Effectiveness of Remote Triage: A Systematic Review

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PREFACE

The VA Evidence Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted health care topics of importance to clinicians, managers, and policymakers as they work to improve the health and health care of Veterans. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The program is comprised of four ESP Centers across the US and a Coordinating Center located in Portland, Oregon. Center Directors are VA clinicians and recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Center Program and Cochrane Collaboration. The Coordinating Center was created to manage program operations, ensure methodological consistency and quality of products, and interface with stakeholders. To ensure responsiveness to the needs of decision-makers, the program is governed by a Steering Committee comprised of health system leadership and researchers. The program solicits nominations for review topics several times a year via the program website.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, Deputy Director, ESP Coordinating Center at Nicole.Floyd@va.gov.

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This topic was developed in response to a nomination by Jennifer MacDonald, MD, Office of Connected Care for the purpose of developing an enterprise master plan for clinical contact center optimization. The scope was further developed with input from the topic nominators (*ie*, Operational Partners), the ESP Coordinating Center, the review team, and the Technical Expert Panel (TEP).

In designing the study questions and methodology at the outset of this report, the ESP consulted several technical and content experts. Broad expertise and perspectives were sought. Divergent and conflicting opinions are common and perceived as healthy scientific discourse that results in a thoughtful, relevant systematic review. Therefore, in the end, study questions, design, methodologic approaches, and/or conclusions do not necessarily represent the views of individual technical and content experts.

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Operational Partner

Operational partners are system-level stakeholders who have requested the report to inform decision-making. They recommend TEP participants; assure VA relevance; help develop and approve final project scope and timeframe for completion; provide feedback on draft report; and provide consultation on strategies for dissemination of the report to field and relevant groups.

Jennifer MacDonald, MD
Clinical Lead
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Technical Expert Panel (TEP)

To ensure robust, scientifically relevant work, the TEP guides topic refinement; provides input on key questions and eligibility criteria, advising on substantive issues or possibly overlooked areas of research; assures VA relevance; and provides feedback on work in progress. TEP members are listed below:

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Peer Reviewers

The Coordinating Center sought input from external peer reviewers to review the draft report and provide feedback on the objectives, scope, methods used, perception of bias, and omitted evidence. Peer reviewers must disclose any relevant financial or nonfinancial conflicts of interest. Because of their unique clinical or content expertise, individuals with potential conflicts may be retained. The Coordinating Center and the ESP Center work to balance, manage, or mitigate any potential nonfinancial conflicts of interest identified.

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EVIDENCE REPORT

INTRODUCTION

The US health care system currently faces several challenges, including caring for an increasing elderly population,[1] large numbers of patients with multiple chronic conditions,[2,3] and an uneven distribution of primary care providers across the country.[4] The full appointment schedules of many primary care physicians compound this workforce shortage, making it challenging for many patients to access acute and chronic care within a primary care setting.[5] Additionally, many patients experience barriers to receiving care, which span financial and nonfinancial burdens.[6] In rural areas, for example, patients may face not only a decreased number of providers, but also challenges with internet access and public transportation for arranging and attending appointments.[7]

Such access challenges may lead people to seek acute or chronic care in settings such as emergency departments (EDs) when their needs could have likely been addressed in a primary care setting. Increasingly, acute care visits take place outside of the primary care setting.[8] The number of annual ED visits has been growing,[9] and, in 2010 the United States spent $328.1 billion on ED care.[10] In 2016 Gindi et al[11] found that 12% of patients visited the ED because it was not during their primary care office hours and another 7% visited the ED because of an inability to visit another provider. As might be expected, patients who have access to after-hours care at their usual primary care practice have lower rates of higher level care utilization.[12] One way of providing patient access to the appropriate level of care is through remote technology. The use of technology to reach across distances to deliver health care is known as telemedicine and has the potential to impact society, health care systems, and individual patients and family.[13] In certain settings, the use of telemedicine has been shown to reduce both time and financial costs, while 86% of patients in a large health care systems noted increased access to care.[14]

Telemedicine can be delivered via a synchronous format (“real-time” communication between patient and provider), asynchronous format (“one-way” communication to either patient or provider), or remote monitoring.[15] Specific technologies to deliver telemedicine may include email, internet-based, and remote store-and-forward platforms,[16] as well as video conferencing and satellite-based technologies,[17] among others. These technologies may also be used in multiple ways: telephone interactions, for example, can be used to address acute, chronic, and preventive care issues.[18] Similarly, patients also can use secure email as a means of first contact to address a wide variety of concerns such as acute conditions, test results, medication, chronic care, and requests for referrals.[19]

Remote decision-making is defined as making clinical decisions in the absence of a face-to-face encounter.[20] Remote decision-making can overcome barriers such as demand for in-person clinical services. In a 2004 Cochrane systematic review, Bunn et al[21] determined telephone consultation with patients and triage decreased urgent visits for medical and surgical patients, but further research is needed to determine if this represents an absolute decrease in appointment utilization versus a deferral in care to a later time. Another, more recent systematic review found limited information available to broadly assess the impact of remote triage on clinical outcomes and cost with mixed results related to the impact on emergency department use.[22] These latter findings are similar to findings of another study that determined additional information is needed related to the outcomes of telephone triage and advice lines.[23]

The implementation of any technology-based system is complex and requires the evaluation of multiple factors within an organization as part of the planning process. General factors that would affect deploying telemedicine strategies include the specific clinical and population contexts, cultural influences within the patient population, the ability to sustain the process, and legal considerations around medical decision-making and disposition.[17] Another study identified specific issues requiring consideration for execution, including the system's adaptability to fit local needs, the complexity of both the system and the intervention, cost, external forces such as incentives and mandates, internal forces such as supportive resources, and top-down engagement.[24] For example, primary care providers (PCPs) in the United Kingdom have implemented a practice of requiring phone consultations with patients requesting same-day appointments to assess whether the condition could be addressed without a face-to-face visit. This practice led to a decrease in face-to-face acute visits, although it increased PCP workload to manage the triage.[25]

The current review was requested by the VA Office of Connected Care, which partners with the Office of Nursing Services to develop an enterprise master plan for clinical contact center optimization. The review will be used to identify the current evidence base and its quality surrounding outcomes related to remote triage services for acute care needs across multiple platforms. Furthermore, it will identify best practices and potential barriers in the further adoption of these telemedicine platforms within the Veterans Health Administration (VHA) system. Prior systematic reviews on this topic are inadequate for the needs of these stakeholders because they do not include recent important studies nor consider geographic and integration issues in a system the size of the VHA. Additionally, we seek to determine whether data exist to adequately determine performance of these remote triage systems for continuous measurement and improvement.

METHODS

We followed a standard protocol for this review. Each step was pilot-tested to train and calibrate study investigators. The PROSPERO registration number is CRD42019112262. We adhered to the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines.[26]

TOPIC DEVELOPMENT

This topic was proposed by a multi-program office, multidisciplinary governance structure led by the Office of Connected Care and Office of Nursing Services to develop an enterprise master plan for clinical contact center optimization. Additionally, this VHA structure will become part of a larger department-level governance structure overseeing all contact center modernization, including administrative efforts. This information will be relevant to the VHA, Veterans Benefit Association, and the National Cemetery Association stakeholders as enterprise-level technology, staffing, and other decisions are to be made.

Key Questions

The Key Questions (KQs) for this report were:

KQ 1:

- **A**. For adults, what are the effects of remote triage on health care utilization, case resolution, patient safety, patient satisfaction, and cost?
- **B**. What is the impact of remote triage by different modalities (*eg*, telephone, video, web, short message service [SMS])?

KQ 2: What are the identified best practices that impact the planning, execution, and evaluation of remote triage for adults seeking clinical care advice in a large-scale health system such as the VA?

KQ 3: What are the types of outcomes used to assess the impact of remote triage?

SEARCH STRATEGY

In collaboration with an expert reference librarian, we conducted 2 different primary literature searches (one for KQs 1 and 3 and a separate search for KQ 2) from inception through July 27, 2018, of MEDLINE® (via PubMed®), EMBASE, and CINAHL. We used a combination of MeSH keywords and selected free-text terms (*eg*, triage, telenurses, helpline) to search titles and abstracts (Appendix A). We also conducted hand-searches of references from selected high-quality systematic reviews and exemplar studies identified during the topic development process and identified by our stakeholders.

Our search strategy was informed by the Cochrane Effective Practice and Organization of Care (EPOC) Group.[27] EPOC criteria were developed to capture both randomized and nonrandomized study designs. All citations were imported into 2 electronic databases (for referencing, EndNote®, Clarivate Analytics, Philadelphia, PA; for data abstraction, DistillerSR; Evidence Partners Inc., Manotick, ON, Canada).

STUDY SELECTION

We used the artificial intelligence (AI) technology developed as part of the DistillerSR software, called DistillerAI, to assist with screening abstracts. Using prespecified inclusion/exclusion criteria (Table 1), the titles and abstracts of a subset of articles (n=100 for KQ1 and n=150 for KQ 2) identified through our primary search were classified independently by 2 senior investigators for relevance to the KQs. After resolving disagreements between the investigators, this set of included and excluded articles was used to train DistillerAI.[28]

We used DistillerAI to screen citations using different approaches for KQs 1and 3 and KQ 2. For both approaches, the titles and abstracts were assigned a probability of relevance to the study questions by DistillerAI using both a Naive Bayes classifier and Support Vector Machine classifier. For literature associated with KQ 1, all citations with a relevance probability score of 1 underwent full-text review by 2 investigators. All citations classified as lower probability of inclusion were screened by 1 investigator. The citations that were unclassified by DistillerAI underwent screening by 2 investigators. For literature associated with KQ 2, all titles and abstracts were reviewed by DistillerAI. Citations with ≥50% probability of inclusion advanced to the full-text review stage. Citations classified by DistillerAI as excluded (<51% probability) were reviewed by 1 investigator.

Citations included by an investigator or DistillerAI based on the title and abstract underwent full-text screening. At the full-text screening stage, 2 independent investigators agreed on a final inclusion/exclusion decision. All articles meeting eligibility criteria were included for data abstraction. The outcomes used to assess remote triage (KQ 3) used publications identified in KQ 1.

Table 1. Eligibility Criteria

Study Characteristic	Inclusion Criteria	Exclusion Criteria
Population	KQ 1/KQ 3, KQ 2: Adults (≥18 years of age) and their families and caregivers KQ 2: Stakeholders involved in the uptake, management, and implementation of remote triage services (*eg*, nurses, administrators, organizational leadership)	Inpatient populations Populations in residential facilities that provide regular medical care (*eg*, long-term care, nursing home)
Intervention	**Remote triage services**, defined as services pertaining to the initial assessment and management of acute, undifferentiated, or unscheduled care initiated by a patient or family member from a distance that is focused on a clinical care issue	Interventions defined primarily as: ● Telemonitoring ● Health coaching ● In-person presentations (*eg*, walk-ins) ● Counseling ● Longitudinal care management (*ie*, more than 1 contact for an ongoing condition, routine follow-up)

Study Characteristic	Inclusion Criteria	Exclusion Criteria
		● Provider-to-provider communications or consultations beyond the initial transfer of information from a patient-initiated contact ● Urgent mental health crisis lines (*eg*, suicide hotlines) or emergency medical services (*eg*, 911) Interventions related only to the use of remote triage for the following: · Specific population or demographic (*eg*, pediatric only, ethnic minority) · Specific condition (*eg,* depression) medical specialty (*eg,* asthma) or ongoing or chronic conditions (*eg*, diabetes) · Technical assessments not related to patient or health care outcomes · General health education
Comparator	KQ 1: ● Usual care/standard of care, waitlist control ● Other active comparator (*eg*, in-person care KQ 2, KQ 3: No comparator required	KQ 1: No controls KQ 2, KQ 3: No exclusion criteria
Outcome[a]	KQ 1: Patient satisfaction, health care utilization, case resolution, cost to deliver or cost per member, and patient safety KQ 2: Best practices for remote triage system (*eg*, insights into personnel, processes, and technologies needed to establish a remote triage; implications for what works well and what does not in conducting remote triage) KQ 3: Outcomes used to assess remote triage from publications identified in KQ 1	Any outcomes not listed
Setting	Outpatient general medical settings (*eg*, family medicine, general internal medicine, integrative medicine, urgent care, emergency departments) Community settings KQ 2: Large health care systems	Intervention delivered primarily in hospital inpatient setting Mass casualty event Specialty medical settings for management of chronic medical conditions

Study Characteristic	Inclusion Criteria	Exclusion Criteria
Study design	KQ 1: EPOC criteria studies[a] that have prospective data collection: ● Randomized trials ● Nonrandomized trials ● Controlled before-after studies ● Interrupted time-series studies or repeated measures studies KQ 2, KQ 3: ● Above KQ study designs, and the following designs if they address best practices in implementing remote triage services: ● Qualitative studies ● Systematic reviews ● Organizational case studies	KQ 1: ● Self-described pilot studies without adequate power to assess impact of intervention on outcomes. ● Studies of small sample sizes (n<100) ● Not a clinical study (*eg*, editorial, nonsystematic review, letter to the editor) ● Uncontrolled clinical study ● Qualitative studies ● Prospective and retrospective observational studies ● Clinical guidelines ● Measurement or validation studies KQ 2, KQ 3: Studies that do not include exploration of best practices in remote triage
Language	English	Non-English
Countries	OECD[b]	Non-OECD
Years	1990 forward	None
Publication types	Full publication in a peer-reviewed journal	Letters, editorials, reviews, dissertations, meeting abstracts, protocols without results

[a] See Cochrane EPOC criteria for definitions and details.[27]
[b] OECD = Organization for Economic Co-operation and Development includes Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

DATA ABSTRACTION

Data from published reports were abstracted into a customized DistillerSR database by 1 reviewer and over-read by a second reviewer. Disagreements were resolved by consensus or by obtaining a third reviewer's opinion when consensus was not reached. Data elements included descriptors to assess applicability, quality elements, intervention/exposure details, and outcomes. When we used an existing high-quality systematic review, we spot-checked critical data from the primary literature as needed to confirm accurate abstraction/interpretation by the authors of the review.

