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# Standard nurse phone triage versus tele–emergency care pilot on Veteran use of in-person acute care: An instrumental variable analysis

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## Abstract

**Objectives:** Use of acute care telemedicine is growing, but data on quality, utilization, and cost are limited. We evaluated a Veterans Affairs (VA) tele–emergency care (tele-EC) pilot aimed at reducing reliance on out-of-network (OON) emergency department (ED) care, a growing portion of VA spending. With this service, an emergency physician virtually evaluated selected Veterans calling a nurse triage line.

**Methods:** Calls to the triage line occurring January–December 2021 and advised to seek care acutely within 24 h were included. We described tele-EC user characteristics, common triage complaints, and patterns in referral to and management by tele-EC. The primary outcome was acute care visits (ED, urgent care, and hospitalizations at VA and OON sites) within 7 days of the index call. Secondary outcomes included mortality, OON acute care spending, and the effect of tele-EC visit modality (phone vs. video). We used both standard regression and instrumental variable (IV) analysis, using the tele-EC physician schedule as the instrument.

**Results:** Of 7845 eligible calls, 15.5% had a tele-EC visit, with case resolution documented in 57%. Compared to standard nurse triage, tele-EC users were less likely to be Black, had more prior ED visits, and were triaged as higher acuity. Calls concerning dizziness/syncope, blood in stool, and chest pain were most likely to have a tele-EC visit. Tele-EC was associated with fewer ED visits than standard nurse triage in both regression (average marginal effect [AME] −16.8%, 95% confidence interval [CI] −19.2 to −14.4) and IV analyses (AME −17.5%, 95% CI −25.1 to −9.8), lower hospitalization rate (AME −3.1%, 95% CI −6.2 to −0.0), and lower OON spending (AME −$248, 95% CI −$458 to −$38).

**Conclusions:** Among Veterans initially advised to seek care within 24 h, use of tele-EC compared to standard phone triage led to decreased ED visits, hospitalizations, and OON spending within 7 days.

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## INTRODUCTION

Utilization of emergency departments (EDs) for lower acuity conditions has increased in the past several decades for multiple reasons, including difficulty accessing timely alternative care and perceived inconvenience of the outpatient clinic setting compared to the ED.[1,2] In addition, overall spending on ED care has continued to rise both in the private sector and for the Veterans Health Administration (VA).[3,4] Projected VA spending for services provided by non-VA health systems (also referred to as out-of-network [OON] or community care) for 2022 is $23.42 billion, with increases from prior years largely attributable to more accessible urgent care as a result of the 2018 VA Maintaining Internal Systems and Strengthening Integrated Outside Networks (MISSON) Act.[5] More recently, VA spending on community emergency care alone exceeded $5 billion in 2021.[6]

Telemedicine has been widely employed over the last 2 years of the COVID-19 pandemic to reduce the risk and inconvenience associated with in-person visits. The VA, which provides care to over 9 million Veterans and has been a leader in telehealth even prior to the pandemic, increased telehealth visits overall by >1700% since March 2020, and >2800% for highly rural Veterans.[7,8] Although telemedicine has been employed successfully to improve care for ED patients with psychiatric emergencies and is increasingly used to address minor urgent concerns, evidence of its effectiveness in addressing a broader range of acute medical conditions is still lacking.[9,10] If effective, telemedicine could eliminate the need for an in-person visit in many cases, reducing downstream ED visits. If ineffective, it could increase overall utilization by adding an unnecessary intermediate visit without reducing the number of subsequent in-person visits. A 2019 feasibility study at the San Francisco VA demonstrated that among 104 telemedicine urgent care evaluations, only eight resulted in a subsequent ED visit and 21 ED visits were diverted, with most cases of nonresolution with telemedicine due to technical difficulties or patient preference for in-person care.[11] Other VA sites have since adopted similar pilots, and the VA is considering further expansion of tele-EC.[12] On the other hand, a number of studies have reported that telemedicine can result in increased care utilization for acute respiratory infection.[13,14] Finally, although nurse-staffed telephone triage lines are commonly employed to evaluate the acuity of patients' concerns and direct need for ED care, a 2019 systematic review concluded that telephone triage had no effect on ED utilization, with one included study reporting an actual increase in ED use.[15]

Telemedicine may be a useful adjunct to telephone triage to reduce ED utilization and spending, particularly for integrated health systems. To build on this existing work, we evaluated the effect of a pilot tele-EC service at the VA Ann Arbor Healthcare System (VAAAHS) by comparing rates of subsequent acute care use for Veterans calling a standard nurse triage line who did and did not have a tele-EC visit. To account for potential selectivity in patients who opt to receive tele-EC services, and other potential confounders, we used an instrumental variable (IV) analysis in addition to conventional multivariable regression. This IV approach uses pseudo-random variation in the availability of tele-EC services based on calendar time (e.g., day and time of the week) to identify the independent effect of tele-EC on downstream use of in-person care. We additionally quantified differences in community care spending between tele-EC and the standard nurse triage group and examined chief complaints addressed by the tele-EC service. We hypothesized that the tele-EC service would address many Veterans' acute care needs without an in-person ED visit or direct them to an appropriate alternative site of care in a majority of cases and that this intervention would have a measurable impact on short-term ED visits and community care spending.

