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Effectiveness of Acute Care Remote Triage Systems: a Systematic Review



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BACKGROUND: Technology-based systems can facilitate remote decision-making to triage patients to the appropriate level of care. Despite technologic advances, the effects of implementation of these systems on patient and utilization outcomes are unclear. We evaluated the effects of remote triage systems on healthcare utilization, case resolution, and patient safety outcomes.

METHODS: English-language searches of MEDLINE (via PubMed), EMBASE, and CINAHL were performed from inception until July 2018. Randomized and nonrandomized comparative studies of remote triage services that reported healthcare utilization, case resolution, and patient safety outcomes were included. Two reviewers assessed study and intervention characteristics independently for study quality, strength of evidence, and risk of bias.

RESULTS: The literature search identified 5026 articles, of which eight met eligibility criteria. Five randomized, two controlled before-and-after, and one interrupted time series study assessed 3 categories of remote triage services: mode of delivery, triage professional type, and system organizational level. No study evaluated any other delivery mode other than telephone and in-person. Meta-analyses were unable to be performed because of study design and outcome heterogeneity; therefore, we narratively synthesized data. Overall, most studies did not demonstrate a decrease in primary care (PC) or emergency department (ED) utilization, with some studies showing a significant increase. Evidence suggested local, practice-based triage systems have greater case resolution and refer fewer patients to PC or ED services than regional/national

systems. No study identified statistically significant differences in safety outcomes.

CONCLUSION: Our review found limited evidence that remote triage reduces the burden of PC or ED utilization. However, remote triage by telephone can produce a high rate of call resolution and appears to be safe. Further study of other remote triage modalities is needed to realize the promise of remote triage services in optimizing healthcare outcomes.

PROTOCOL REGISTRATION: This study was registered and followed a published protocol (PROSPERO: CRD42019112262).

KEY WORDS: remote triage; telephone triage; healthcare utilization; patient safety; systematic review.

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INTRODUCTION

The US health care system currently faces several challenges, including caring for an increasing elderly population,¹ patients with multimorbidity,^{2, 3} and uneven geographic distributions of primary care providers (PCPs).⁴ Busy PCP appointment schedules compound these issues, making it challenging to access acute and chronic care within many primary care (PC) settings.⁵ Many patients experience additional access barriers,⁶ including poor internet access and insufficient public transportation.⁷ Such challenges push patients to seek acute and chronic care outside the PC setting.⁸ A recent study reported 12% of patients visited emergency departments (ED) due to care needed outside of their PCP office hours and another 7% of patients for an inability to visit another

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provider.⁹ Unsurprisingly, patients with after-hours PCP availability have lower rates of higher level care utilization.¹⁰

One method of triaging patients to the appropriate level of care is through technology-based systems that facilitate remote decision-making, defined as making clinical decisions in the absence of face-to-face encounters. Thus, remote triage can be delivered in synchronous or asynchronous formats via platforms such as telephone, email, or video conferencing to address barriers to access.^{11–14} Authors of a 2004 Cochrane systematic review¹⁵ determined telephone triage consultation decreased urgent after-hours general practitioner (GP) patient visits, although it remains unknown if this represents an absolute decrease in utilization or care deferral to a later time. A more recent systematic review found limited information to assess clinical outcomes of remote triage, with mixed results on ED utilization.¹⁶ Another recent review determined additional information is needed for outcomes of telephone-only triage.¹⁷ Given persistent uncertainty around clinical and utilization outcomes after accessing acute care remote triage services, we conducted a systematic review to examine outcomes across various triage modalities.

METHODS

Study Design

This work is part of a Veterans Health Administration (VHA)–funded report (www.hsrd.research.va.gov/publications/esp). This review addresses “What are the outcomes of care utilization, case resolution, and patient safety associated with remote triage systems?” We followed a published protocol (PROSPERO: CRD42019112262) and PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidance.¹⁸

Data Sources and Searches

In collaboration with a reference librarian, we searched MEDLINE® (via PubMed®), EMBASE, and CINAHL from inception through July 27, 2018 (Appendix Table 1). We also screened references from high-quality systematic reviews and studies identified by stakeholders during topic development.

Study Selection

Our prespecified inclusion and exclusion criteria are listed in Appendix Table 2. Major inclusion criteria were comparative evaluation of remote triage services for initial assessment and management of acute, undifferentiated, and unscheduled outpatient general medical clinical issues initiated by patients. We used artificial intelligence (AI) technology (DistillerAI, Evidence Partners Inc., Manotick, ON, Canada) to assist with initial abstract screening.¹⁹ Abstracts of 100 articles were classified independently for relevance by two senior investigators and used as an AI training set. Articles were assigned a relevance probability by DistillerAI using Naive Bayes and

Support Vector Machine classifiers. All citations with probability of 1 proceeded to full-text review. All lower probability citations were screened by one investigator for progression to full-text review. Citations unclassified by DistillerAI underwent screening by two investigators. Articles included by either investigator or DistillerAI underwent full-text screening by two investigators for inclusion. Disagreements were resolved by consensus between investigators or by a third investigator.