Key characteristics abstracted were patient descriptors (*eg*, age, sex, race, Veteran status), intervention characteristics (*eg*, interventionist, delivery modality, key intervention components), comparator, and outcomes, as described previously. For studies relevant to KQ 2, we abstracted best practices (*ie*, description of themes or factors that relate to the planning, execution, evaluation, people, process and technology) for the implementation of remote triage services. For KQ 3 we abstracted the measures and metrics used to evaluate remote triage systems. Multiple reports from a single study were treated as a single data point, prioritizing results based on the most complete and appropriately analyzed data. Key features relevant to applicability included

the match between the sample and target populations *(eg*, age, Veteran status). For details of intervention characteristics and study characteristics, see Appendices B and C. Appendix D lists excluded studies and the reason for exclusion.

QUALITY ASSESSMENT

Quality assessment was done by the investigator abstracting or evaluating the included article and was over-read by a second, highly experienced investigator. Disagreements were resolved by consensus between the 2 investigators or, when needed, by arbitration by a third investigator.

For all KQs, we used the Cochrane EPOC risk of bias (ROB) tools, which are applicable to randomized studies, nonrandomized studies, controlled before-after studies, and interrupted time-series studies.[27] These criteria are adequacy of randomization and allocation concealment; comparability of groups at baseline; blinding; completeness of follow-up and differential loss to follow-up; whether incomplete data were addressed appropriately; protection against contamination; and selective outcomes reporting. The criteria specific to interrupted time-series studies include intervention independence from other changes; prespecified shape of intervention effect; intervention unlikely to affect data collection; knowledge of allocated interventions adequately prevented; incomplete outcome data addressed; absence of selective outcome reporting; and absence of other risks of bias. We assigned a summary ROB score (low, unclear, high) to individual studies.

Summary ROB ratings are defined as follows:

- Low ROB: Bias, if present, is unlikely to alter the results seriously.
- Unclear ROB: A risk of bias that raises some doubts about the results.
- High ROB: Bias may alter the results seriously.

For KQ 2 qualitative studies, we used the 5 items specific to qualitative studies from the Mixed Methods Appraisal Tool (MMAT).[29] These criteria address the appropriateness of the qualitative approach; the adequacy of data collection methods; findings adequately derived from the data; results sufficiency supported by the data; coherence between qualitative data sources, collection, analysis and interpretation. The MMAT rates each item “Yes,” “No,” or “Can’t tell”; there is no summary rating.

For KQ 2 systematic review studies, we adapted the AMSTAR critical appraisal tool.[30] These criteria address *a priori* design; specified eligibility criteria; appropriateness of eligibility restrictions; comprehensive literature search strategy; comprehensive search terms; restrictions on strategy appropriate; selection bias; duplicate study selection and data abstraction; characteristics of the included studies provided; quality of included studies assessed; quality of included studies appropriately addressed in conclusions; methods used to combine findings appropriate; addressed between-study variation; publication bias assessed; conclusions supported by data; and conflict of interest stated. We assigned a summary ROB score (good, fair, poor) to individual studies.

DATA SYNTHESIS

KQ 1—Effects of Remote Triage

We summarized the primary literature using relevant data abstracted from the eligible studies. Summary tables describe the key study characteristics of the primary studies: study design, patient demographics, and details of the intervention and comparator. We then determined the feasibility of completing a quantitative synthesis (*ie*, meta-analysis) to estimate summary effects. For meta-analyses, feasibility depends on the volume of relevant literature, conceptual homogeneity of the studies, and completeness of results reporting. We were unable to aggregate outcomes because of heterogeneity of outcome reporting, time points, and methodology. Thus, we analyzed the data narratively. We gave more weight to the evidence from higher quality studies (*eg*, randomized designs, low ROB studies) with more precise estimates of effect. When possible, we present forest plots of the point estimates of individual studies, grouped by the overall type of comparison drawn in each study. Narrative synthesis focused on documenting and identifying patterns in results of the interventions across conditions and outcome categories. We analyzed potential reasons for inconsistency in effects across studies by evaluating differences in the study population, triage system, comparator, and outcome definitions.

KQ 2—Best Practices for Remote Triage

For the KQ 2 analysis, we set up a team of 3 co-investigators (JMG, AAL, SR) who had experience in qualitative methodology. The qualitative team analyzed the abstracted data from the KQ 2 studies using thematic synthesis and the framework method.[31,32] Using the KQ 2 question as a guide, they created an *a priori* framework developed in collaboration with our stakeholders and Technical Expert Panel. This framework included *3 phases* of best practice: planning, execution, and evaluation; and *3 aspects* of best practice: people, processes, and technology. All abstracted findings were first categorized into phase (*ie*, planning, execution, and evaluation), and then within each phase were categorized by aspect (*ie*, people, processes, and technology) Abstracted data could be categorized into more than 1 phase and aspect; additionally, text sections could be categorized into multiple relevant phases and/or aspects. For instance, an abstracted piece of text could be categorized as execution phase and both as person and process aspects.

The qualitative team first abstracted data into a Microsoft Excel spreadsheet for data cleaning and organization. Then, the team used NVivo software to support first- and second-level coding and analysis (QSR International Pty Ltd, Version 12, 2018). Rigor and validity were established during data cleaning and organization as the qualitative team over-read 100% of abstracted data in Excel. After the data were coded, a coder external to the project over-read 100% of the coded text in NVivo to assess validity of the coding schema. When a disagreement in abstracted or coded text arose, the team discussed the text as a group and came to a consensus at their weekly meeting. This over-reading process confirmed the validity of the interpretations.

After the data were independently coded, over-read, and discussed among the 3 qualitative researchers, they conducted a thematic synthesis by identifying and grouping related codes across each phase (*eg*, planning, execution, and evaluation) and aspect (people, processes, and technology). The creation and identification of codes and themes was iterative. To ensure rigor and validity of these findings, the team independently coded and developed themes and then discussed theme development and identification until they reached agreement. As a data-

reduction technique, we used matrix analysis and categorized themes in each phase of best practice to compare and contrast findings.[33]

KQ 3—Assessment of Remote Triage

For the studies that met inclusion criteria for KQ 1, we categorized the types of metrics used to assess the impact of remote triage. We adapted 6 categories developed by Carrasqueiro et al[34]: (1) enhanced access to care; (2) change in rates or trends of services use or change in professionals' workload; (3) adverse events (deaths, emergency department attendance, hospital admissions) and delayed care; (4) clinical outcomes after triage; (5) patient satisfaction measured via Likert scales; and (6) savings from avoided services use and triage costs.

RATING THE BODY OF EVIDENCE

The certainty of evidence (COE) for KQ 1 was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE)[35] approach. We limited GRADE ratings to those outcomes identified by the stakeholder and Technical Expert Panel as critical to decision-making, specifically health care utilization, patient safety, and patient satisfaction. In brief, this approach requires assessment of 4 domains: risk of bias (ROB), consistency, directness, and precision. Additional domains to be used when appropriate are coherence, dose-response association, impact of plausible residual confounders, strength of association (magnitude of effect), and publication bias. These domains were considered qualitatively, and a summary rating was assigned after discussion by 2 investigators (AMG, JMG) as high, moderate, low, or very low COE.

PEER REVIEW

A draft version of this report was reviewed by technical experts and clinical leadership. A transcript of their comments and our responses is in Appendix E.

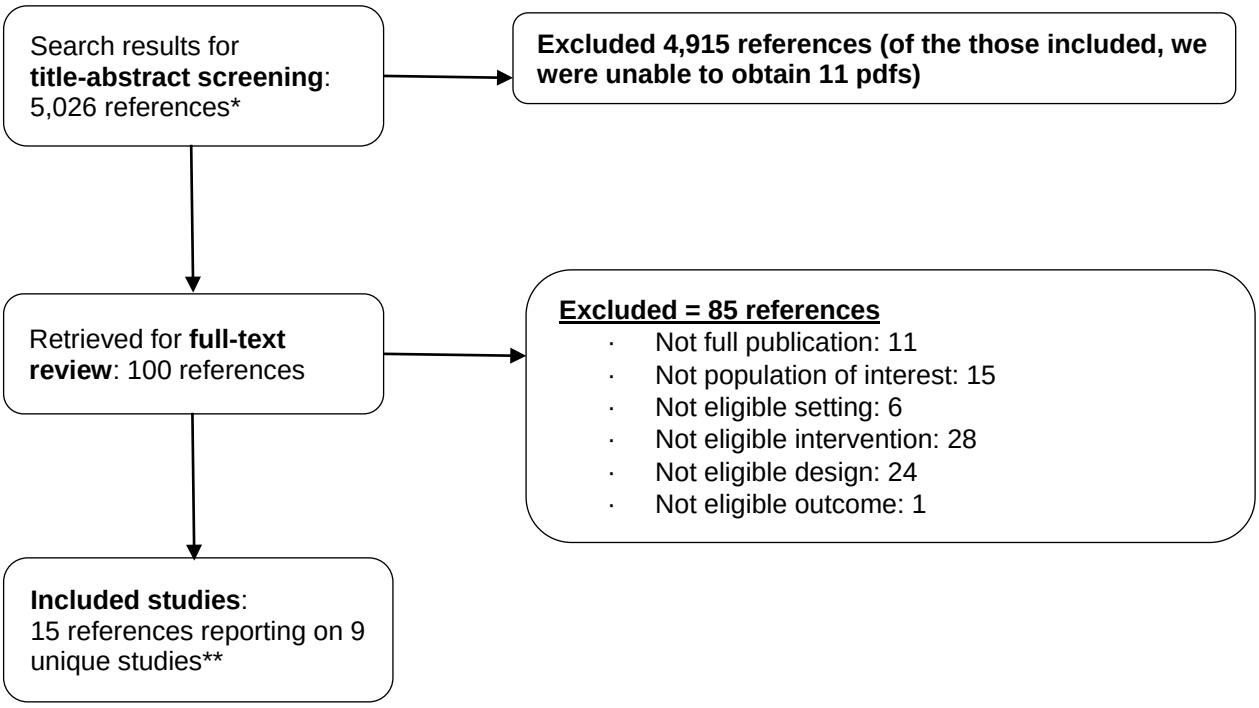
RESULTS

LITERATURE FLOW

We identified 5,026 articles relevant to KQ 1 and 6,911 articles relevant to KQ 2 through searches of MEDLINE (via PubMed), EMBASE, and CINAHL (Figures 1 and 2). An additional 2 articles for KQ 2 were identified through reviewing bibliographies of relevant review articles for a total of 6,913 articles.

For KQ 1 and KQ 3, after applying inclusion and exclusion criteria to titles and abstracts, 100 articles remained for full-text review. Of these, 9 unique studies were retained for data abstraction (Figure 1). One study was an individual randomized trial, 4 were cluster-randomized clinical trials (RCTs), 3 were controlled before-after studies, and 1 was an interrupted time-series study. All studies were conducted in Europe.