## METHODS

### Description of tele-EC pilot program

To improve Veteran access to care and address community care spending on ED visits, the VAAAHS piloted a tele-EC service in January 2021. Tele-EC shares many elements of direct-to-consumer tele–urgent care,[16] with a key difference being in the lead-up to the visit. In conventional virtual urgent care, individuals initiate the telemedicine encounter. In tele-EC, a triage nurse determines whether to offer a telemedicine visit. Veterans calling the VAAAHS call center with a symptom-based complaint are triaged by a nurse using TriageXpert Dual Purpose, a clinical decision support software tool (DSHI Systems, Inc.). In order of descending acuity, potential triage recommendations included: 911, ED now, 2–8 h, 12–24 h, 24–48 h, 2–3 days, 3–4 days, 5–7 days, 1–2 weeks, 2–3 weeks, and self-care. For calls not triaged as 911 or ED now, the triage nurse will attempt to schedule the Veteran for a primary care visit within the recommended time frame. If no appointment is available, the Veteran is instructed to go to urgent care or the ED.

In the tele-EC pilot, Veterans receiving a triage recommendation to be seen by a provider within 24 h (i.e., 911, ED now, 2–8 h, 12–24 h) may be offered a tele-EC visit. Veterans receiving a triage recommendation to call 911 are offered tele-EC only if they decline immediate in-person emergency care. The tele-EC provider is an emergency physician who is scheduled for a dedicated tele-EC shift. Shifts are scheduled from 8 a.m. to 6 p.m. Monday–Friday, excluding federal holidays, and adjusted so as to have sufficient coverage for in-person ED shifts, which take priority. Whether a Veteran is referred for a tele-EC visit is dependent on nurse discretion and tele-EC physician availability that day. The tele-EC physician evaluates the Veteran via VA Video Connect (VVC) or telephone, depending on Veteran preference, and may render treatment while also advising Veterans on the most appropriate avenue and time frame for follow-up. Their documentation indicates whether the Veteran's concern was resolved using tele-EC or if they recommended primary care, urgent care, or ED evaluation. If needed, tele-EC physicians communicate with the triage nurse to coordinate follow-up scheduling and tele-EC documentation is routed to the Veteran's primary care provider.

## Data sources

We integrated encounter-level data from a variety of clinical and administrative VA data sets, linked using Social Security Number and date. Nurse triage calls were identified from the Veterans Integrated Service Network (VISN) 10 call center log. Triage call data included the date and time of the call, the Veteran's chief complaint, and the nurse triage recommendation. Information about tele-EC visit modality, diagnosis, and disposition were extracted from tele-EC visit notes. We obtained Veteran demographic, comorbidity, care utilization, and mortality data from the VA Corporate Data Warehouse, a clinical and operational data repository used for research, clinical, and business analytic purposes.[17] For care utilization data, VA ED visits and hospitalizations were identified using stop codes, VA identifiers that capture the type of clinical services delivered at a designated location. OON visits and spending information were identified from community care dashboards (Office of Community Care Informatics and Data Analytics Reporting) for Ann Arbor, Detroit, and Saginaw, Michigan, which represent the catchment area for this population of Veterans. Tele-EC service availability by date was obtained from the monthly ED provider schedule. Duplicate encounters (same Social Security Number and same call date/time) and calls with other less acute nurse triage recommendations were excluded. Any discrepancies between triage calls that were eligible for tele-EC services and actual tele-EC visits were reconciled with chart review. Encounters with insufficient detail in the triage telephone note to determine a triage acuity were excluded.

## Study population

The study population included Veteran calls to the VAAAHS call center during business hours from January 1–December 31, 2021, with a symptom-based complaint and which received a triage recommendation from the nurse of going to the ED or following up with their primary care practitioner urgently within 12–24 h. Calls triaged as 911 were also included because they comprised a similar proportion (8%) of tele-EC and non–tele-EC encounters and fewer than half were recommended to go to the ED following a tele-EC visit, suggesting a high rate of overtriage. Veterans were identified as having a tele-EC visit if they had a tele-EC note documented on the same day as a nurse triage call.

We examined age, gender, race/ethnicity, rurality, Charlson Comorbidity Index scores, and historical ED utilization for Veterans who did and did not have a tele-EC visit. We calculated Veterans' Charlson Comorbidity Index and the number of ED visits in the prior year as multiple chronic health problems and prior care utilization are known to be predictors of subsequent care utilization. We also described the most common chief complaints and examined tele-EC use and tele-EC physician-reported effectiveness across a spectrum of conditions.

## Outcome measures

Our primary outcome was the rate of subsequent acute care visits within 7 days of the index triage call. We separately identified VA, OON, and overall ED visits and hospitalizations as well as OON urgent care visits. Primary care clinics were able to schedule urgent visits, but these were indistinguishable from other primary care visits in our data, so were not included. Secondary outcomes included 7-day and 30-day mortality, the association between telehealth modality (video vs. audio-only) and downstream acute care use (ED visit, urgent care visit, or hospitalization), and between tele-EC and spending (VA payments) on OON acute care visits.

## Statistical analysis

We compared baseline Veteran characteristics and unadjusted rates of acute care utilization by whether a Veteran had a tele-EC visit on the day of their nurse triage call (referred to as tele-EC vs. standard nurse triage groups). We used chi-square and two-sample *t*-tests to determine statistically significant differences between groups.

Our primary objective was to determine the independent association between tele-EC use for a given encounter and downstream care utilization in our study population after adjusting for differences in Veteran characteristics and triage acuity. Veteran characteristics included age, sex, race/ethnicity, rurality, Charlson Comorbidity Index, and ED visits in the prior year. Triage acuity was determined by the nurse triage recommendation for that particular triage call. We first performed multivariable logistic regression using tele-EC use as our primary explanatory variable.