Data Extraction and Quality Assessment

One investigator abstracted data into a customized DistillerSR database; a second investigator reviewed data for accuracy. Data elements included descriptors of applicability to our review question, study quality, interventions, and outcomes. Multiple reports from a single study were treated as one study. Two investigators independently assessed study quality using the Cochrane Effective Practice and Organisation of Care (EPOC) Risk of Bias (ROB) Tool.²⁰ We assigned summary ROB scores (low, unclear, or high) to individual studies.

Data Synthesis and Analysis

After summarizing study characteristics (Appendix Table 3), we determined feasibility of completing quantitative synthesis (i.e., meta-analysis) to estimate summary effects. We were unable to aggregate outcomes because of study design and outcome heterogeneity; therefore, we narratively analyzed data. In narrative synthesis, we prioritized evidence from higher quality studies (e.g., randomized designs, low ROB) and focused on identifying patterns in results across outcomes. We categorized studies by type of remote triage comparison: mode of triage delivery (i.e., telephone, in-person), triage professional type (e.g., nonclinical call handler, nurse, GP), and organizational level (e.g., national triage systems, local in-practice triage systems). When possible, we present forest plots of point estimates and 95% confidence intervals of individual studies.

Role of the Funding Source

The US Department of Veterans Affairs was not involved in the design, conduct, or analysis interpretation.

RESULTS

From 5026 screened citations, we reviewed 100 full-text articles and identified 8 unique eligible studies (1 individual randomized clinical trial (RCT), 4 cluster RCTs, 2 controlled before-after studies, and 1 interrupted time series study) (Appendix Fig. 1). All studies were conducted in Europe.

Intervention Characteristics

Details of included studies are in Appendix Table 3 and Appendix Table 4.^{21–28} Studies assessed the effects of remote triage on health care utilization ($n = 8$),^{21–28} case resolution

($n = 4$),^{23, 24, 26, 27} and patient safety ($n = 2$).^{21, 26} In four studies, the unit of enrollment was patients;^{23–25, 27} in three, it was incoming phone calls;^{22, 26, 28} and in one, it was after-hours periods for involved practices.²¹ We were able to calculate mean differences (MDs) and risk ratios (RRs) for seven studies.^{21–27}

Effects on Health Care Utilization

Health care utilization was the most commonly reported metric (eight studies, Table 1.^{21–28} Seven studies (four randomized, three nonrandomized) measured utilization as PC visits,^{21–25, 27, 28} while seven (four randomized, three nonrandomized) measured ED utilization.^{21–26, 28}

Studies assessing subsequent PC utilization after remote triage compared telephone triage to in-person visits ($n = 3$),^{21, 24, 25} as well as calls managed by different triage professional types ($n = 1$)²² and at different levels of triage organization ($n = 3$, Fig. 1).^{23, 27, 28} Only one study,²⁸ a controlled before-after study rated high ROB, demonstrated a reduction in utilization of PC services attributable to the tested telephone triage system. Four studies reported statistically significant increases in PC utilization with telephone triage,^{21, 22, 24, 25} while three showed nonsignificant effects.^{22, 23, 27} One study reported insufficient information to calculate a point estimate.²⁸]->