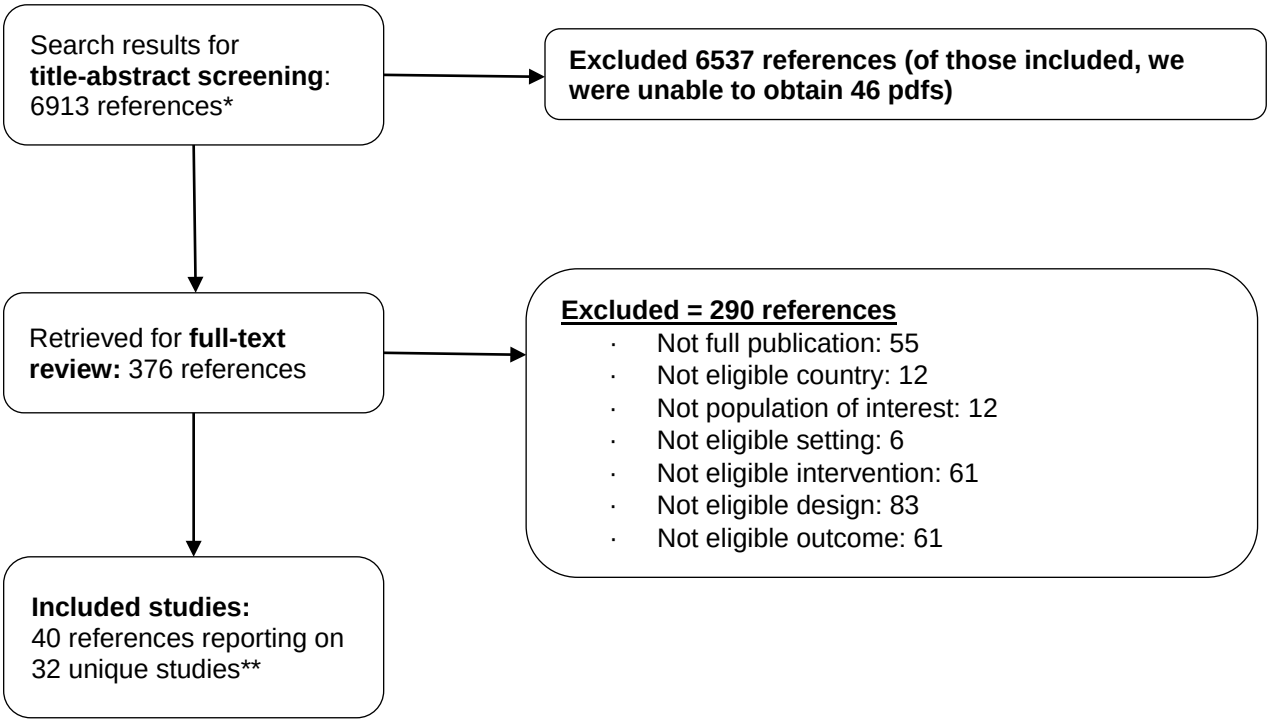
Figure 1. Literature Flow Diagram for KQ 1 and KQ 3



* Search results from MEDLINE (2,289), EMBASE (2,662), and CINAHL (961) were combined, removing duplicate articles (886)
** Some studies addressed more than one key question (6).

For KQ 2, after applying inclusion and exclusion criteria to titles and abstracts, 330 articles remained for full-text review. Of those, 32 unique studies were retained for data abstraction (Figure 2). Six were EPOC criteria studies, 17 were qualitative, 4 were mixed-methods, 1 was an organizational case study, and 4 were systematic reviews. The studies were conducted in Europe or Australia. The systematic reviews reported on studies conducted in multiple countries including the United States, Canada, and New Zealand.

Figure 2. Literature Flow Diagram for KQ 2



* Search results from MEDLINE (4,108), EMBASE (3,750), and CINAHL (961) were combined, removing duplicate articles (1,906)
** Some studies addressed more than one key question (6).

EVIDENCE PROFILE

Table 2 shows the evidence profile of studies included in this systematic review. Appendix B presents detailed intervention characteristics for included studies. Appendix C contains detailed study characteristics for included studies. Appendix D lists the excluded studies and reasons for exclusion.

Table 2. Evidence Profile for Studies of Remote Triage Interventions for Adults

	Randomized (n=5)	Nonrandomized (n=4)	Other (n=26)
Study design	1 Randomized 4 Cluster-randomized	3 Controlled before-after 1 Interrupted time series	17 Qualitative 4 Mixed methods 1 Organizational case study 4 Systematic reviews[a]
Number of encounters	42,740	484,273	765
Region	5 Europe 0 US 0 Australia 0 Other	4 Europe 0 US 0 Australia 0 Other	11 Europe, UK 8 Europe, other 2 Australia 1 Multiple 0 US

	Randomized (n=5)	Nonrandomized (n=4)	Other (n=26)
Population	0 Adults only 2 Adults and children 3 NR	0 Adults only 3 Adults and children 1 NR/NA	13 Adults only 2 Adults and children 12 NR
Median age (range)	43.1 (41.5 to 44.7) 3 studies NR 1 study reported age in several categories	NR (0 to 75) 2 studies NR 1 study reported age in several categories	48.7 (<1 to 95) 14 studies NR
Sex %	60% Women 2 studies NR	55% Women 2 studies NR	36% Women 15 studies NR
Race %	51% White <1% Black 4 studies NR	87% White NA % Black 3 studies NR	96% White 4% Black 21 studies NR
Insurance type	0 Private insurance 0 Medicaid/Medicare 2 Other government health care 0 None 3 studies NR	0 Private insurance 0 Medicaid/Medicare 3 Other government health care 0 None 1 study NR	0 Private insurance 0 Medicaid/Medicare 10 Other government health care 0 None 12 studies NR
Triage delivery mode	5 telephone 0 internet	4 telephone 0 internet	21 telephone 1 internet
Staff delivering triage service	3 MD 1 Nurse Practitioner 1 RN 2 Nurse (credentials unspecified) 0 LPN/LVN 1 Admin/receptionist 1 Other (0 studies NR)	0 MD 0 Nurse Practitioner 1 RN 2 Nurse (credentials unspecified) 0 LPN/LVN 1 Admin/receptionist 1 Other (0 studies NR)	6 MD 2 Nurse Practitioner 5 RN 11 Nurse (credentials unspecified) 0 LPN/LVN 2 Admin/receptionist 8 Other (1 study NR)
Outcomes reported	Case resolution: 3 Resolved during call 3 Triaged to primary care 2 Triaged to ED Health care utilization: 4 ED visits 5 Primary care visits Process of care: 2 Patient safety events 3 Patient satisfaction 3 Cost	Case resolution: 2 Resolved during call 2 Triaged to primary care (included 1 Triaged to ED Health care utilization: 3 ED visits 2 Primary care visits Process of care: 0 Patient safety events 1 Patient satisfaction 1 Cost	Qualitative analysis of best practices: 19 Planning 11 Execution 14 Evaluation 14 People 27 Process 8 Technology
Risk of bias	Objective[b]: 1 High risk 1 Unclear risk 3 Low risk 0 NA Patient-reported[c]: 2 High risk 1 Unclear risk 0 Low risk	Objective: 1 High risk 1 Unclear risk 1 NA Patient-reported: 1 High risk 0 Unclear risk 0 Low risk 3 NA	Appropriate approach: 21 Yes 0 Unclear Adequate data collection: 19 Yes 2 Unclear Findings derived from data: 19 Yes

	Randomized (n=5)	Nonrandomized (n=4)	Other (n=26)
	2 NA	Interrupted time series: 1 Low risk	2 Unclear Results substantiated by data: 21 Yes 0 Unclear Coherence between data and interpretation: 19 Yes 2 Unclear

[a] Data from included systematic reviews are not reported in this table.
[b] Objective outcomes (*ie*, non–patient-reported outcomes) are not subject to a large degree of individual interpretation.
[c] Patient-reported outcomes are directly reported by the patient without interpretation of the patient's response.
Abbreviations: ED=emergency department; LPN=licensed practical nurse; LVN=licensed vocational nurse; MD-medical doctor; NA=not applicable; NR=not reported

PATTERNS OF OUTCOME REPORTING

KQ 1—Effects of Remote Triage

With guidance from our Operational Partner and Technical Expert Panel, we prioritized outcomes for KQ 1 as health care utilization, case resolution, patient safety, patient satisfaction, and cost. Within each outcome section, we group results by the overall type of comparison drawn in each study. These categories include the mode of interaction between patient and practitioner, triage professional type, and level of triage organization (Table 3). Of the studies that met eligibility criteria for KQ 1, only 2 modes of triage delivery were described: in-person and over the telephone. The studies that compared professional type evaluated nonclinical call handlers, nurse call handlers, and GP call handlers. Within the level of organization category, studies compared triage systems that were embedded within local primary care practices and systems operated on a regional or national level.

Table 3. Definitions of Remote Triage Comparison Types

Comparison Type	Definition
Mode	Studies that compare triage delivered by different modes. The modes evaluated in the included studies are in-person and telephone.
Professional type	Studies that compared triage systems delivered primarily by different types of professionals. The types of professionals evaluated in the included studies are nonclinical call handler, nurse, and general practitioner.
Organizational level	Studies that compare triage systems implemented at different levels of organization. The included studies evaluated triage systems implemented at the local level imbedded within primary care centers, at the regional level, and at the national level.

KQ 2—Best Practices for Remote Triage

Similarly for KQ 2, our stakeholders provided guidance for the outcome framework of best practice phases: planning, execution, and evaluation (Table 4). The KQ 2 results section is organized using this framework as well as the subcategories of the 3 aspects of best practice defined as people, process, and technology.

Table 4. Framework for Organizing Best Practice Considerations for Remote Triage

Framework Domain	Definition
Planning for remote triage launch	Current problem, scope, and resources needed to prepare for innovation (happens before interactions with patients); the thinking, curating, and planning prior to testing the remote triage innovation
Planning for people	Anticipated human capital needed to build the innovation
Planning for processes	Policies, procedures, and infrastructures that need to be in place to launch innovation
Planning for technologies	Hardware and software needed to prepare to launch the innovation
Execution of remote triage	Activities needed to execute the innovation
Implementation of people	Anticipated human capital needed to execute the innovation
Implementation of processes	Day-to-day activities needed to sustain the innovation
Implementation of technologies	Hardware and software needed to sustain the innovation
Evaluation of remote triage	Appraisal or assessment of the innovation; can include summative or formative evaluation
Evaluation of people	Assessing the appropriateness of the human capital needed to execute the innovation (*eg*, staff performance, staff training, quantity and type of personnel)
Evaluation of processes	Assessing the protocol, procedures, and infrastructure needed for the innovation
Evaluation of technologies	Assessing how well the innovation hardware and software performed (*eg*, proper quantity, performance issues, proper type)

KQ 3—Assessment of Remote Triage

As described in our methods, we used 6 categories adapted from Carrasqueiro et al[36] to structure our results for KQ 3.

Next, we describe the findings for each KQ. For detailed intervention characteristics for KQ 1 and KQ 2 studies, see Appendix B. For detailed study characteristics for KQ 1 and KQ 2 studies, see Appendix C.

KEY QUESTION 1:

A. For adults, what are the effects of remote triage on health care utilization, case resolution, patient safety, patient satisfaction, and cost?

B. What is the impact of remote triage by different modalities (*eg*, telephone, video, web, SMS)?

Characteristics of Included Studies

Table 5 gives an overview of the 9 studies included for KQ 1, ordered by author.[37-45] Eight studies assessed the effects of remote triage on health care utilization,[38-45] 4 on case resolution,[40,41,43,44] 2 on patient safety,[38,43] 4 on patient satisfaction,[37,38,42,44] and 3 on cost.[38,40,41]

Five studies were RCTs,[38,40,42-44] 3 were controlled before-after studies,[37,39,45] and 1 was an interrupted time-series study.[41] Of the RCTs, 1 was randomized at the individual level,[42] and 4 were cluster RCTs.[38,40,43,44] The sample size of studies ranged from 388 to 1,802,000 with a median of 14,492 participants. In 4 studies the unit of enrollment was patients,[40-42,44] in 3 it was triage phone calls,[39,43,45] and in 1 it was after-hours periods for the involved practices.[38] The risk of bias (ROB) for objective outcomes in 2 studies was rated as unclear,[38,39] in 4 studies as low,[40-43] and in 2 studies as high.[44,45] One study did not report objective outcomes.[37] The ROB for patient-reported outcomes in 3 studies was rated as high[37,42,44] and in 1 study as unclear.[38] Five studies did not describe patient-reported outcomes.[39-41,43,45]

Comparisons, study type, and outcomes were too varied to conduct meta-analysis, but we were able to calculate mean differences (MD) and risk ratios (RR) for 7[38-44] of the 9 studies. We narratively synthesized studies, focusing on the randomized studies first, and organized by type of comparisons tested. When possible, we calculated MD and display estimates on forest plots, grouped by comparison.