We then additionally used an IV analysis to account for unmeasured confounders affecting both Veteran tele-EC use and subsequent care utilization, with the instrument being whether a tele-EC physician was scheduled on a given day. We hypothesized that IV analysis was necessary due to potential selection bias as tele-EC use was driven by both tele-EC availability as well as nurse selection bias in referring Veterans to the tele-EC service. The IV approach seeks to account for this bias and improve causal inference by applying a pseudo-random variable related to the exposure variable, tele-EC use. The instrument selected for this analysis was a binary measure denoting whether a tele-EC physician was scheduled to provide care on the day a patient called the nurse triage line. IVs based on the calendar have been used successfully in prior research.[18] For this instrument to be valid, it must satisfy two conditions.[19] First, the presence of a scheduled tele-EC physician must be a strong predictor of the primary explanatory variable, patient use of tele-EC. This is expected because a patient would not be triaged to tele-EC if a tele-EC physician was not on call. The second assumption is the instrument must not be directly associated with the outcome measures, in-person acute care utilization. We anticipate this is the case because the tele-EC physician schedule was based on provider availability (i.e., essentially random), and there was no way for Veterans to know whether a tele-EC physician was scheduled for a given day. To provide further support for this assumption, we compared all covariates between respective groups of patients who did and did not have a tele-EC physician on call when contacting the nurse triage line. For these comparisons, we calculated standardized mean differences and considered a value of 0.1 as meaningful.[20]

To implement the IV model, we applied the two-stage residual inclusion estimator.[21] This approach first requires estimation of a logistic regression model using tele-EC as the outcome as a function of the instrument and patient covariates as explanatory variables. In the second stage, we then estimated a logistic regression with acute care use as the outcome variable and three groups of explanatory variables: (1) use of tele-EC, (2) the response residual from the first stage, and (3) all patient covariates included in the first stage. From this model, we generated the marginal effect of tele-EC use, which reflects the change in likelihood of a subsequent acute care visit associated with use of tele-EC.[22] Standard error estimates for marginal effects were calculated from parameter estimates and recycled predictions using the delta method.[23] To account for the large zero mass and skewness of health expenditure data, we used two-part modeling to estimate the effect of tele-EC use on community care spending.[24]

Data cleaning and analyses were conducted using Stata/SE 16 (StataCorp LLC) and Microsoft Excel. This study was determined to be a quality improvement project by the VA Ann Arbor Research and Development Committee and therefore did not require institutional review board approval.

# RESULTS

## Veteran characteristics by telehealth usage

A total of 7845 nurse triage calls made by 6182 unique Veterans met inclusion criteria (Figure 1). Of these, 4704 calls took place on a day when a tele-EC physician was scheduled, and 1202 (15% of total nurse triage calls) went on to have a tele-EC encounter. A minority of tele-EC encounters ($n$ = 147, 12% of total tele-EC encounters) took place on a day when no tele-EC physician was scheduled to work. This may have been due to triage nurses messaging physicians who were working in the ED to ask if they could evaluate a Veteran via telehealth. The majority of tele-EC visits were conducted by telephone; video calls comprised 19% of encounters.

There was no meaningful difference between Veterans in the tele-EC and standard nurse phone triage care groups with respect to age, sex, race/ethnicity, rurality, or Charlson Comorbidity Index (Table 1). However, the tele-EC group had greater ED visits in the prior year (47.8% vs. 40.8% with at least one visit), and nurses were more likely to have recommended immediate ED evaluation (46.5% vs. 30.5%) than the standard nurse triage group. When stratified by the instrument—tele-EC physician schedule—the groups were similar (i.e., standardized mean differences were small) across all covariates, including with prior ED utilization and triage acuity.

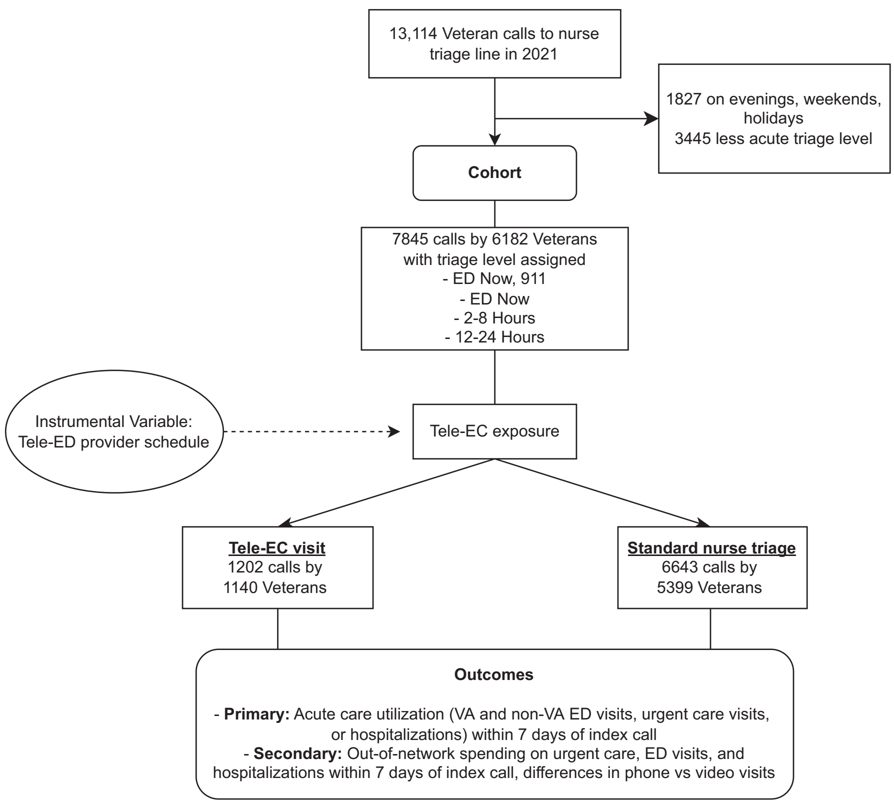


FIGURE 1 Flow diagram of study cohort inclusion and tele-EC group allocation. tele-EC, tele–emergency care; VA, Veterans Affairs.