Table 1 Summary of Utilization Outcomes in Remote Triage Studies

Study design	Comparison	Results
Randomized McKinstry, 2002 ²⁵ Individual-randomized	Face-to-face consultation ($N = 188$) vs telephone advice ($N = 182$)	Number of subsequent primary care contacts, mean (SD) • 0.4 (0.7) vs 0.6 (0.8); difference -0.2 (95% CI -0.3 to 0.0) Number of subsequent emergency department contacts, mean (SD) N • 0.0 (0.1) vs 0.0 (0.2); difference 0.0 (95% CI -0.1 to 0.0)
Campbell, 2014 ²¹ Cluster-randomized	GP triage ($N = 5171$) vs nurse triage ($N = 5648$) vs usual care ($N = 5572$)	Primary care contacts after index over 28-day follow-up period, mean (SD) • GP: 2.62 (2.62) • Nurse: 2.78 (1.5) • Usual care: 1.87 (1.3) Emergency department contacts after index over 28-day follow-up period, mean (SD) • GP: 0.03 (0.19) • Nurse triage: 0.03 (0.22) • Usual care: 0.03 (0.21)
Richards, 2004 ²³ Cluster-randomized	Nurse triage (NHS Direct* $N = 2260$) vs usual practice ($N = 2458$)	Mean number of practice consultation consultations per patient (95% CI) • 1.43 vs 1.37; Poisson regression [†] , 1.04 (0.94 to 1.15) Mean number of after-hours consultation per patient • 0.082 vs 0.077; Poisson regression [†] , 1.05 (0.72 to 1.52) Mean number of ED consultations per patient • 0.053 vs 0.047; Poisson regression [†] , 1.10 (0.79 to 1.54)
Cragg, 1997 ²⁷ Cluster-randomized	Commercial deputized physician ($N = 1082$) vs longitudinal general practice physicians ($N = 1037$)	Use of primary care in 2 weeks after call; percent, (95% CI) • Practice doctors: 46.5 (42.1 to 50.6) vs deputizing doctors: 44.2 (40.2 to 48.3); $p = 0.299$
Lattimer, 1998 ²⁶ Cluster-randomized	Nurse triage ($N = 7184$) vs usual practice ($N = 7308$)	Attendance at ED unit within 3 days of call: • 412 (95% CI 374 to 452) vs 391* (equivalence limits 313 to 489)
Nonrandomized Turner, 2013 ²² Controlled before-after	Total number of NHS 111 calls $N = 408,851$	Monthly ED attendances after implementation of NHS 111; percent change, (95% CI) • -0.1 (-3.8 to 3.7) Percent change in monthly primary care utilization with NHS 111 • 2.5 (-3.5 to 8.5)
Munro, 2000 ²⁸ Controlled before-after	Total number of NHS Direct calls $N = 68,500$	In 3 NHS Direct areas, the estimated trend changed from 2% a month before NHS Direct to -0.8% afterward (estimated relative change -2.9% [95% CI -4.2 to -1.5%]), whereas in the 6 control cooperatives, the trend hardly changed, from 0.8% a month before to 0.9% afterward (relative change 0.1% [95% CI -0.9 to 1.1%])
Richards, 2002 ²⁴ Interrupted time-series	Nurse triage ($N = 3452$) vs usual practice ($N = 1233$)	Emergency department visits within 1 month of initial management; mean, (SD) • 0.033 (0.19) vs. 0.010 (0.10) mean difference: 0.023 (0.16) Primary care visits within 1 month of initial management; mean, (SD) • 1.35 (1.85) vs 1.01 (1.4) mean difference: 0.34

*NHS Direct is the first generation of a national 24-h nurse-led telephone helpline in England

[†]The value of no effect for a Poisson regression is 1.00

[‡]Adjusted for difference in denominator

CI = confidence interval; ED = emergency department; GP = general practitioner; NHS = National Health Service; SD = standard deviation