Table 5. Overview of KQ 1 studies

Study	Study Design	Comparison Type	Outcomes Reported	Companion Papers
Campbell, 2014[38]	RCT: Cluster randomization	Mode Professional type	Utilization Patient safety Patient satisfaction Cost	Kreuter, 2016[46] Buja, 2016[47] Nyamtema, 2017[48] Thomson, 2006[49] Olden, 2017[50] Wang, 2016[51] Grustam, 2014[52] Raymond, 2014[53]
Cragg, 1997[44]	RCT: Cluster randomization	Organizational level	Utilization Case resolution Patient satisfaction Cost	McKinley, 1997[54] Holly, 2012[55]
Knowles, 2016[37]	Controlled before-after	Professional type	Patient satisfaction	Mollerup, 2016[56] De Rosa, 2015[57]
Lattimer, 1998[43]	RCT: Cluster randomization	Professional type	Utilization Case resolution	Lear, 2010[58]

Study	Study Design	Comparison Type	Outcomes Reported	Companion Papers
			Patient safety	
McKinstry, 2002[42]	RCT: Individual randomization	Mode	Utilization Patient satisfaction	None
Munro, 2000[45]	Controlled before-after	Organizational level	Utilization	None
Richards, 2004[40]	RCT: Cluster randomization	Organizational level	Utilization Case resolution Cost	None
Richards, 2002[41]	Interrupted time series	Mode	Utilization Case resolution Cost	Joschko, 2018[59]
Turner, 2013[39]	Controlled before-after	Professional type	Utilization	None

Effects of Remote Triage on Health Care Utilization: Key Points

- Utilization of health care was the most common metric reported across the included studies. Eight studies assessed the impact of remote triage on health care utilization; of those, 7 measured primary care utilization and 7 measured emergency department (ED) utilization after initial consultation. These studies assessed GP face-to-face consultation compared with telephone triage (n=3 studies), call handler professional type (n=3), and relationship of call handler to patient panel (*ie*, organizational level) (n=3).
- The majority of studies showed no reduction in health care utilization.
    - Only 1 nonrandomized study rated as high ROB reported a decrease in primary care utilization resulting from remote triage intervention. Four studies reported an increase in primary care utilization among patients in the telephone remote triage intervention group. Three reported a nonsignificant reduction in primary care utilization.
    - No studies found a decrease in ED utilization resulting from remote triage intervention. One nonrandomized study reported an increase in emergency visits among patients in the telephone remote triage intervention group.
- None of the studies that met KQ 1 eligibility criteria addressed modalities of triage delivery other than in-person and telephone. As a result, we were unable to address KQ 1B, the impact of remote triage by different modalities such as video, web, and SMS.

Detailed Findings

We describe the 8 studies that assessed the effects of remote triage on health care utilization.[38-45] Seven studies measured health care utilization as primary care visits (continuous).[38-42,44,45] Seven studies also measured ED utilization (both continuously and categorically).[38-43,45]

Utilization of Primary Care Services

Four randomized[38,40,42,44] and 3 nonrandomized[39,41,45] studies assessed the impact of remote triage on subsequent utilization of primary care (Figure 3). These studies evaluated telephone mode (3 studies[38,41,42]); impact of the triage professional (1 study[39]); and organizational relationship (3 studies[40,44,45]). Overall only 1 study,[45] a controlled before-after study rated high ROB, demonstrated a reduction in utilization of primary care services attributable to the tested telephone triage system. Four studies reported statistically significant increase in primary care utilization in the telephone triage condition compared to standard care conditions.[38,39,41,42] Three studies showed a nonsignificant effect of the triage interventions.[39,40,44] One study reported insufficient information to calculate a point estimate for utilization on forest plots.[45]

Comparison by Mode of Remote Triage

The first study to assess the impact of mode was a pragmatic, 3-arm cluster RCT of the effectiveness of GP-led and nurse-led telephone triage compared with usual care for patients seeking same-day consultations in primary care.[38] Telephone triage delivered by a GP (33% increase) or nurse (48% increase) was associated with an increase in the number of primary care contacts in the 28 days after a patient's request for a same-day GP consultation compared with usual care. The next RCT was conducted to investigate how the use of GP-led telephone consultations impacts the management of requests for same-day appointments.[42] This study found a statistically significant increase in subsequent use of primary care utilization in the telephone group in the 2 weeks that followed initial consultation (0.2 increase in number of consultations). The last study was a multiple interrupted time-series study that assessed the impact of nurse telephone triage versus standard management of requests for same-day appointments in routine primary care.[41] More patients in the telephone triage system returned for primary care within 1 month of the initial appointment request (MD 0.32, $p<0.001$ for return primary care visit; MD 0.04, $p=0.005$ for after-hours primary care) (Figure 3).

Comparison by Professional Type of Call Handler

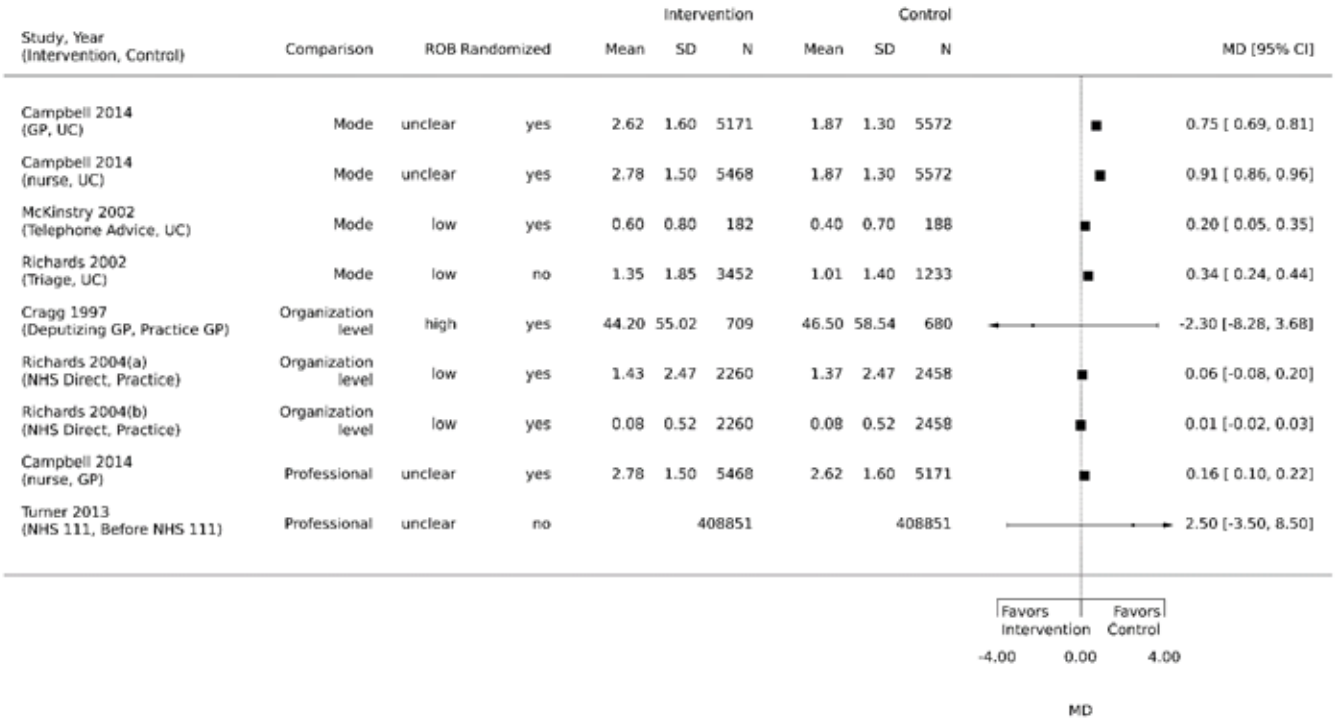
Only 2 studies assessed the impact of the call hander professional type on primary care utilization. The first was the pragmatic, 3-arm cluster RCT of the effectiveness of GP-led or nurse-led telephone triage compared with usual care for patients seeking same-day consultations in primary care.[38] Compared to nurse-led triage, GP-led triage resulted in fewer mean number of primary care contacts in the 28 days after a patient's request for a same-day GP consultation (MD 0.16, 95% CI 0.10 to 0.22). The next study was a controlled before-after assessment of the implementation of an updated national health advice line in England staffed by nonclinical call handlers (NHS 111).[39] Prior to the implementation of NHS 111, all areas in England had a 24-hour nurse-led telephone helpline called NHS Direct, which used an initial contact with a nonclinical call handler who then directed calls to a nurse triage staff either during the same call (sometimes with lengthy hold times) or via a call-back. NHS 111 differed from NHS Direct in that it was managed by nonclinical call handlers who used computerized decision support

software (CDSS) to immediately triage incoming calls, avoiding call-backs and wait times, and had the ability to direct callers to the most appropriate service or offer self-management advice. Clinicians were on site to provide backup to the nonclinical call handlers, if necessary. NHS 111 resulted in an average increase of 47 extra attendances in monthly primary care visits per 1,000 triaged calls (95% CI -66 to 156) after its introduction (Figure 3).

Comparison by Organizational Level

Three additional studies assessed different organizational levels of the relationship of the triage staff to the patient panel.[40,44,45] Of these, 1 cluster RCT compared the process of after-hours care provided by GPs from the patients' own practices to that provided by commercial deputizing services, which are commercial external agencies delegated to cover care for GPs.[44] This study found that after adjusting for age, sex, ethnic group, and access to a car, there were no significant differences in number of visits to primary care in the 2 weeks following remote triage contact (46. 5 vs 44.2, p=0.299). Another RCT assessed the relative effects on consultation workload of off-site triage by NHS Direct for patients requesting same-day appointments compared with usual onsite nurse telephone triage in general practice.[40] This study reported no differences between the intervention and usual care in the number of patients receiving further primary practice-based care (p=0.49) or after-hours care (p=0.81) within 1 month of the index consultation (Figure 3). The last organizational comparison study was a controlled before-after design that assessed NHS Direct telephone triage to GP cooperative telephone triage and reported a small but significant change in GP cooperative triage calls per month after the implementation of NHS Direct (relative change -2.9%; 95% CI -4.2% to -1.5%).[45]

Figure 3. Effects of Remote Triage on Utilization of Primary Care Services



Abbreviations: CI=confidence interval; GP=general practitioner; ROB=risk of bias; SD=standard deviation; UC=usual care

Utilization of Emergency Department Services

Four randomized[38,40,42,43] and 3 nonrandomized[39,41,45] studies assessed the impact of remote triage, on subsequent utilization of ED services. These 7 studies evaluated telephone mode (3 studies[38,41,42]); impact of triage staff profession (2 studies[39,43]); and organizational relationship of triage staff to patient panel (2 studies[40,45]). Overall, none demonstrated a reduction in utilization of ED services attributable to the tested telephone triage system. One nonrandomized study reported a statistically significant *increase* in primary care utilization in the telephone triage condition compared to standard care conditions.[41] Across these studies, comparisons and study type were too varied to conduct meta-analysis. We narratively synthesized studies, focusing on the randomized studies first and organized by type of comparisons tested. One study reported insufficient information to calculate a point estimate for utilization,[45] and 1 measured ED utilization as a categorical outcome.[43] These studies do not appear on the forest plots and are narratively synthesized in the text. Point estimates for all other studies appear in Figure 4, grouped by comparison type.

Comparison by Mode of Remote Triage

Two RCTs assessed the impact of clinical staff (*ie*, nurse, GP) administered telephone triage versus usual in-person care.[38,42] Neither trial found a difference between nurse-led or GP-led telephone triage compared to in-person consultation on ED utilization. An additional nonrandomized study assessed the impact of telephone triage mode on requests for same day appointments in routine primary care.[41] Implementation of telephone triage led to an *increase* in ED visits post-implementation (MD 0.023; 95% CI 0.015 to 0.032, $p<0.001$).

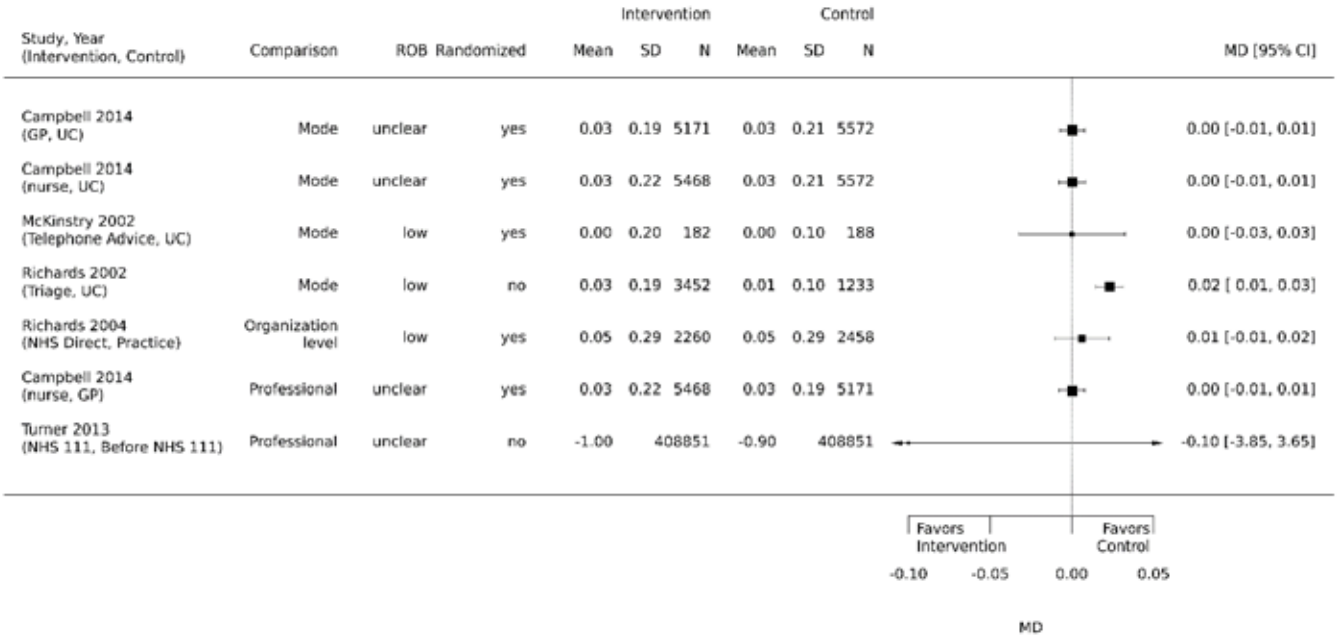
Comparison by Professional Type of Call Handler

One randomized[38] and 2 nonrandomized studies assessed the impact of triage professional type on utilization of ED services.[39,43] The first was a cluster RCT that found statistical equivalence between nurse-led triage and GP-led triage for ED use in the 3 days after telephone triage.[43] The next was a 3-arm cluster RCT of the effectiveness of GP-led or nurse-led telephone triage compared with usual care for patients seeking same-day consultations in primary care.[38] This study found no difference in ED visits 28 days after a patient's request for a same-day GP consultation (OR=0.92, 95% CI 0.67 to 1.26). The next was a controlled before-after study assessing the implementation of an updated national health advice line in England staffed by nonclinical call handlers in NHS 111 that found no change in ED utilization in the year after NHS 111.[39]

Comparison by Organizational Level

Two other studies assessed the impact of organizational level on utilization of ED services.[40,45] The first was a cluster RCT assessing off-site triage by NHS Direct for patients requesting same day appointments compared with usual onsite nurse telephone triage in general practice.[40] The study reported no difference between the intervention and usual care in the number of patients attending the ED within 1 month of initial contact (p=0.58). The next organizational comparison study was a controlled before-after study that assessed NHS Direct telephone triage compared with GP cooperative telephone triage and also reported no difference in ED use after the implementation of NHS Direct.[45]

Figure 4. Effects of Remote Triage on Utilization of Emergency Department Services



Abbreviations: CI=confidence interval; GP=general practitioner; ROB=risk of bias; SD=standard deviation; UC=usual care

Table 6 presents a summary of the impact of remote triage on utilization outcomes reported in the included studies.