**TABLE 1** Comparison of baseline population characteristics by tele-EC receipt and provider schedule.

| | Treatment received | | | Tele-EC provider schedule | | |
|---|---|---|---|---|---|---|
| | Nurse triage (*n* = 6643) | Nurse triage + tele-EC (*n* = 1202) | SMD | Tele-EC unavailable (*n* = 3141) | Tele-EC available (*n* = 4704) | SMD |
| Age (years) | 62.1 (±16.1) | 62.3 (±15.6) | −0.009 | 62.0 (±16.1) | 62.3 (±16.0) | −0.017 |
| Female | 12.6% | 11.6% | 0.030 | 12.8% | 12.3% | 0.015 |
| White | 87.0% | 89.1% | 0.066 | 87.5% | 87.2% | 0.009 |
| Black | 11.4% | 9.3% | 0.071 | 10.7% | 11.4% | 0.020 |
| Other | 2.4% | 2.4% | 0.000 | 2.9% | 2.0% | 0.055 |
| Hispanic or Latino | 2.5% | 1.8% | 0.049 | 2.5% | 2.3% | 0.015 |
| Rural | 35.0% | 35.9% | 0.019 | 35.0% | 35.2% | 0.004 |
| Charlson Comorbidity Index | | | 0.052 | | | 0.042 |
| 0–1 | 51.9% | 50.8% | | 52.8% | 51.1% | |
| 2–3 | 35.8% | 35.1% | | 35.3% | 35.9% | |
| 4+ | 12.3% | 14.1% | | 11.9% | 13.0% | |
| ED visits in prior year | | | 0.143 | | | 0.064 |
| 0 | 59.2% | 52.2% | | 59.2% | 57.5% | |
| 1–2 | 27.8% | 32.1% | | 26.8% | 29.6% | |
| 3+ | 13.0% | 15.7% | | 14.1% | 13.0% | |
| Nurse triage acuity | | | 0.412 | | | 0.040 |
| ED now, 911 | 8.0% | 8.1% | | 7.7% | 8.3% | |
| ED now | 30.5% | 46.5% | | 34.0% | 32.3% | |
| 2–8 h | 24.2% | 24.9% | | 23.9% | 24.6% | |
| 12–24 h | 37.3% | 20.6% | | 34.4% | 34.9% | |

*Note*: Data are reported as mean (±SD) or %. A difference greater than 0.1 is considered meaningfully different.

Abbreviations: tele-EC, tele–emergency care; SMD, standardized mean difference.

## Use of tele-EC by chief complaint and triage acuity

The 20 most common chief complaint groups, comprising 81.2% of all included triage calls, were tabulated and reported in Table 2. Overall, 57.0% of tele-EC visits were documented as "resolved" by the tele-EC physician. Dizziness (20.8%), blood in stool (20.6%), and chest pain (20.5%) were among the most common chief complaints to go on to have a tele-EC visit and were resolved using tele-EC 60.4%, 46.4%, and 49.1% of the time, respectively. Calls related to ear problems (7.7%), rashes/skin problems (8.2%), and fatigue (10.3%) were least likely to be evaluated by tele-EC. Concerns about rash/skin problems (73.2%), cough/upper respiratory infection (URI; 72.7%), and headache (69.7%) were most likely to be considered resolved using tele-EC. Fatigue was least likely to be resolved with a tele-EC visit and was the most likely to have a follow-up ED visit within 7 days.

Of note, 8% (*n* = 97) of calls in the tele-EC group were for Veterans who received a triage recommendation to call 911 to go to the ED immediately, most commonly for calls related to chest pain, shortness of breath, and back pain (results not shown). Per protocol, the triage nurse only referred these Veterans for tele-EC evaluation if they declined to go to the ED. Of these, 41.2% were advised by the tele-EC physician to go to the nearest ED (and 67.5% of these had a subsequent ED visit identified), but 39.1% were documented as resolved by the tele-EC physician (of which 15.8% had a subsequent ED visit).

## Acute care utilization within 7 days

Compared to standard nurse phone triage (*n* = 6643), the tele-EC group (*n* = 1202) had significantly fewer acute care visits within 7 days of the index call (Table 3). When assessing calls based on the tele-EC physician availability (referred to as tele-EC available vs. unavailable), the difference in rates of downstream ED visits decreased but persisted, with tele-EC available days having a lower rate of both VA and OON ED visits.