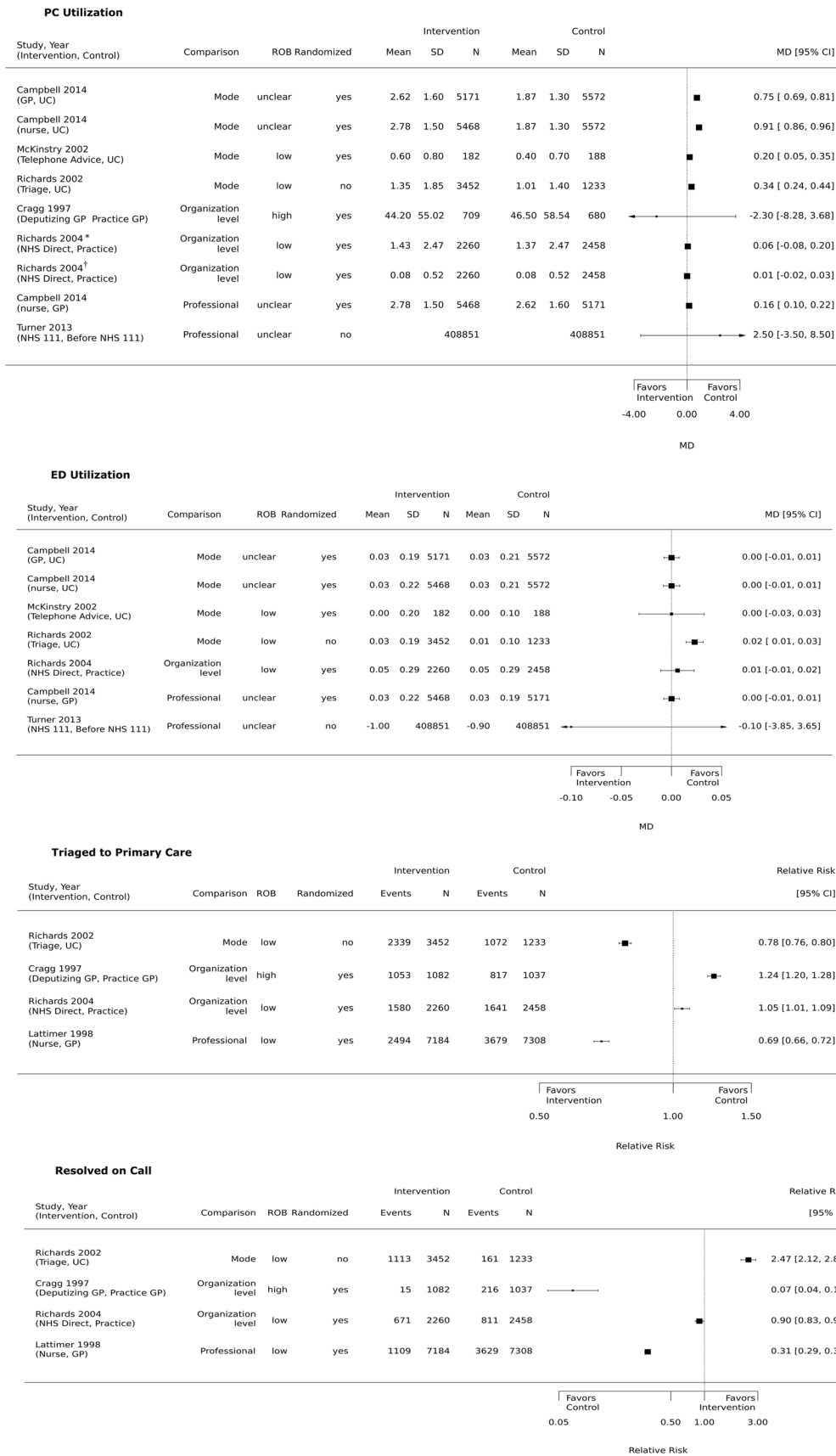


Figure 1 Effects of remote triage on utilization and case resolution outcomes. *Number of primary practice-based care visits within 30 days of index contact. †Number of after-hours visits within 30 days of index contact. CI = confidence interval; GP = general practitioner; ROB = risk of bias; UC = usual care.

Studies assessing utilization of ED services compared telephone triage to in-person visits ($n = 3$),^{21, 24, 25} management by different triage professional types ($n = 2$),^{22, 26} and at different levels of triage organization ($n = 2$, Fig. 1).^{23, 28} Overall, no study demonstrated a reduction in utilization of ED services attributable to the tested telephone triage system, while one nonrandomized study reported a statistically significant increase.²⁴ Two studies were not included in forest plots for methodological reasons.^{26, 28}

Comparison by Modality. All three studies comparing telephone triage services to in-person practice-based care found an increase in PC utilization with telephone triage over follow-up periods ranging from 14 to 30 days (Fig. 1).^{21, 24, 25} A pragmatic, three-arm cluster RCT compared both GP-led telephone triage and nurse-led telephone triage to usual care for patients seeking same-day PC consultations; telephone triage by GPs and nurses was associated with increased PC contacts of 33% and 48%, respectively, over 28 days.²¹ Another RCT investigated GP-led telephone consultations and found a statistically significant increase in subsequent PC utilization of 0.2 visits in the telephone group within 2 weeks.²⁵ Finally, a multiple interrupted time series study assessed nurse telephone triage versus standard management of routine requests for same-day appointments, finding more telephone patients returned for PC within 1 month (MD 0.32, $p < 0.001$, for return visits and MD 0.04, $p = 0.005$, for after-hours care, Fig. 1).²⁴

Neither of two RCTs^{21, 25} found a difference in ED utilization between nurse-led and GP-led telephone triage compared with in-person consultation. An additional nonrandomized study²⁴ found implementation of telephone triage compared with standard care led to an increase in ED visits post-implementation of telephone triage (MD 0.023, $p < 0.001$).

Comparison by Professional Type. Two studies assessed effect of triage professional type on PC utilization.^{21, 22} Compared with nurse-led triage, GP-led triage resulted in fewer mean PC contacts within 28 days (MD -0.16 , 95% CI -0.10 to -0.22).²¹ The other study was a controlled before-after assessment of an updated National Health Service (NHS) advice line staffed by nonclinical call handlers (NHS 111).²² NHS 111 differed from the previous system, NHS Direct, in that nonclinical call handlers applied computerized decision support software with clinician backup to immediately triage incoming calls to appropriate services or offer self-management advice. Compared with NHS Direct, implementation of NHS 111 resulted in an average increase of 2.5% of 47 monthly PC visits (95% CI -3.5 to 8.5%, Fig. 1).

Two randomized²¹ and one nonrandomized^{22, 26} studies assessed the effect of triage professional type on utilization of ED services (Fig. 1). The cluster RCT found statistical equivalence between nurse-led triage and GP-led triage for ED use over 3 days.²⁶ The cluster RCT comparing GP-led or nurse-led telephone triage with usual care²¹ found no difference in ED visits over 28 days (OR = 0.92, 95% CI 0.67 to

1.26). The study assessing enactment of NHS 111 also identified no change in ED utilization over 1 year.²²