Table 6. Summary of Utilization Outcomes in Remote Triage Studies

Study Design	Comparison	Results
Randomized		
McKinstry, 2002[42] 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)

Study Design	Comparison	Results
Campbell, 2014[38] Cluster-randomized	GP triage (N=5,171) vs nurse triage (N=5,648) vs usual care (N=5,572)	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[40] Cluster-randomized	Nurse triage (NHS Direct,[a] N=2,260) vs usual practice (N=2,458)	Mean number of practice consultation consultations per patient (95% CI) · 1.43 vs 1.37; Poisson regression[b], 1.04 (0.94 to 1.15) Mean number of after-hours consultation per patient · 0.082 vs 0.077; Poisson regression[b], 1.05 (0.72 to 1.52) Mean number of ED consultations per patient · 0.053 vs 0.047; Poisson regression[b], 1.10 (0.79 to 1.54)
Cragg, 1997[44] Cluster-randomized	Commercial deputized physician (N=1,082) vs longitudinal general practice physicians (N=1,037)	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[43] Cluster-randomized	Nurse triage (N=7,184) vs usual practice (N=7,308)	Attendance at ED unit within 3 days of call: · 412 (95% CI 374 to 452) vs 391[c] (equivalence limits 313 to 489)
Nonrandomized		
Turner, 2013[39] 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 NHS 111 · 2.5 (-3.5 to 8.5)
Munro, 2000[45] Controlled before-after	Total number of NHS Direct calls N=68500	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%])

Study Design	Comparison	Results
Richards, 2002[41] Interrupted time-series	Nurse triage (, N=3,452) vs usual practice (N=1,233)	Emergency department visits within one 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 one month of initial management; mean, (SD) · 1.35 (1.85) vs 1.01 (1.4) mean difference: 0.34

[a] NHS Direct is the first generation of a national 24-hour nurse-led telephone helpline in England.
[b] The value of no effect for a Poisson regression is 1.00.
[c] adjusted for difference in denominator
Abbreviations: CI=confidence interval; ED=emergency department; GP=general practitioner; NHS=National Health Service; SD=standard deviation

Effects of Remote Triage on Case Resolution: Key Points

- Compared with local, practice-based telephone triage services, regional or national telephone-based remote triage services may refer higher percentages of callers to additional primary care services.
- Compared with regional or national telephone-based remote triage services, local practice-based telephone triage services resolve more calls during the initial contact without referral to emergency or primary care services.
- Only 1 study assessed the rate of referral to emergency services. In that study, both local and regional/national telephone-based remote triage services referred very low numbers of patients to emergency services.

Detailed Findings

Four studies assessed the effects of remote triage on case resolution.[40,41,43,44] In these studies, people who contacted remote triage services received 1 of 3 possible resolutions to their call: they were triaged to either emergency services or primary care services (including urgent care visits, home visits, or primary care clinic visits whether after-hours, the same day, or on a future date), or they achieved resolution of their health concern during the initial contact.

Three of the 4 were cluster RCTs involving a total of 21,362 patients.[40,43,44] The fourth was an interrupted time-series study of 4,685 patients by the same authors as 1 of the cluster RCTs using a similar population.[41] One study, the interrupted-time series, evaluated mode of triage delivery through in-person triage as compared to nurse telephone triage.[41] One study evaluated triage professional type; specifically, a nurse telephone triage system compared to a GP telephone triage system.[43] Two studies looked at the organizational level of the triage service comparing regional or national remote telephone triage services to local, practice-based telephone triage services. Both local, practice-based services differed from the other.[40,44]

Only 1 study reported the proportion of patients triaged to emergency services by either triage service,[44] while all 4 studies reported both the proportion of patients triaged to additional primary care services and achieving resolution during the initial call. Overall, case resolution outcomes

from 1 of the 3 cluster RCTs was rated to be at high ROB,[44] while outcomes in 2 studies were deemed low ROB.[40,43] The case resolution outcomes in the interrupted time-series study were also deemed low ROB.[41]

Triage to Emergency Department Services

In 1 study evaluating level of triage organization and triage to emergency services, very few callers in either arm were referred directly to emergency services, representing 14 of 1,082 callers (1.3%) in the deputized service arm, compared to 4 of 1,037 (0.4%) in the practicing physician arm.[44] Appropriateness of these referrals to emergency services by either triage method was not evaluated.

Triage to Primary Care Services

All 4 studies reported rates of referral to in-person primary care services (Figure 5).[40,41,43,44] Two RCTs referred higher rates of callers to primary care services than usual practice coverage.[40,44] Lower rates were reported in the third cluster RCT.[43] This third trial was an equivalence study of the safety of a nurse triage service compared to physician triage, and therefore these rates were not studied for superiority.[43]

Comparison by Mode of Remote Triage

The interrupted time-series study compared the triage mode using telephone nurse triage service versus the current practice standard of assigning patients to same-day appointments with GPs.[41] This comparison showed fewer appointments being scheduled in primary care with a triage service (2,339 of 3,452 callers, or 67.8%) than in trying to accommodate as many callers as possible within open appointment slots in the primary care setting (1,072 of 1,233 callers, or 86.9%).

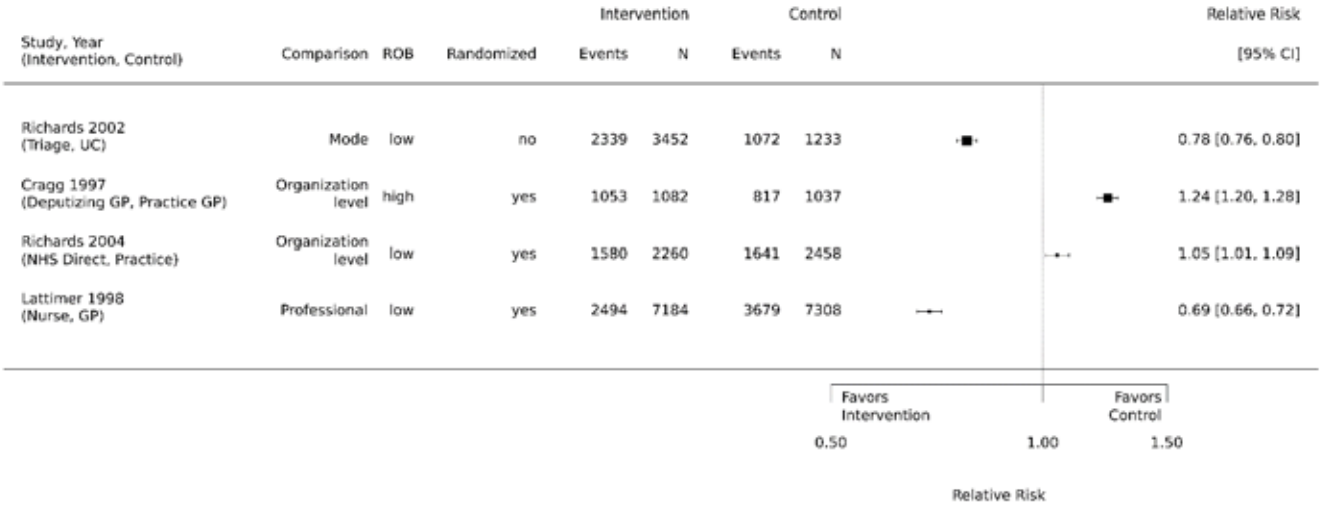
Comparison by Professional Type of Call Handler

The cluster RCT evaluating triage professional type using trained nurse-led versus standard practice GP-led after-hours remote triage scheduled 2,494 of 7,184 (34.7%) callers in the nurse triage arm to a primary care service, as compared to 3679 of 7,308 (50.3%) callers in the standard practice GP-led arm.[43] This reduction in primary care service use in the nurse-led triage arm represented a 38% reduction in primary care visits and a 23% reduction in home visits during the intervention period.

Comparison by Organizational Level

Two RCTs evaluated triage systems at different organizational levels. One cluster RCT that compared the NHS Direct triage service to the local practice triage service during usual office hours[40] assigned 1,580 of 2,260 (69.9%) NHS Direct callers to a same-day primary care service, while usual practice nurse triage assigned 1641 of 2458 (66.8%) callers to same-day primary care services—a 3.2% increase relative in the NHS Direct arm. The other cluster RCT of after-hours remote triage services using commercial deputized versus practice physicians[44] found 1,053 of 1,082 callers (97.3%) in the deputizing physician arm were triaged to either home visitation after-hours or urgent care center evaluation. Alternatively, only 817 of 1,037 (78.8%) callers in the general practice physician arm were referred to primary care services.

Figure 5. Effects of Remote Triage on Cases Triaged to Primary Care



Abbreviations: CI=confidence interval; GP=general practitioner; NHS=National Health Service; ROB=risk of bias; UC=usual care

Case Resolution During Initial Contact

All 4 studies reported the rates of call resolution during initial contact (Figure 6). Call resolution during initial contact means that calls did not require triage to either emergency or primary care services. In the 2 cluster RCTs,[40,44] remote telephone triage in the local practice-based triage service arms resolved more calls during the initial contact than did the regional or national triage intervention arms. In one RCT, the GP-led triage resolved more calls compared to the nurse-led triage.[43] The interrupted time-series study of a triage nurse line resolved more calls during the initial contact than the comparison practice model of maximizing attendance at same-day appointments.[41]

Comparison by Mode of Remote Triage

The interrupted time-series studying mode through a triage nurse service compared to assignment into same-day appointments resolved 1,113 of 3,452 (32.2%) calls in the nurse triage arm, compared with 161 of 1,233 of calls in the usual practice appointment arm (13.1%, RR 2.41 for resolution with NHS Direct, 95% CI 2.08 to 2.80).[41]

Comparison by Professional Type of Call Handler

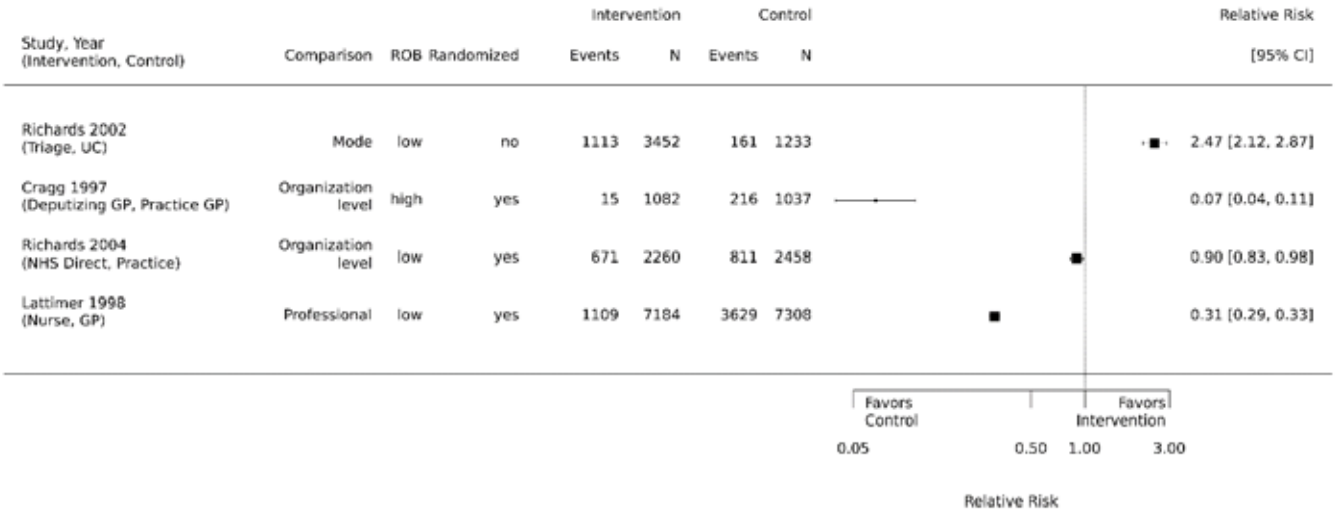
Similarly, the RCT examining triage professional type through trained nurse-led versus physician-led after-hours remote triage resolved 1,109 of 7,184 (15.4%) calls in the nurse triage arm, versus 3,629 of 7308 (49.7%) calls in the physician-led arm.[43]

Comparison by Organizational Level

Two RCTs evaluated triage organizational level. One study using a commercial deputized physician group versus local practice physicians resolved only 15 of 1,082 calls (1.4%) in the deputizing physician arm compared to 216 of 1,037 in the practice physician arm (20.8%).[44] The

other RCT comparing the NHS Direct triage service to practice-based triage during regular office hours resolved 671 of 2,260 (29.7%) calls in the NHS Direct arm, while usual practice triage resolved 811 of 2,458 (33.0%) calls—a 3.3% increase in case resolution.[40]

Figure 6. Effects of Remote Triage on Cases Resolved on Initial Contact



Abbreviations: CI=confidence interval; GP=general practitioner; ROB=risk of bias; UC=usual care

Table 7 presents a summary of the impact of remote triage on case resolution outcomes reported in the included studies.