Adjusting for individual factors and triage acuity using multivariable logistic regression, the predicted rates of downstream ED visits was 35.0% in the standard nurse triage group and 18.2% in the tele-EC group, an absolute reduction in ED visits of 16.8% (95% confidence interval [CI] −19.2 to −14.4). When using IV analysis, tele-EC availability was a strong predictor of tele-EC use (odds ratio [OR] 6.4, 95% CI 5.3 to 7.8) after adjusting for other covariates

**TABLE 2** Tele-EC use and outcomes stratified by top 20 nurse triage complaints.

| | | | Triage acuity, % of total | | | | Nurse triage alone | | Nurse triage + tele-EC | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Tele-EC disposition, % | | | | | |
| Chief complaint group | *n* (%) | % | 911 | ED now | 2–8 h | 12–24 h | % of *n* | (a) ED visit in 7 days, % | % of *n* | Resolved | PCP | Urgent care | ED | (b) ED visit in 7 days, % | (b) − (a) |
| Lower extremity pain | 977 | 12.5 | 0.4 | 33.4 | 29.9 | 36.3 | 84.5 | 26.8 | 15.5 | 58.3 | 25.8 | 3.3 | 12.6 | 22.5 | −4.3 |
| Upper extremity pain | 606 | 7.7 | 1.8 | 28.6 | 27.1 | 42.6 | 87.8 | 21.4 | 12.2 | 54.1 | 32.4 | 1.4 | 12.2 | 16.2 | −5.2 |
| Cough/URI | 589 | 7.5 | 5.6 | 14.1 | 44.0 | 36.3 | 83.2 | 32.5 | 16.8 | 72.7 | 5.1 | 7.1 | 15.2 | 16.2 | −16.3 |
| Back pain | 549 | 7.0 | 7.8 | 25.1 | 27.5 | 39.5 | 84.9 | 29.4 | 15.1 | 57.8 | 20.5 | 2.4 | 19.3 | 20.5 | −8.9 |
| Urinary problem | 510 | 6.5 | 0.8 | 21.2 | 29.0 | 49.0 | 87.7 | 27.5 | 12.4 | 61.9 | 12.7 | 1.6 | 23.8 | 20.6 | −6.9 |
| Rash/skin problem | 503 | 6.4 | 1.2 | 1.6 | 34.4 | 62.8 | 91.9 | 15.2 | 8.2 | 73.2 | 9.8 | – | 17.1 | 17.1 | 2.1 |
| Shortness of breath | 306 | 3.9 | 35.0 | 45.4 | 10.5 | 9.2 | 83.7 | 53.9 | 16.3 | 40.0 | 18.0 | 4.0 | 38.0 | 30.0 | −23.9 |
| Abdominal pain | 282 | 3.6 | 16.0 | 49.7 | 27.7 | 6.7 | 80.9 | 50.4 | 19.2 | 35.2 | 27.8 | 1.9 | 35.2 | 24.1 | −26.3 |
| Chest pain | 278 | 3.5 | 48.6 | 41.4 | 4.3 | 5.8 | 79.5 | 53.4 | 20.5 | 49.1 | 12.3 | 3.5 | 35.1 | 19.3 | −33.9 |
| Lower extremity swelling | 263 | 3.4 | 1.9 | 39.5 | 19.0 | 39.5 | 84.4 | 41.0 | 15.6 | 51.2 | 29.3 | 2.4 | 17.1 | 17.1 | −23.9 |
| Dizziness/syncope | 231 | 2.9 | 12.6 | 69.7 | 1.7 | 16.0 | 79.2 | 50.3 | 20.8 | 60.4 | 14.6 | – | 25.0 | 16.7 | −33.6 |
| Eye problem | 208 | 2.7 | 1.9 | 43.8 | 33.7 | 20.7 | 89.4 | 24.2 | 10.6 | 50.0 | 13.6 | 4.6 | 31.8 | 22.7 | −1.5 |
| Ear problem | 207 | 2.6 | 0.5 | 4.4 | 27.1 | 68.1 | 92.3 | 18.9 | 7.7 | 68.8 | 18.8 | 6.3 | 6.3 | 18.8 | −0.1 |
| Headache | 177 | 2.3 | 2.8 | 61.0 | 7.9 | 28.3 | 81.4 | 37.5 | 18.6 | 69.7 | 18.2 | – | 12.1 | 18.2 | −19.3 |
| GU/GYN problem | 160 | 2.0 | – | 36.3 | 25.6 | 38.1 | 85.0 | 33.8 | 15.0 | 50.0 | 12.5 | – | 37.5 | 29.2 | −4.6 |
| Blood in stool | 136 | 1.7 | 0.7 | 56.6 | 12.5 | 30.2 | 79.4 | 46.3 | 20.6 | 46.4 | 17.9 | 3.6 | 32.1 | 7.1 | −39.2 |
| Diarrhea | 119 | 1.5 | 5.0 | 28.6 | 18.5 | 47.9 | 85.7 | 36.3 | 14.3 | 47.1 | 29.4 | 5.9 | 17.7 | 23.5 | −23.8 |
| Nausea/vomiting | 112 | 1.4 | 13.4 | 51.8 | 12.5 | 22.3 | 85.7 | 57.3 | 14.3 | 62.5 | 12.5 | – | 25.0 | 56.3 | −1.0 |
| Palpitations | 79 | 1.0 | 21.5 | 51.9 | 7.6 | 19.0 | 86.1 | 54.4 | 13.9 | 36.4 | 9.1 | – | 54.6 | 36.4 | −18.0 |
| Fatigue | 78 | 1.0 | 12.8 | 51.3 | 11.5 | 24.4 | 89.7 | 47.1 | 10.3 | 12.5 | 62.5 | – | 25.0 | 50.0 | 2.9 |
| Other | 1475 | 18.8 | 10.0 | 39.0 | 20.1 | 30.9 | 82.0 | 38.6 | 18.0 | 59.4 | 16.9 | 1.9 | 21.8 | 25.2 | −13.4 |
| Total | 7845 | 100 | 8.0 | 33.0 | 24.3 | 34.7 | 84.7 | 33.7 | 15.3 | 57.0 | 18.7 | 2.6 | 21.7 | 22.0 | −11.7 |

Abbreviations: GU/GYN, genitourinary/gynecology; PCP, primary care practitioner; tele-EC, tele–emergency care; URI, upper respiratory infection.