Comparison by Organization Level. Three additional studies assessed levels of triage organization.^{23, 27, 28} One cluster RCT compared after-hours care provided by GPs from the patients' own practices to that provided by deputizing services, which are commercial external agencies delegated to cover care for GPs.²⁷ This study found no significant differences in number of PC visits over 2 weeks following triage (46.5 vs 44.2, $p = 0.299$). Another RCT assessed the relative effects of off-site triage by NHS Direct on consultation workload for PC patients requesting same-day appointments compared with usual onsite nurse telephone triage.²³ This study reported no differences in patients receiving PC services ($p = 0.49$) or after-hours care ($p = 0.81$) within 1 month (Fig. 1).²³ This study was a controlled before-after design evaluating NHS Direct triage versus GP cooperative telephone triage that reported a small, significant decrease in monthly GP cooperative triage calls after NHS Direct implementation (-2.9% ; 95% CI -4.2 to -1.5%).²⁸

Two studies investigated level of triage organization on utilization of ED services (Fig. 1).^{23, 28} The study of off-site NHS Direct triage²³ reported no difference in the number of ED patient visits within 1 month, compared with onsite telephone triage ($p = 0.58$). The controlled before-after study assessing NHS Direct telephone triage also reported no difference after implementation.²⁸

Effects on Case Resolution

Four studies assessed the effects of remote triage on case resolution (Table 2).^{23, 24, 26, 27} In these studies, people received one of three resolutions: triage to either (1) emergency services or (2) PC services (including urgent care, home, or PC visits immediately or on a future date), or (3) they achieved resolution during initial contact. Three studies were cluster RCTs involving 21,362 patients.^{23, 26, 27} The fourth was an interrupted time series study of 4685 patients.²⁴ One study evaluated modality,²⁴ one evaluated triage professional type,²⁶ and two looked at triage organization level.^{23, 27}

Only one study reported the proportion of patients triaged to emergency services,²⁷ while all studies reported both proportions of patients triaged to additional PC services and achieving immediate resolution. Resolution outcomes were rated high ROB in one cluster RCT²⁷ and low ROB in two other RCTs and the interrupted time series study.^{23, 24, 26}

In the study reporting emergency referrals, very few callers were referred directly, representing 14 of 1082 callers (1.3%) in the deputized service arm versus 4 of 1037 (0.4%) in the local GP arm.²⁷ Appropriateness of referrals was not evaluated.

Cluster RCTs reporting rates of referral to in-person PC services (Fig. 1)^{23, 26, 27} found triage interventions referred higher rates of callers to PC services than usual practice

Table 2 Summary of Case Resolution Outcomes in Remote Triage Studies

Study design	Comparison	Case resolution rate (%)
Randomized Cragg, 1997 ²⁷ Cluster-randomized	Commercial deputized physician (n = 1082) vs longitudinal general practice physicians (n = 1037)	Referred to emergency services: • 14 of 1082 (1.3%) vs 4 of 1037 (0.4%) Referred to primary care services: • 1053 of 1082 (97.3%) vs 817 of 1037 (78.8%) Resolved during initial contact without referral: • 15 of 1082 (1.4%) vs 216 of 1037 (20.8%)
Lattimer, 1998 ²⁶ Cluster-randomized	Nurse triage (n = 7184) vs GP triage usual practice (n = 7308)	Referred to primary care services: • 2494 of 7184 (34.7%) vs 3679 of 7308 (50.3%) Resolved during initial contact without referral: • 1109 of 7184 (15.4%) vs 3629 of 7308 (49.7%)
Richards, 2004 ²³ Cluster-randomized	Nurse triage (NHS Direct, n = 2260) vs usual practice nurse triage (n = 2458)	Referred to primary care services: • 1580 of 2260 (69.9%) vs 1641 of 2458 (66.8%), risk difference 3.15% Resolved during initial contact without referral: • 671 of 2260 (29.7%) vs 811 of 2458 (33.0%); risk difference - 3.30%
Nonrandomized Richards, 2002 ²⁴ Interrupted time-series	Nurse triage (n = 3452) vs usual practice same-day appointment assignment (n = 1233)	Referred to primary care services: • 2339 of 3452 (67.8%) vs 1072 of 1233 (86.9%) Resolved during initial contact without referral: • 1113 of 3452 (32.2%) vs 161 of 1233 (13.1%), RR 2.41 (95% CI 2.08 to 2.80)

CI = confidence interval; GP = general practitioner; NHS = National Health Service; RR = relative risk

coverage in two studies^{23, 27} and lower rates in a third, non-inferiority study.²⁶

All three cluster RCTs reporting rates of call resolution during initial contact (Fig. 1) found local, practice-based services resolved more calls than regional or national triage interventions.^{23, 26, 27} The interrupted time series study of a triage nurse line found more calls were resolved than the compared practice of maximizing same-day appointments.²⁴

Comparison by Modality. The interrupted time series study compared the NHS Direct nurse telephone triage service to a practice standard of assigning patients to same-day GP appointments.²⁴ This comparison showed fewer PC appointments scheduled with a triage service (2339 of 3452 callers, 67.8%) than accommodating the maximum number of callers within open appointments (1072 of 1233 callers, 86.9%). NHS Direct also resolved a higher percentage of calls (1113 of 3452 [32.2%] vs 161 of 1233 [13.1%], RR 2.41, 95% CI 2.08 to 2.80).²⁴