Table 7. Summary of Case Resolution Outcomes in Remote Triage Studies

Study Design	Comparison	Case Resolution Rate (%)
Randomized		
Cragg, 1997[44] Cluster-randomized	Commercial deputized physician (n=1,082) vs longitudinal general practice physicians (n=1,037)	Referred to emergency services: · 14 of 1,082 (1.3%) vs 4 of 1,037 (0.4%) Referred to primary care services: · 1,053 of 1,082 (97.3%) vs 817 of 1,037 (78.8%) Resolved during initial contact without referral: · 15 of 1082 (1.4%) vs 216 of 1,037 (20.8%)
Lattimer, 1998[43] Cluster-randomized	Nurse triage (n=7,184) vs GP triage usual practice (n=7,308)	Referred to primary care services: · 2,494 of 7,184 (34.7%) vs 3,679 of 7,308 (50.3%) Resolved during initial contact without referral: · 1,109 of 7,184 (15.4%) vs 3,629 of 7,308 (49.7%)
Richards, 2004[40] Cluster-randomized	Nurse triage (NHS Direct, n=2,260) vs usual practice nurse triage (n=2,458)	Referred to primary care services:

Study Design	Comparison	Case Resolution Rate (%)
		· 1,580 of 2,260 (69.9%) vs 1,641 of 2,458 (66.8%), risk difference 3.15% Resolved during initial contact without referral: · 671 of 2,260 (29.7%) vs 811 of 2,458 (33.0%); risk difference -3.30%
Nonrandomized		
Richards, 2002[41] Interrupted time-series	Nurse triage (n=3,452) vs usual practice same-day appointment assignment (n=1,233)	Referred to primary care services: · 2,339 of 3,452 (67.8%) vs 1,072 of 1,233 (86.9%) Resolved during initial contact without referral: · 1,113 of 3,452 (32.2%) vs 161 of 1,233 (13.1%), RR 2.41 (95% CI 2.08 to 2.80)

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

Effects of Remote Triage on Patient Safety: Key Points

- Only 2 studies addressed safety outcomes including accident and ED visits, emergent hospitalization, and death.
- Neither study identified statistically significant differences in safety outcomes among study arms, although there were significant methodologic differences between the trials.

Detailed Findings

Two RCTs addressed the effects of remote triage on patient safety.[38,43] One trial included patients calling to request same-day appointments and evaluated safety as a secondary outcome,[38] while the other included patients calling during specified after-hours and reported patient safety events as a primary outcome.[43] Both studies were cluster RCTs. In one, randomization was at the level of individual after-hours periods.[43] Both trials included emergent hospitalization and death in their safety outcomes, although the follow-up period for some of these outcomes differed between the studies. One study was rated as unclear ROB,[38] and 1 was rated as low ROB.[43]

One study primarily evaluated the mode of remote triage through comparing nurse or GP-led triage systems to in-person usual care. However, this 3-arm study also evaluated triage professional type by comparing between the nurse-led and the GP-led arms for hospitalization and ED attendance. There was no statistical difference between these groups.[38] Both trials compared professional type, although with different approaches. The second study similarly showed no difference in safety outcomes between nurse triage and GP-led usual care.[43]

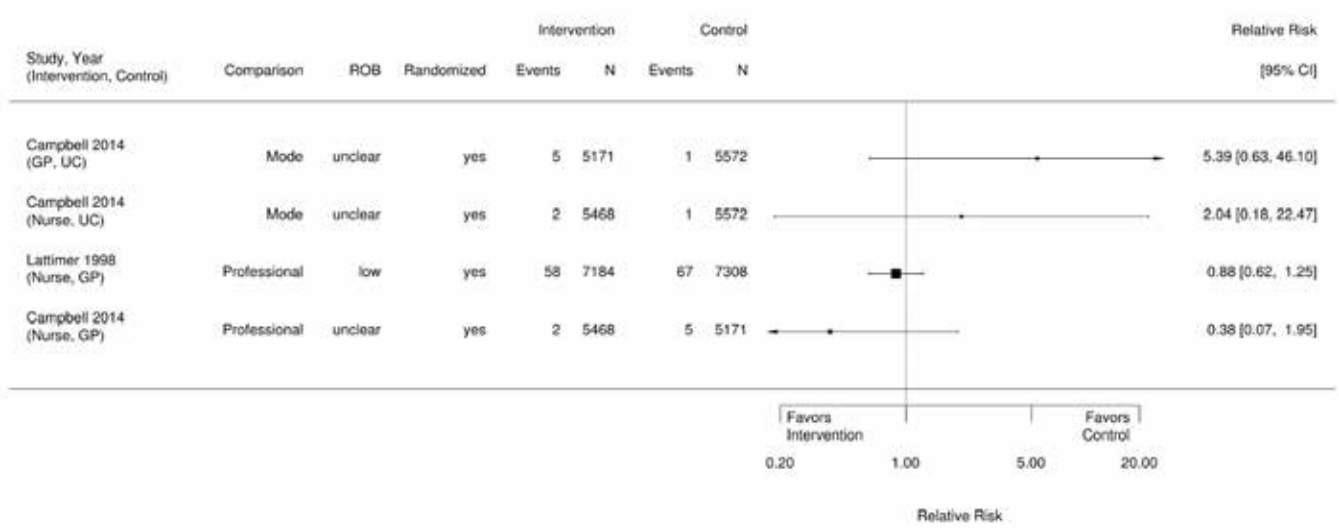
Patient Deaths

The trial that examined patient safety events as a secondary outcome had 3 arms: telephone triage by nurse, telephone triage by GP, and usual care.[38] There were a total of 8 deaths reported in the follow-up time period of 7 days post-contact (GP triage n=5, 0.07%, nurse triage n=2,

0.03%, and usual care n=1, 0.01%). The authors reported that 2 independent adjudicators determined that the deaths were not associated with the trial group or procedure. They did not report any statistical comparison between groups (Figure 7).[38]

The other trial compared patients who received usual care telephone management by a GP with telephone-based nurse triage.[43] This equivalence trial found no difference in death within 7 days between those in the control group (n=66, equivalence 53 to 83) and intervention (n=58, 95% CI 44 to 75); hospital admission measured at 24 hours (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).

Figure 7. Effects of Remote Triage on Patient Deaths



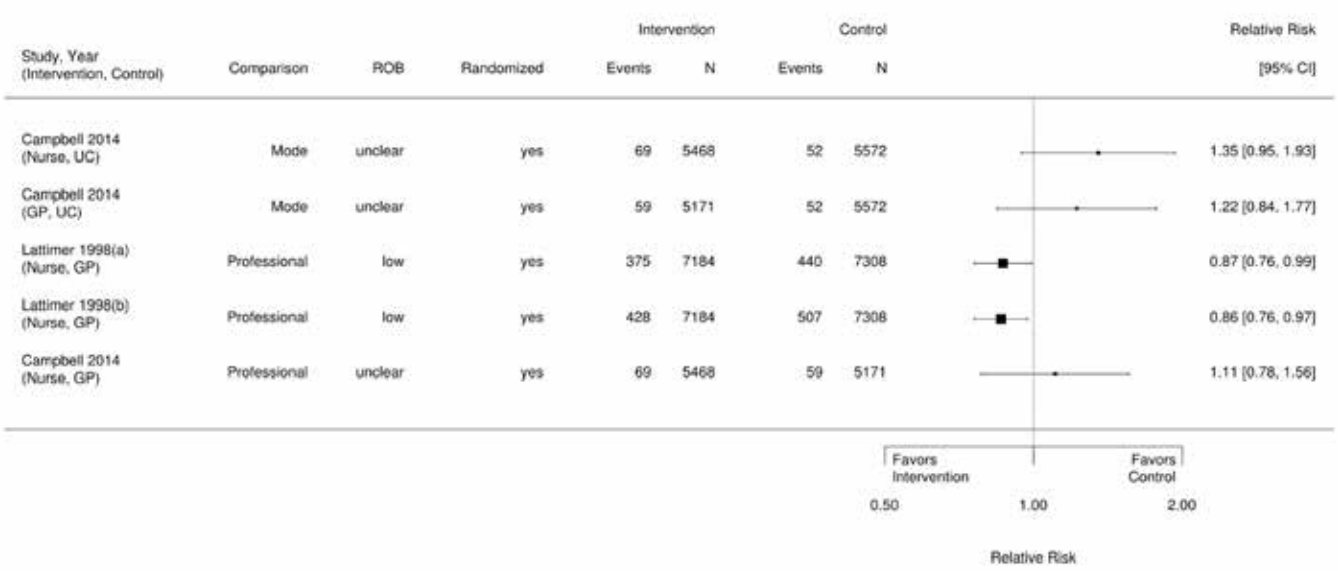
Abbreviations: CI=confidence interval; GP=general practitioner; ROB=risk of bias; SD=standard deviation; SD=standard deviation; UC=usual care

Hospitalizations

For the 3-arm RCT comparing both mode and professional type, approximately 1% of patients in each group had at least 1 emergency hospital admission within 7 days of triage: GP triage n=59 (1.1%), nurse triage n=69 (1.2%), and usual care n= 52 (0.9%) (Figure 8). When compared to patients receiving usual care, telephone triage was associated with a nonsignificant trend toward increased admissions when the triage was performed by either GPs (OR 1.17, 95% CI 0.75 to 1.85) or nurses (OR 1.31, 95% CI 0.83 to 2.07). There was similarly no significant difference between patients who received nurse telephone triage compared to GP telephone triage (OR 1.12, 95% CI 0.73 to 1.72).[38]

The other trial compared professional type through evaluating patients who received usual care telephone management by a GP with telephone-based nurse triage.[43] This equivalence trial found no difference hospital admission measured at 24 hours (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).