**TABLE 3** Acute care visits within 7 days of triage call, unadjusted.

| | Treatment received | | | Tele-EC provider schedule | | |
|---|---|---|---|---|---|---|
| | Nurse triage ($n = 6643$) | Nurse triage + tele-EC ($n = 1202$) | $p$-value | Tele-EC unavailable ($n = 2937$) | Tele-EC available ($n = 4487$) | $p$-value |
| No visit | 4293 (64.6) | 932 (77.5) | <0.001 | 2003 (63.8) | 3261 (69.3) | <0.001 |
| Any ED visit | 2238 (33.7) | 264 (22.0) | <0.001 | 1102 (35.1) | 1400 (29.8) | <0.001 |
| VA ED | 1902 (28.6) | 251 (20.9) | <0.001 | 941 (30.0) | 1212 (25.8) | <0.001 |
| OON ED | 371 (5.6) | 16 (1.3) | <0.001 | 178 (5.7) | 209 (4.4) | 0.014 |
| Any admission | 336 (5.1) | 48 (4.0) | 0.115 | 168 (5.4) | 216 (4.6) | 0.128 |
| VA admission | 245 (3.7) | 44 (3.7) | 0.963 | 128 (4.1) | 161 (3.4) | 0.133 |
| OON admission | 95 (1.4) | 4 (0.3) | 0.002 | 43 (1.4) | 56 (1.2) | 0.488 |
| Urgent care visit | 121 (1.8) | 5 (0.4) | <0.001 | 57 (1.8) | 69 (1.5) | 0.231 |

*Note*: Data are reported as $n$ (%).

Abbreviations: OON, out of network; tele-EC, tele–emergency care; VA, Veterans Affairs.

(Table S1). After including the response residual from the first stage (see Table S2), the effect of tele-EC on ED visits was predicted to decrease ED visits by 17.5% (95% CI −25.1 to −9.8), a relative reduction of 49.7%. Multivariable logistic regression and IV analysis likewise showed similar trends in reduced VA and OON ED visits associated with tele-EC use (Table 4; see Table S3 for ORs).

Using multivariable regression, tele-EC was associated with a 1.7% (95% CI −2.9 to −0.6) reduction in overall hospital admissions within 7 days, primarily due to a reduction in OON admissions. Similarly, in the IV model, tele-EC was predicted to reduce overall hospital admissions by 3.1% (95% CI −6.2 to −0.0). When VA and OON hospital admissions were measured separately, the two models had slightly differing results and the differences did not reach statistical significance: IV analysis predicted difference in VA admissions of −2.7% (95% CI −5.2 to 0.5) and OON admissions of −1.0% (95% CI −2.1 to 0.0). Tele-EC was also associated with a reduction in urgent care visits in multivariable regression modeling, but its effect did not reach statistical significance in the IV analysis.

## Secondary outcomes

No deaths were identified within 7 or 30 days following the index call in either the standard nurse triage group or the tele-EC group.

Downstream acute care use further differed by the telehealth modality used. In adjusted regression analysis, the rate of any acute care use was predicted to be 14.6% after a video visit compared to a 23.4% after a tele-EC visit done by phone (difference −8.8%, 95% CI −14.8 to −2.8; results reported only in text).

VA spending on OON acute care (ED visits, ED visits inclusive of related hospital admissions, and urgent care visits outside the VA system within 7 days of an index nurse triage call) occurred in 6.5% of encounters in the study population. Mean spending per OON visit was $3282 (median $592). In unadjusted comparison, the mean OON spending in the tele-EC group was $60, compared to $240 in the standard nurse triage group ($p = 0.006$). Using two-part modeling, the average marginal effect (AME) of tele-EC was estimated to be −$228 (95%CI −$338 to −$117). When using an IV model, the result was similar (AME −$248, 95% CI −$458 to −$38).

# DISCUSSION

Among Veterans calling a standard nurse triage line and recommended to seek care within 24 h, the use of a tele-EC service was associated with lower rates of subsequent ED visits within 7 days both at VA and OON locations as well as lower rates of overall hospitalization and no deaths in either study group. Video compared to phone visits, which was used less commonly than phone visits, was associated with an even lower rate of subsequent acute care use. Furthermore, on average, tele-EC use was associated with $248 lower spending on community care per episode. The use of tele-EC was similar across Veteran age, gender, race/ethnicity, and rurality. Taken together, these findings suggest that tele-EC has the potential to address a wide variety of clinical conditions and reduce the need for in-person ED care.