Comparison by Professional Type. A cluster RCT assessing triage-trained nurse-led versus standard practice GP-led after-hours remote triage scheduled 2494 of 7184 (34.7%) nurse triage callers to PC services, as compared with 3679 of 7308 (50.3%) GP triage callers.²⁶ This 38% reduction in the nurse-led arm included a 23% reduction in home visits. However, the nursing arm resolved only 1109 of 7184 (15.4%) calls versus 3629 of 7308 (49.7%) physician calls.²⁶

Comparison by Organization Level. One cluster RCT comparing NHS Direct triage to local practice triage during usual office hours²³ assigned 1580 of 2260 (69.9%) NHS Direct callers to same-day PC service versus 1641 of 2458

(66.7%) callers in the local arm, a 3.2% relative increase. The other cluster RCT of after-hours remote triage services using deputized versus practice physicians²⁷ found 1053 of 1082 callers (97.3%) in the deputized arm were triaged to immediate evaluation as compared to 817 of 1037 (78.8%) callers to the practice arm.

Similarly, the NHS Direct triage service resolved 671 of 2260 (29.7%) calls, while usual practice triage resolved 811 of 2458 (33.0%) calls.²³ In the other study, the deputized service resolved only 15 of 1082 calls (1.4%) versus 216 of 1037 (20.8%) in the practice physician arm.²⁷

Effects on Patient Safety

Two cluster RCTs addressed the effects of remote triage on patient safety (Table 3).^{21, 26} One trial rated unclear ROB evaluated safety as a secondary outcome for patients requesting same-day appointments,²¹ while the other rated low ROB reported safety events as a primary outcome during randomized after-hours periods.²⁶ Both trials included ED visitation, hospitalization, and death as safety outcomes and showed no difference in safety outcomes between nurse triage and GP-led usual care.^{21, 26}

Patient Deaths. The three-arm trial examining safety as a secondary outcome had eight total deaths reported during 7-day follow-up (GP triage n = 5, 0.7%, nurse triage n = 2, 0.3%, and usual care n = 1, 0.1%)²¹ (Fig. 2).²¹ The other, an equivalence trial comparing patients receiving usual GP telephone management with phone-based nurse triage, found no difference in death within 7 days between the control group (n = 66, equivalence 53 to 83) and intervention (n = 58, 95% CI 44 to 75).²⁶

Table 3 Summary of Patient Safety Outcomes in Remote Triage Studies

Study	Comparison and follow-up period	Results
Mortality		
Campbell, 2014 ²¹	GP triage (<i>N</i> = 5171) vs nurse triage (<i>N</i> = 5648) vs usual care (<i>N</i> = 5572) 28 days	Number of deaths per arm (per 1000) <ul style="list-style-type: none"> • GP triage <i>n</i> = 5 (0.7 deaths per 1000) • Nurse triage <i>n</i> = 2 (0.3 deaths per 1000) • Usual care <i>n</i> = 1 (0.1 deaths per 1000)
Lattimer, 1998 ²⁶	Nurse triage (<i>n</i> = 7184) vs GP triage usual practice (<i>n</i> = 7308) 7 days	Number of deaths per call per arm (percent), (95% equivalence limit) <ul style="list-style-type: none"> • Nurse triage <i>n</i> = 58* (0.8%), (44% to 75%) • Control group <i>n</i> = 66* (0.9%), (80% to 125%; equivalence 53 to 83)
Hospitalization		
Campbell, 2014 ²¹	GP triage (<i>N</i> = 5171) vs nurse triage (<i>N</i> = 5648) vs usual care (<i>N</i> = 5572) 7 days	Number of hospitalizations after index contact per arm (percent) <ul style="list-style-type: none"> • GP triage <i>n</i> = 59 (1.1%) • Nurse triage <i>n</i> = 69 (1.2%) • Usual care <i>n</i> = 52 (0.9%)
Lattimer, 1998 ²⁶	Nurse triage (<i>n</i> = 7184) vs GP triage usual practice (<i>n</i> = 7308) 3 days	Number of hospitalizations after index contact per arm (percent), (95% CI) <ul style="list-style-type: none"> • Nurse triage 428 (6.0%),[†] (390 to 468) • Usual care 498 (6.8%), (80 to 125%; equivalence 398 to 623)
Emergency department visits		
Campbell, 2014 ²¹	GP triage (<i>N</i> = 5171) vs nurse triage (<i>N</i> = 5648) vs usual care (<i>N</i> = 5572) 28 days	Number of ED visits after index contact per arm (percent) <ul style="list-style-type: none"> • GP triage <i>n</i> = 171 (3.3%) • Nurse triage <i>n</i> = 156 (2.8%) • Usual care <i>n</i> = 166 (3.0%)