Figure 8. Effects of Remote Triage on Hospitalizations

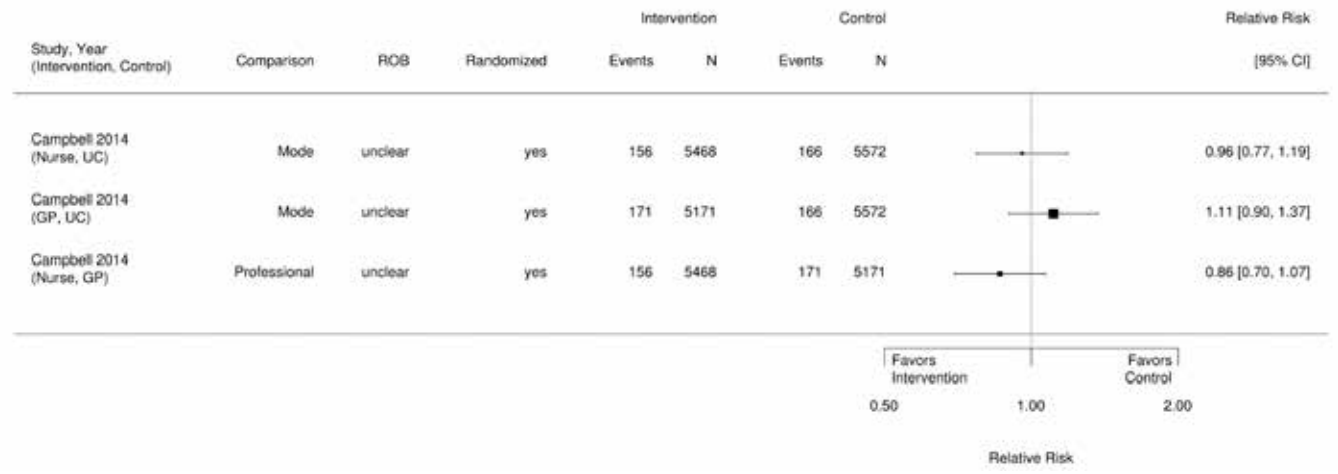


[a] Number of hospital admissions within 24 hours of index contact.
[b] Number of hospital admissions within 3 days of index contact.
Abbreviations: CI=confidence interval; GP=general practitioner; ROB=risk of bias; UC=usual care

Emergency Department Visits

The RCT comparing both mode and professional type found that approximately 3% of patients in each group had at least 1 ED visit during the 28-day study period (GP triage n=171 (3.3%), nurse triage n=156 (2.8%), or usual care n=166 (3.0%)) (Figure 9). There were similar nonsignificant trends in patients with an ED visit when comparing nurse triage to usual care (OR 1.09, 95% CI 0.80 to 1.49), GP triage to usual care (OR 1.18, 95% CI 0.87 to 1.61), or nurse triage to GP triage (OR 0.92 95% CI 0.67 to 1.26).[38]

Figure 9. Effects of Remote Triage on Emergency Department Visits



Abbreviations: CI=confidence interval; GP=general practitioner; ROB=risk of bias; UC=usual care

Notably, the rates of recorded, emergent hospital admission and death were much greater in 1 trial.[43] This was true despite the shorter follow-up window for ED visit (3 days vs 28 days) and

hospital admission (3 days vs 7 days). There was also higher mortality in this trial (overall 0.86% vs 0.048%[38]), although the observed mortality was similar to the expected population mortality rate cited in their methods and power calculation (110 deaths per 10,000 population[43]). Multiple factors including trial design, patient population, and study time period potentially contributed to these differences. For example, the trial with the lower mortality rates included only patients calling to request a same-day visit, and patients seeking emergency care were excluded.[38] Patients were not excluded based on the reason for calls, and patients with potentially urgent or life-threatening conditions may have been included in this trial but excluded from the other.

One trial did not report rates of chronic illness or comorbidities in their patient population, although a higher percentage of patients were elderly in the trial with the higher estimate of safety events (≥75 years of age, 13% compared with 10.2%).[43] Finally, the trial with the higher rates of safety events[43] was performed more than a decade before the trial with the lower rates.[38]

Table 8 presents a summary of the impact of remote triage on patient safety outcomes reported in the included studies.

Table 8. Summary of Patient Safety Outcomes in Remote Triage Studies

Study	Comparison and Follow-up Period	Results
Mortality		
Campbell, 2014[38]	GP triage (N=5,171) vs nurse triage (N=5,648) vs usual care (N=5,572) 28 days	Number of deaths per arm (per 1000) · GP triage n=5 (0.7 deaths per 1000) · Nurse triage n=2 (0.3 deaths per 1000) · Usual care n=1 (0.1 deaths per 1000)
Lattimer, 1998[43]	Nurse triage (n=7,184) vs GP triage usual practice (n=7,308) 7 days	Number of deaths per arm (percent), (95% CI) · Nurse triage n=58[a] (0.8%), (44 to 75) · Control group n=66[a] (0.9%), (80% to 125%; equivalence 53 to 83)
Hospitalization		
Campbell, 2014[38]	GP triage (N=5,171) vs nurse triage (N=5,648) vs usual care (N=5,572) 7 days	Number of hospitalizations after index contact per arm (percent) · GP triage n=59 (1.1%) · Nurse triage n=69 (1.2%) · Usual care n=52 (0.9%)
Lattimer, 1998[43]	Nurse triage (n=7,184) vs GP triage usual practice (n=7,308) 3 days	Number of hospitalizations after index contact per arm (percent), (95% CI) · Nurse triage 428 (6.0%),[b] (390 to 468) · Usual care 498 (6.8%), (80% to 125%; equivalence 398 to 623)
Emergency department visits		
Campbell, 2014[38]	GP triage (N=5,171) vs nurse triage (N=5,648) vs usual care (N=5,572) 28 days	Number of ED visits after index contact per arm (percent) · GP triage n=171 (3.3%) · Nurse triage n=156 (2.8%) · Usual care n=166 (3.0%)

[a] Unable to calculate percentage because the number of patients are not reported per arm
[b] Percentages calculated based on the total number of calls

Effects of Remote Triage on Patient Satisfaction: Key Points

- Four studies assessed patient satisfaction with remote triage. There was great diversity of outcomes measured under the construct "patient satisfaction"; no outcome was evaluated by more than 1 study.
- No clear pattern emerged about the effects of remote triage on patient satisfaction. Some evidence supports that patient satisfaction is influenced by the degree of concordance between the service patients receive and the service they expected (*eg*, same-day vs after-hours advice).

Detailed Findings

Four studies assessed the effects of remote triage on patient satisfaction.[37,38,42,44] Of these, 3 were randomized controlled trials (RCTs; 1 individual randomization[42] and 2 cluster randomization[38,44]) and 1 was a controlled before-after study.[37] The comparisons drawn in each study differed substantively. Specifically, outcomes included difference in satisfaction by modality,[38,42] triage professional type,[37,38] and organizational level of triage service[44]. Three studies examined patient satisfaction among patients calling their practices for same-day appointments or after-hours care,[38,42,44] and 1 study looked at satisfaction before-after the introduction of a new type of triage service for emergency and urgent care within the UK's National Health Service (NHS) system.[37] Of these studies, 1 RCT was found to have unclear ROB for patient reported outcomes.[38] The other 2 RCTs were rated as high ROB.[42,44] The controlled before-after study was also rated as high ROB.[37]

Comparison by Mode of Remote Triage

One 3-arm trial evaluated triage mode as well as triage professional type, depending on arm.[38] Questionnaires about patients' experience of care were mailed after 4 weeks. Of the 16,211 patients included in primary analyses, 12,132 (74.8%) returned completed questionnaires for analysis. Patient satisfaction was measured with a single question on the questionnaire: "Overall, how satisfied or dissatisfied were you with the care received on that day?" rated on a 5-point Likert scale from "very satisfied" to "very dissatisfied." Satisfaction was observed to be significantly lower for nurse triage compared to both GP triage and usual care (Figure 6).[38] In another trial evaluating triage modality, patients were mailed a questionnaire asking whether they would be willing to use telephone contact for a similar problem in future, and a 5-item Patient Enablement Instrument (PEI)[60] that measured how well they felt the consultation improved their ability to cope with and manage their medical problem. Approximately half the patients said they would be willing to use telephone contact for similar problems in the future, and there were no significant differences between the groups on this outcome or on the overall PEI score (Figure 10).[42]

Comparison by Professional Type of Call Handler

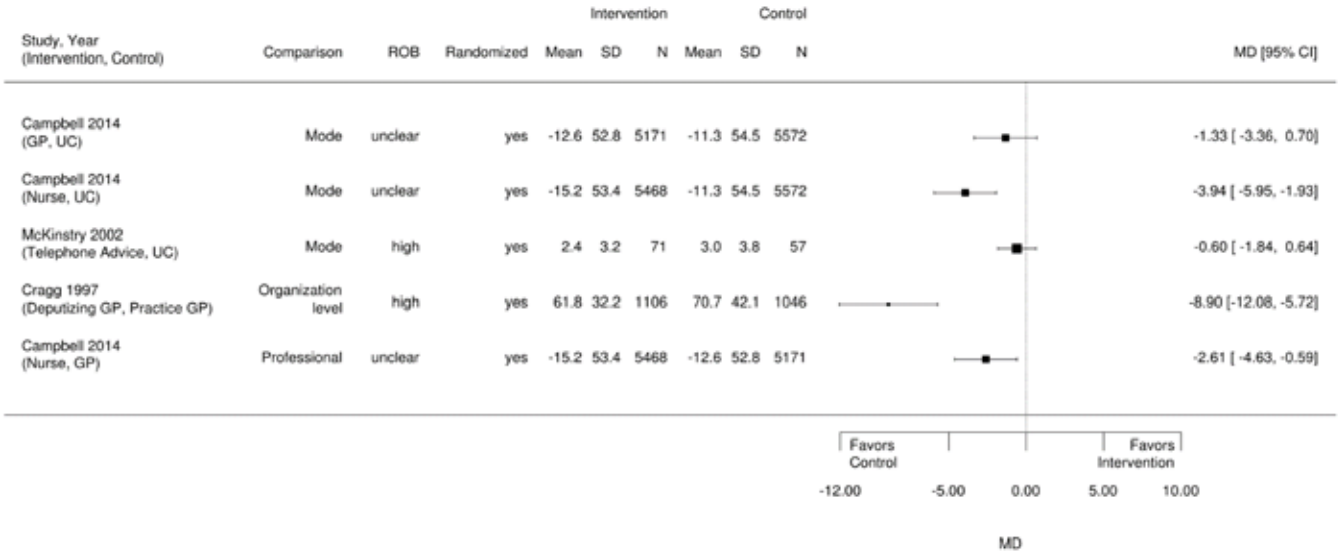
Two studies compared the impact of professional type on patient satisfaction.[37,38] One 3-arm cluster RCT compared nurse-led or GP-led remote triage to usual care and found a higher global rating of patient satisfaction with care provided on the day of the consultation request in the GP-led arm when compared to the nurse-led arm.[38] The second study was a controlled before-after

study comparing a nonclinical call handler to nurse-led triage on patient satisfaction before and after the introduction of NHS 111, and compared this to 3 matched-control areas in England where NHS 111 had not been introduced.[37] Of those surveyed, 2,237 reported having used the remote urgent care system within 3 months prior to survey administration; these users were asked to rate their satisfaction on a 5-point scale from "poor or very poor" to "excellent." The primary outcome was dichotomized to evaluate the proportion of patients rating their recent use of urgent care services at the highest rating compared with all other ratings. Results indicated no difference between nonclinical call handler and nurse-led triage control areas in the change in proportion of highly satisfied patients from before to after introduction of NHS 111 (odds ratio [OR] for % "excellent" 0.97; 95% CI 0.69 to 1.37). As with 2 of the 3 RCTs evaluating patient satisfaction, this study was also rated as high ROB for patient-reported outcomes.[37]

Comparison by Organizational Level

One RCT that compared triage organizational level also evaluated patient satisfaction outcomes. Patients were interviewed about their experience between 24 and 120 hours after placing the call.[44] Patient satisfaction was rated on a scale with a range of 0 to 100. Among the 71% of the sample who completed an interview, mean patient satisfaction was significantly higher for those who received telephone consultation by a practice physician compared to those who received consultation by a commercial deputizing service.

Figure 10. Effects of Remote Triage on Patient Satisfaction



Abbreviations: CI=confidence interval; GP=general practitioner; ROB=risk of bias; SD=standard deviation; UC=usual care

The diversity of outcomes measured under the construct "patient satisfaction" makes it difficult to draw overall conclusions from these studies. Three studies examined patient satisfaction among those seeking same-day appointments or after-hours care from their regular physician practices (Figure 10). Of these, the ESTEEM cluster RCT suggested that patients who called their practice to request a same-day appointment with their physician were less satisfied receiving nurse triage than physician triage or usual care.[38] The other cluster RCT found that when patients called their practices to receive after-hours medical care, those who received

consultation from a practice physician reported significantly higher satisfaction than those who received consultation from a deputizing service.[44] Similarly, the third RCT found that while people calling to request same-day, face-to-face appointments reported no difference in their ability to deal with their medical problem regardless of mode of consultation, only about half (55.4%) of the total sample said they would be willing to use a telephone consult for a similar problem in the future.[42] It may be that patient satisfaction decreases to the degree that patients perceive the triage service to differ from their expectations of care needed at the time of contact (*eg*, the caller expects to receive a same-day appointment rather than after-hours advice from a nonclinical call handler).

Table 9 presents a summary of the impact of remote triage on patient satisfaction outcomes reported in the included studies.