The results from this study have implications for addressing unscheduled acute care delivery both within and outside the VA, particularly for integrated health systems and accountable care networks. Specifically within the VA, scaling up this particular application of telemedicine holds promise for addressing the growing costs of community care. Although the exact reason why tele-EC led to a greater relative reduction in OON ED visits than VA ED visits should be further explored, it may be that Veterans see value in continuity of care after virtual evaluation by a VA physician who works with them to develop a care plan. However, the encounters linked to our study population represented only a small portion of the unscheduled community care visits in the study region (internal data), meaning the vast majority did not contact the call center prior to presenting to an OON ED. Increasing use of the nurse triage line for Veterans considering an ED visit may further decrease community care spending. Additionally, although this was not the primary purpose of the pilot,

**TABLE 4** Effect of tele-EC on acute care utilization within 7 days of index nurse triage call in logistic regression versus IV analysis.

| | Nurse triage alone | Tele-EC | Absolute difference[a] | *p*-value |
|---|---|---|---|---|
| Any ED visit, % | | | | |
| Unadjusted regression | 33.7 | 22.0 | −11.7 (−14.3 to −9.1) | <0.001 |
| Adjusted regression | 35.0 | 18.2 | −16.8 (−19.2 to −14.4) | <0.001 |
| IV | 35.2 | 17.7 | −17.5 (−25.1 to −9.8) | <0.001 |
| VA ED | | | | |
| Unadjusted regression | 28.6 | 20.9 | −7.7 (−10.3 to −5.2) | <0.001 |
| Adjusted regression | 30.1 | 17.3 | −12.8 (−15.2 to −10.5) | <0.001 |
| IV | 30.1 | 17.6 | −12.4 (−20.2 to −4.7) | 0.002 |
| OON ED | | | | |
| Unadjusted regression | 5.6 | 1.3 | −4.3 (−5.1 to −3.4) | <0.001 |
| Adjusted regression | 5.4 | 1.3 | −4.2 (−5.0 to −3.3) | <0.001 |
| IV | 5.7 | 1.0 | −4.7 (−6.8 to −2.6) | <0.001 |
| Any admission, % | | | | |
| Unadjusted regression | 5.1 | 4.0 | −1.1 (−2.3 to 0.2) | 0.089 |
| Adjusted regression | 5.1 | 3.4 | −1.7 (−2.9 to −0.6) | 0.003 |
| IV | 5.5 | 2.4 | −3.1 (−6.2 to −0.0) | 0.050 |
| VA admission | | | | |
| Unadjusted regression | 3.7 | 3.7 | −0.0 (−1.2 to 1.1) | 0.963 |
| Adjusted regression | 3.8 | 3.0 | −0.7 (−0.2 to 0.3) | 0.171 |
| IV | 4.3 | 1.9 | −2.4 (−5.2 to 0.5) | 0.102 |
| OON admission | | | | |
| Unadjusted regression | 1.4 | 0.3 | −1.1 (−1.5 to −0.7) | <0.001 |
| Adjusted regression | 1.3 | 0.3 | −1.1 (−1.5 to −0.6) | <0.001 |
| IV | 1.3 | 0.3 | −1.0 (−2.1 to 0.0) | 0.051 |
| Urgent care visit, % | | | | |
| Unadjusted regression | 1.8 | 0.4 | −1.4 (−1.9 to −0.9) | <0.001 |
| Adjusted regression | 1.8 | 0.5 | −1.3 (−1.8 to −0.7) | <0.001 |
| IV | 1.8 | 0.5 | −1.3 (−2.8 to 0.2) | 0.093 |
| OON acute care spending, $ | | | | |
| Unadjusted regression | 240.0 | 60.5 | −179.6 (−307.3 to −51.8) | 0.006 |
| Adjusted regression | 268.3 | 40.1 | −228.1 (−338.4 to −117.9) | <0.001 |
| IV | 279.1 | 30.8 | −248.3 (−458.4 to −38.2) | 0.021 |

Abbreviations: AME, average marginal effect; IV, instrumental variable; OON, out of network; tele-EC, tele–emergency care; VA, Veterans Affairs.
[a]Estimated using AMEs.

tele-EC physicians were occasionally asked to evaluate Veterans who were reluctant to seek in-person ED care as recommended by the triage nurse. In some cases, this option could prevent further delays in care. Adaptations of the tele-EC service beyond the VA setting may also improve care access and reduce acute care utilization for other patient populations as well. Potential examples include postoperative, recently discharged, or other medically complex patients.

We also found that tele-EC was used both to directly address a wide variety of Veteran concerns and to encourage timely ED care when appropriate. The most common nurse triage concerns in our study—musculoskeletal pain, cough/URI, urinary problems, rash, shortness of breath, abdominal pain, and chest pain—are similar to the most common reasons for Veteran visits to community urgent care centers as well as ED visits more generally.[25,26] There was significant variation in which conditions went on to have a tele-EC visit, indicating a degree of selection bias, though we did not examine whether this was driven by patient, nurse, or physician preference. Tele-EC physicians indicated they were able to resolve the Veteran's concern in a majority of encounters, though this was not uniform across conditions. Additionally, there was general concordance between the tele-EC recommendation and subsequent ED visits, with the notable exception of calls related to nausea or vomiting. This group had the highest rate of downstream ED visits despite a majority documented as resolved with tele-EC. Chief complaints related to URI, rash, headache, and ear problems were most successfully addressed with tele-EC. Fatigue, abdominal pain, and palpitations were least likely to achieve case resolution and were among the most likely to have a subsequent ED visit.