[†]Percentages calculated based on the total number of calls

Hospitalizations. Within 7 days, approximately 1% of patients in the three-arm RCT had at least one hospital admission: GP triage (*n* = 59, 1.1%), nurse triage (*n* = 69, 1.3%), and usual care (*n* = 52, 0.9%, Fig. 2). Compared with usual care, telephone triage was associated with a nonsignificant trend toward increased admissions with GPs (OR 1.17, 95% CI 0.75 to 1.85) or nurses (OR 1.31, 95% CI 0.83 to 2.07), with no significant difference between nurse versus GP triage (OR 1.12, 95% CI 0.73 to 1.72).²¹ The equivalence trial comparing GP with nurse telephone triage found no differences in hospitalizations at 24 h (433, equivalence 346 to 541 vs 375; 95% CI 339 to 414) or 3 days (498, equivalence 398 to 623 vs 428; 95% CI 390 to 468).²⁶

ED Visits. Over 28 days, the three-arm RCT found approximately 3% of patients had at least one ED visit (GP triage *n* = 171 (3.3%), nurse triage *n* = 156 (2.9%), or usual care *n* = 166 (3.0%), Fig. 2). There were similar nonsignificant findings comparing nurse (OR 1.09, 95% CI 0.80 to 1.49) or GP triage (OR 1.18, 95% CI 0.87 to 1.61) to usual care, and nurse triage to GP triage (OR 0.92 95% CI 0.67 to 1.26).²¹

Quality of Evidence

Across all five randomized studies, three were rated low ROB,^{23, 25, 26} one unclear ROB,²¹ and one high ROB.²⁷ One nonrandomized design was rated low ROB,²⁴ one unclear ROB,²² and one high ROB.²⁸ Results are further summarized in Appendix Figs. 2–4.

DISCUSSION

Remote acute clinical triage centers are an increasingly prevalent feature of health care delivery, particularly among large organizations, and can vary by contact modalities and staffing models. The promise of these systems is to expand access while decreasing barriers related to distance, cost, and provider and patient time.¹⁷ Increasing access to timely PC advice may also avert costly ED and urgent care visits.²⁹ Despite technological advances, there remain many unanswered questions about the impact of remote triage on key health care outcomes. We sought to evaluate the effectiveness of remote triage innovations and explore differences by triage mode. Unfortunately, the identified studies were too heterogeneous to conduct meta-analyses. Further, no study meeting eligibility criteria investigated delivery modalities other than in-person and telephone, making it impossible to address the impact of different modalities, such as video.

Most included studies did not demonstrate a decrease in PC or ED utilization; however, the current evidence on subsequent utilization after use of remote telephone triage services is limited and of marginal quality. Only one high ROB study found a significant decrease in subsequent PC utilization when comparing a national telephone triage system to a local telephone system,²⁸ and no study found a decrease in ED utilization. Instead, four studies reported significant increases in utilization.^{21, 22, 24, 25}

One possible goal for remote triage centers is providing case resolution at initial contact. In this review, two studies showed local, practice-based phone triage services resulted in a greater

