, Aronsky D. Systematic review of emergency department crowding: Causes, effects, and solutions. *Ann. Emerg. Med.* 2008; **52**: 126–36.
2. Morley C, Unwin M, Peterson GM, Stankovich J, Kinsman L. Emergency department crowding: a systematic review of causes, consequences and solutions. *PLoS One* 2018; **13**: e0203316.
3. Kubicek K, Liu D, Beaudin C *et al.* A profile of non-urgent emergency department usage in an urban pediatric hospital. *Pediatr. Emerg. Care* 2012; **28**: 977–84.
4. Northington WE, Brice JH, Zou B. Use of an emergency department by nonurgent patients. *Am. J. Emerg. Med.* 2005; **23**: 131–7.
5. Pines JM, Hollander JE. Emergency department crowding is associated with poor care for patients with severe pain. *Ann. Emerg. Med.* 2008; **51**: 1–5.
6. Rodi SW, Grau MV, Orsini CM. Evaluation of a fast track unit: Alignment of resources and demand results in improved satisfaction and decreased length of stay for emergency department patients. *Qual. Manag. Health Care* 2006; **15**: 163–70.
7. McNeeley S. Urgent care centers: An overview. *Am. J. Clin. Med.* 2012; **9**: 80–1.
8. Cooper A, Davies F, Edwards M *et al.* The impact of general practitioners working in or alongside

emergency departments: A rapid realist review. *BMJ Open* 2019; **9**: e024501.

9. Mason S, Wardrope J, Perrin J. Developing a community paramedic practitioner intermediate care support scheme for older people with minor conditions. *Emerg. Med. J.* 2003; **20**: 196–8.

10. Innes K, Jackson D, Plummer V, Elliott D. Emergency department waiting room nurse role: A key informant perspective. *Australas. Emerg. Nurs. J.* 2017; **20**: 6–11.

11. Crawford K, Morphet J, Jones T, Innes K, Griffiths D, Williams A. Initiatives to reduce overcrowding and access block in Australian emergency departments: A literature review. *Collegian* 2014; **21**: 359–66.

12. Moss JE, Flower CL, Houghton LM, Moss DL, Nielsen DA, Taylor DM. A multidisciplinary care coordination team improves emergency department discharge planning practice. *Med. J. Aust.* 2002; **177**: 435–9.

13. Herrington G, Zardins Y, Hamilton A. A pilot trial of emergency telemedicine in regional Western Australia. *J. Telemed. Telecare* 2013; **19**: 430–3.

14. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: The RE-AIM framework. *Am. J. Public Health* 1999; **89**: 1322–7.

15. Jessup RL, Tacey M, Glynn M, Kirk M, McKeown L. Evaluation of the effectiveness of a comprehensive care plan to reduce hospital acquired complications in an Australian hospital: Protocol for a mixed-method preimplementation and postimplementation study. *BMJ Open* 2020; **10**: e034121.

16. Campbell J, Fletcher E, Britten N *et al.* The clinical effectiveness and cost-effectiveness of telephone triage for managing same-day consultation requests in general practice: a cluster randomised controlled trial comparing general practitioner-led and nurse-led management systems with usual care (the ESTEEM trial). *Health Technol. Assess.* 2015; **19**: 1–212.

17. Bernal JL, Soumerai S, Gasparrini A. A methodological framework for model selection in interrupted time series studies. *J. Clin. Epidemiol.* 2018; **103**: 82–91.

18. Sekhon M, Cartwright M, Francis JJ. Acceptability of healthcare interventions: An overview of reviews and development of a theoretical framework. *BMC Health Serv. Res.* 2017; **17**: 88.

19. Jessup RL, Bramston C, Beauchamp A *et al.* Impact of COVID-19 on emergency department attendance in an Australia hospital: A parallel convergent mixed methods study. *BMJ Open* 2021; **11**: e049222.

## Supporting information

Additional supporting information may be found in the online version of this article at the publisher's web site:

**Appendix S1.** Virtual emergency triage.