The way in which Veterans accessed tele-EC likely contributed to the large effect size we found. The tele-EC pilot in this study was similar to a previously described telemedicine urgent care pilot at another VA site that also integrated telemedicine into the existing nurse triage system.[11] The fact that Veterans were first triaged by a nurse and determined to need care within 24 h to be eligible for a tele-EC visit likely mitigated the potential for care overutilization found in prior studies of direct-to-consumer telemedicine, where patients could initiate visits with little prescreening for minor chief complaints and who otherwise may not have sought care.[27] For example, a prior study comparing direct-to-consumer telemedicine and matched in-person visits for acute respiratory infection found a 0.1% decrease in downstream ED usage but increased urgent care and office visits within 7 days of an initial telemedicine encounter, with overall a 4.4% greater likelihood of obtaining follow up after an initial telemedicine encounter versus in-person visit.[13] Ashwood et al.[14] also found that existing direct-to-consumer telemedicine access decreased ED expenditures, but increased overall health care utilization and costs per patient for acute respiratory infections due to increased access. In contrast, we found that tele-EC was associated with a large decrease in ED visits without a corresponding increase in urgent care visits for a broad spectrum of acute conditions, though we did not examine downstream office visits. Another potential reason for this difference is that many direct-to-consumer tele–urgent care visits are with third-party providers external to a patient's typical care context; the fact that the tele-EC physicians had access to Veterans' health records likely improved care coordination and continuity.

Our findings are in line with prior work evaluating telemedicine for a variety of acute conditions in other care contexts. Implementation of acute care telemedicine at senior living facilities was found to decrease ED visits by 24% in one study and by 27% in a skilled nursing facility.[28,29] A retrospective evaluation of telemedicine implemented at a correctional facility also concluded that 64% of inmates evaluated by telemedicine did not require transportation to the ED, though this study had a number of methodologic limitations. One commonality between the tele-EC service and these studies is that the telemedicine care model also had a clinician—most commonly a nurse—who screened patients and identified an appropriate level of need requiring escalation of care. The use of an intermediary, such as a nurse advice line or text-based questionnaire, to determine when a virtual visit is appropriate may be of interest to health systems or payers trying to optimize patient access to the most appropriate level of care.

Finally, we found that within tele-EC visits, phone visits were much more common than video visits, but video visits were found in the analysis to have a lower rate of subsequent ED visits. Although other studies have reported on the prevalence of phone visits,[30,31] evidence comparing outcomes after phone and video visits, particularly for acute unscheduled care, is lacking. A study comparing primary care visit modality found no difference in ED visit rates following phone, video, and in-person visits in an integrated health system from 2016 to 2018.[32] While additional clinical information is available in a video visit compared to a phone visit when evaluating a patient for an acute problem, it is encouraging that we found such a large reduction in ED visits despite a majority of tele-EC visits being performed by phone. This evidence lends support to proponents of continued reimbursement for audio-only telehealth services. While select states have passed legislation requiring payment parity for audio-only telehealth services, federally, this provision is set to expire at the end of the COVID-19 public health emergency (with the exception of tele–mental health services).[33,34]

## LIMITATIONS

The study had several limitations, although a notable strength of our approach was in employing an IV analysis to improve causal inference of the estimated effect size. First, we evaluated a pilot program offered at a single site whose VA population and integrated health system context may not be fully generalizable to other health systems. Tele-EC deployed across a more fragmented health care system may not be as effective in reducing ED visits if telemedicine providers are unable to access patient records or coordinate testing and follow-up care. Although we identified no deaths in either group, a larger sample size may be needed to draw firm conclusions about the safety of tele-EC. The VAAAHS call center nurse triage service may also be unique in that nurses not only make a triage recommendation but also work with Veterans to coordinate follow-up appointments. However, this process applied equally to both tele-EC and standard nurse triage groups, so likely did not affect the magnitude of our findings. In addition, we did not capture outpatient visits, so we could not measure the impact of tele-EC on overall utilization. It is possible that tele-EC increased outpatient visits; however, the marginal cost of increased office visits in an integrated health system is likely outweighed by the savings from avoided spending on community care ED visits. Finally, we did not have data on the cost of care for Veterans who had a subsequent ED visit or hospitalization within the VA system. Therefore, we were unable to conduct a formal financial analysis of the return on investment for staffing a tele-EC service with emergency physicians.

## CONCLUSIONS

In conclusion, we found that a tele–emergency care service integrated into an existing nurse triage workflow reduced subsequent ED visits by nearly half and in particular reduced short-term Veteran visits to EDs outside the Veterans Affairs system. Within the Veterans Affairs, expanding this service could improve Veterans' access to timely acute care while reducing spending related to travel and community care. Increasing the use of video-based tele–emergency care visits relative to phone visits may further improve outcomes. This tele–emergency care pilot can also serve as a model for balancing access and care utilization to reduce the burden on strained EDs more broadly. Future work is needed to evaluate the impact of tele–emergency care or similar services on overall care utilization and conduct a more formal cost–benefit analysis of scaling up such services.

## AUTHOR CONTRIBUTIONS

Kathleen Y. Li, Paul S. Kim, and Keith E. Kocher were responsible for study concept and design. Paul S. Kim and Kathleen Y. Li acquired the data. Kathleen Y. Li, Paul S. Kim, Joshua Thariath, and Jonathan Barkham contributed to data cleaning. Edwin S. Wong provided statistical expertise. Kathleen Y. Li performed the analysis. All authors discussed interpretation of the results. Kathleen Y. Li and Joshua Thariath drafted the manuscript, and all authors contributed to critical revision of the manuscript for important intellectual content.

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## CONFLICT OF INTEREST STATEMENT

All authors declare no conflicts of interest.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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