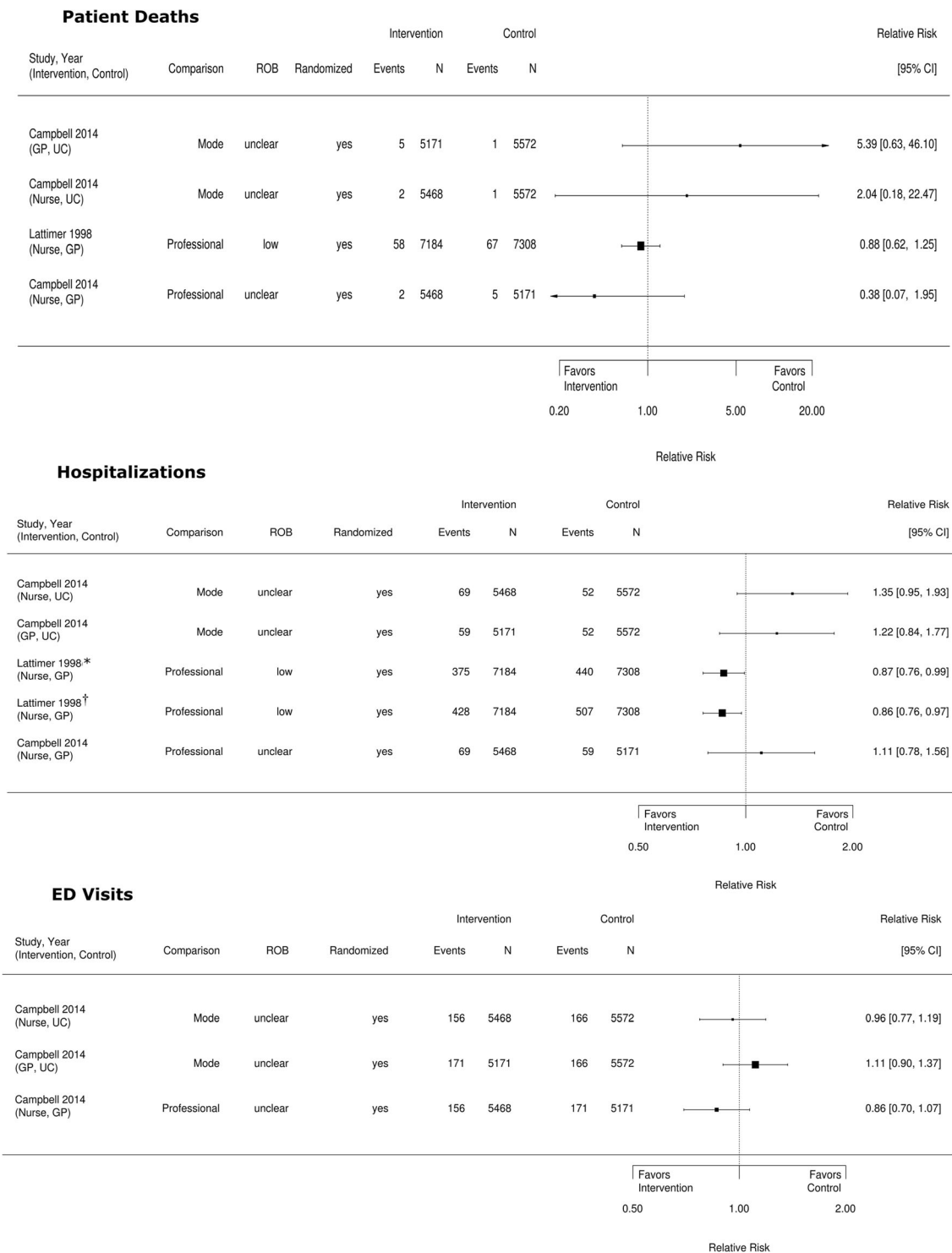


Figure 2 Effects of remote triage on patient safety outcomes. *Number of hospital admissions within 24 h of index contact. †Number of hospital admissions within 3 days of index contact. CI = confidence interval; GP = general practitioner; ROB = risk of bias; UC = usual care.

percentage of case resolution compared with regional/national systems.^{23, 27} Thus, remote triage systems at higher organizational levels may need to prioritize determining appropriate triage destinations over case resolution. Such remote triage systems covering larger areas should consider organizational structures to enhance integration with the practices they serve. For instance, services could be designed with different teams

of call handlers for each practice or small group of practices, with access to full patient records. No clear patterns emerged about the effects of remote triage on patient safety, although only two studies^{21, 26} addressed safety outcomes.

Most prior reviews of telephone triage have included primarily observational studies,^{17, 30, 31} with only an older Cochrane review similarly limiting studies to those meeting

comparative study designs included in the EPOC criteria. Like our review, no other study found sufficient homogeneity to allow meta-analyses.³² Across the literature, the most consistent finding is that telephone triage does not decrease ED visits,³² similar to this report. There is evidence as noted in the original Cochrane review that telephone triage may reduce GP workload in the near-term, although later studies have suggested visits may merely be deferred rather than prevented.^{30, 32} In contrast to previous studies, we report no reduction of PC utilization in patients experiencing remote triage and found four studies identifying increased rates of PC use. Only three of our eight studies also were included in the 2004 Cochrane review, likely accounting for the differences in utilization results in our current work.

As multimodal contact options are important when designing a modern remote triage system, entering triage systems by means other than telephone would be important to study and understand. In particular, SMS, video calls, and chat features may be preferred means of contact for many patients, underscoring the need for more study of how triage professionals receive and process requests. Unfortunately, we were not able to identify evidence regarding multimodal contact centers.

Our review has a number of strengths, including a protocol-driven design, a comprehensive search, inclusion of EPOC designs to assess interventions, and careful quality assessment. Both our review and the literature, however, have limitations. Our review was limited to English-language publications, although the likelihood of identifying relevant data unavailable from these sources is low. The number of comparative EPOC studies was small, and most had design limitations. Given this small number, formal statistical analysis to detect publication bias was not performed. Additionally, many of the studies available had significant potential biases, with 50% of studies assessed as unclear or high ROB. Further, interventions were often described incompletely for key details such as triage protocols. Finally, remote clinical triage is a complex intervention, and identified studies were too heterogeneous to perform meta-analysis. We therefore clustered our narrative synthesis by comparison type, focusing first on higher quality designs.

CONCLUSIONS

The US health care system faces several challenges limiting access to PC, pushing some patients to seek care in other settings. Our review found limited evidence to support remote triage as a viable approach to reducing the burden on PC or ED utilization. However, remote triage by telephone can produce a high rate of call resolution and did not show evidence of patient harm in limited studies assessing safety outcomes. Further study is needed to realize the promise of remote triage in optimizing health care outcomes.

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Compliance with Ethical Standards:

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