Table 9. Summary of Patient Satisfaction Outcomes in Remote Triage Studies

Study Design Number of Patients	Triage Comparison	Assessment Scale	Results
Randomized			
McKinstry, 2002[42] Individual RCT N=388 patients[a]	GP face-to-face consultation vs GP telephone consultation	PEI: 6-item scale measuring improvement in ability to cope/manage problem as a result of consultation Range 0 (no change) to 12 (maximum increase) Single Yes/No question: Willing to use telephone contact for similar problem in future?	PEI score; mean, (SD): · 3.0 (3.8) vs 2.4 (3.2); Mean difference (95%CI): 0.6 (-0.6 to 1.8) Willing to use telephone contact for similar problem in future; percent, (95% CI): · 50.6% vs 59.0% Difference: 8.4% (-23.1% to 6.4%)
Campbell, 2014[38] Cluster RCT N=20990 patients [b]	GP telephone triage vs nurse telephone triage vs usual care	Single item, linearized 0-100 point Likert scale: "Overall how satisfied or dissatisfied were you with the care received on that day?" with a positive to negative scoring (higher score = worse satisfaction)	Overall satisfaction; mean difference, (95% CI)[d]: · GP triage vs usual care: 1.33 (-0.69 to 3.35) · Nurse triage vs usual care: 3.94 (1.88 to 5.99) · Nurse triage vs GP triage: 2.60 (0.58 to 4.63)
Cragg, 1997[44] Cluster RCT N=2152 patients[c]	Deputizing service vs practice doctors	Patient Satisfaction Questionnaire: Range 0 to 100%, with higher scores reflecting greater satisfaction	Patient satisfaction; mean, (95% CI): · 61.8 (59.9 to 63.7) vs 70.7 (68.1 to 73.2); · p of difference <0.0001
Nonrandomized			
Knowles, 2016[37] Controlled before-after	· Arms 1 and 2: Before/after	5-point scale for overall satisfaction from	Comparison, between pilot and control regions, of pre-intervention to post-intervention

Study Design Number of Patients	Triage Comparison	Assessment Scale	Results
N=2237 patients	NHS 111 in pilot regions · Arms 3 and 4: Before/after NHS 111 in control regions	"poor or very poor" to "excellent," dichotomized to reflect "excellent" vs all others	change in proportion of "excellent" rating of urgent care services: OR (95% CI) · 0.97 (0.69 to 1.37)

[a]186 satisfaction questionnaires (47.9% of total sample).
[b]12,132 questionnaire respondents (74.8% of total sample).
[c]1,466 satisfaction questionnaires (71% of total sample).
[d] Lower mean difference is greater satisfaction.
Abbreviations: CI=confidence interval; GP=general practitioner; NHS=National Health Service; OR=odds ratio; PEI=Patient Enablement Instrument; RCT=randomized controlled trial; SD=standard deviation

Effects of Remote Triage on Cost: Key Points

- Only 3 studies assessed the cost of delivering remote triage. There was great variability in how cost was estimated.
- Telephone-based remote triage does not have an effect on adjusted overall cost-of-care for 28 days following triage.

Detailed Findings

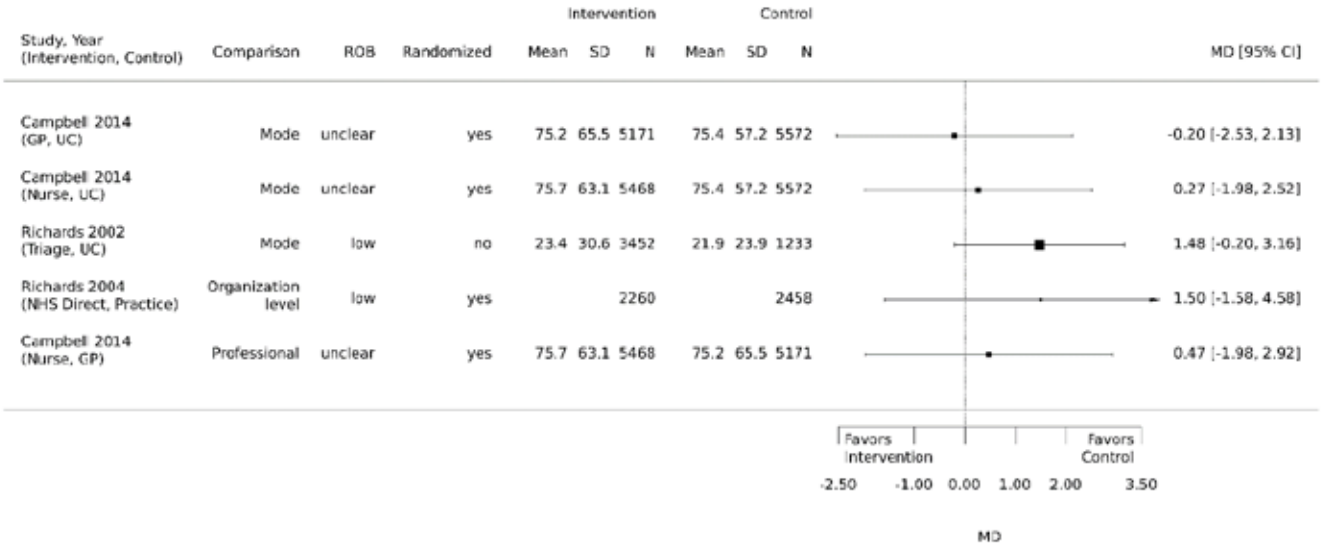
Three studies assessed the effects of remote triage on cost.[38,40,41] Two were cluster RCTs,[38,40] and 1 was an interrupted time-series.[41] Two studies evaluated modality of triage delivery,[38,41] 1 evaluated profession of call handler,[38] and 1 evaluated organizational level of triage delivery.[40] All studies evaluated total costs of care for the patient including the initial day of contact and the following month. Costs were computed indirectly for all studies. In 1 trial, patient resource utilization was linked to estimated costs of care, resulting in higher estimated total 28-day costs (£75.21 to £75.68).[38] The other trials estimated costs based on reported physician or nurse time (range of total 28-day costs £20.73 to £23.61).[40,41] Only 1 trial included the cost of implementing the triage system (including the CDSS, staff training, and triage time).[38] One study was rated as unclear ROB,[38] and 2 other studies were rated as low ROB.[40,41]

One 3-arm cluster RCT evaluating mode and call hander professional type found no difference between costs of usual care (£69.78), nurse-led triage (£69.54), or GP-led triage (£69.18) after adjustment.[38] Despite slight differences in utilization of various services, this study found no difference in cost attributable to triage, GP contacts, nurse contacts, after-hours, walk-in centers, or accident and ED use. The second study was an interrupted time-series study.[41] This study found no difference in overall cost of care (mean difference [MD] £1.48, -0.19 to 3.15, p=0.081), although there were significant differences in several components of patient cost. Specifically, triage patients had lower costs of same-day appointments (MD -£2.01, -2.43 to -1.59, p<0.001) and lower drug costs (MD -£0.79, -1.52 to -0.06, p=0.033), but higher costs for nurse same-day appointments (MD £1.07; 1.01 to 1.12; p<0.001), nurse follow-up (MD £0.46, 0.35 to 0.55,

p<0.001), and after-hours and accident and emergency utilization (MD £2.25, 1.33 to 3.17, p<0.001) (Figure 11).

One cluster RCT evaluating organizational level of triage delivery using NHS Direct health line service compared to primary care triage reported unadjusted cost that was higher with NHS Direct triage than with practice-based triage (£23.61 vs £20.73, difference £2.88 [95% CI 0.88 to 4.87], p=0.007).[40] This difference in cost was driven by increased same-day costs of nursing visits (£2.69 vs £1.18, difference £1.51 [1.31 to 1.71], p<0.001) and general-practitioner visits (£5.71 vs £5.08, difference £0.63 [0.23 to 1.71], p=0.003). However, the difference in overall cost was not seen when controlled for the final point of contact (1.50 [-1.58 to 4.58], p=0.320) (Figure 11).

Figure 10. Effects of Remote Triage on Cost



Abbreviations: CI=confidence interval; GP=general practitioner; ROB=risk of bias; SD=standard deviation; UC=usual care

Table 10 presents a summary of the impact of remote triage on costs reported in the included studies.

Table 10. Summary of Cost Outcomes in Remote Triage Studies

Study Design	Comparison	Total Cost £
Randomized		
Campbell, 2014[38] Cluster-randomized	GP triage (n=5,171) vs nurse triage (n=5,648) vs usual care (n=5,572)	Adjusted total cost; mean (SD) · GP triage: 75.21 (65.45) · Nurse triage: 75.68 (63.09) · Usual care: 75.41 (57.19)
Richards, 2004[40] Cluster-randomized	NHS Direct (n=2,260) vs usual practice (n=2,458)	Unadjusted total cost · 23.61 vs 20.73

Study Design	Comparison	Total Cost £
		Adjusted difference in cost · 1.50 (-1.58 to 4.58); p=0.320
Nonrandomized		
Richards, 2002[41] Interrupted time-series	Nurse triage (n=3452) vs usual care (n=1233)	Total cost per arm (SD), Mean difference (95%CI) · 23.37 (30.65) vs 21.89 (23.89), MD 1.48 (-0.19 to 3.15); p=0.081

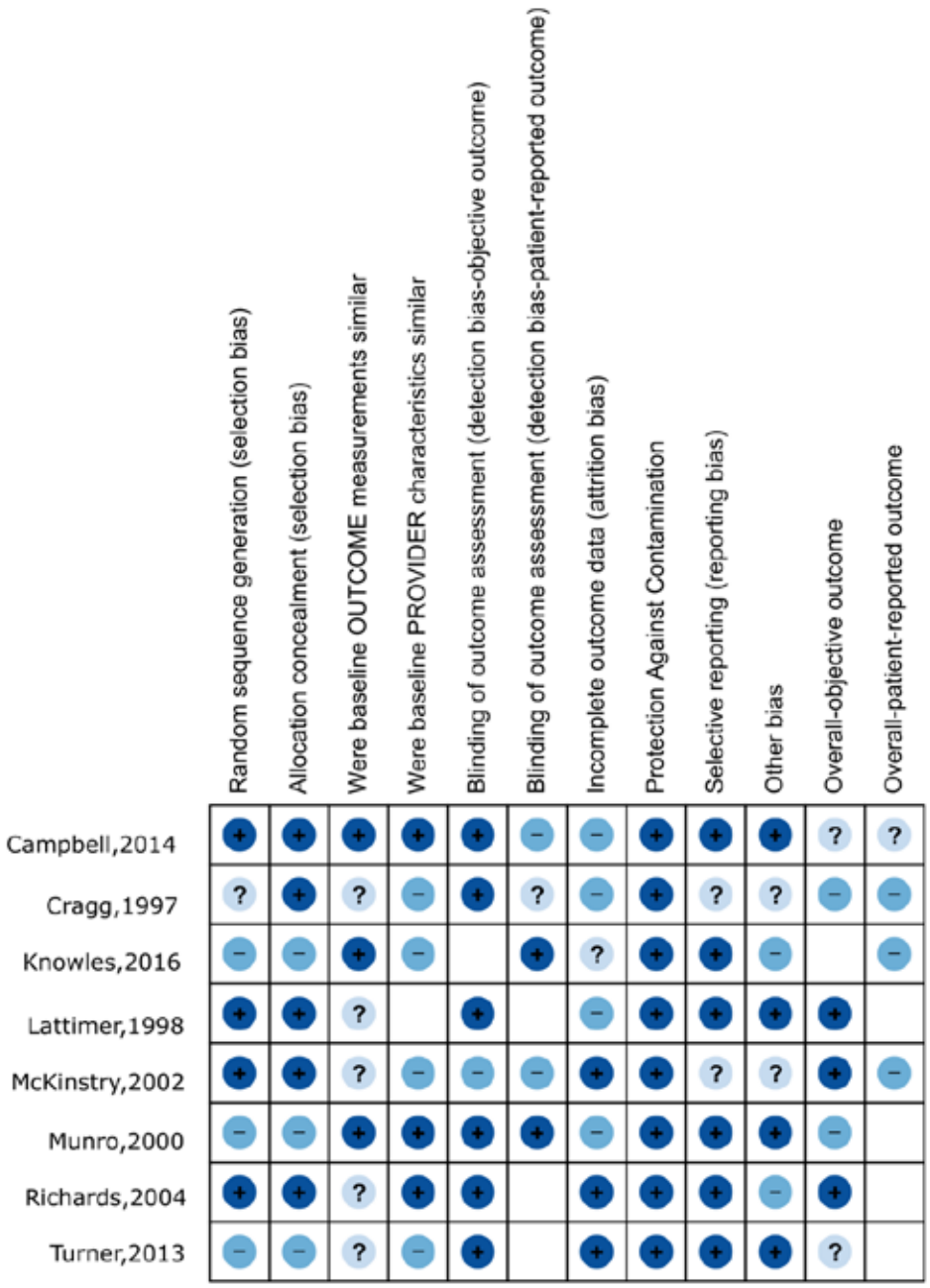
Abbreviations: GP=general practitioner; MD=mean difference

Quality of Evidence for Key Question 1

Across all 5 randomized studies that reported objective measures, 3 were rated low ROB,[40,42,43] 1 unclear ROB,[38] and 1 high ROB.[44] Three randomized designs also had patient-reported outcomes; of these 2 were rated high ROB[42,44] and 1 unclear.[38] Patterns that led to judgments of higher ROB included unclear balance of baseline outcomes across groups (n=4); outcome assessments that did not clearly blind to intervention assignment (n=3); and incomplete outcome data (n=3). In the 3 controlled before-after designs, 2 reported objective measures; of these, 1 was rated high ROB[45] and the other unclear.[39] Only 1 controlled before-after study had patient-reported outcomes and was of high ROB.[37] These controlled before-after studies suffered from additional bias such as lack of random sequence generation, inherent in their design, and an inability to balance provider characteristics.

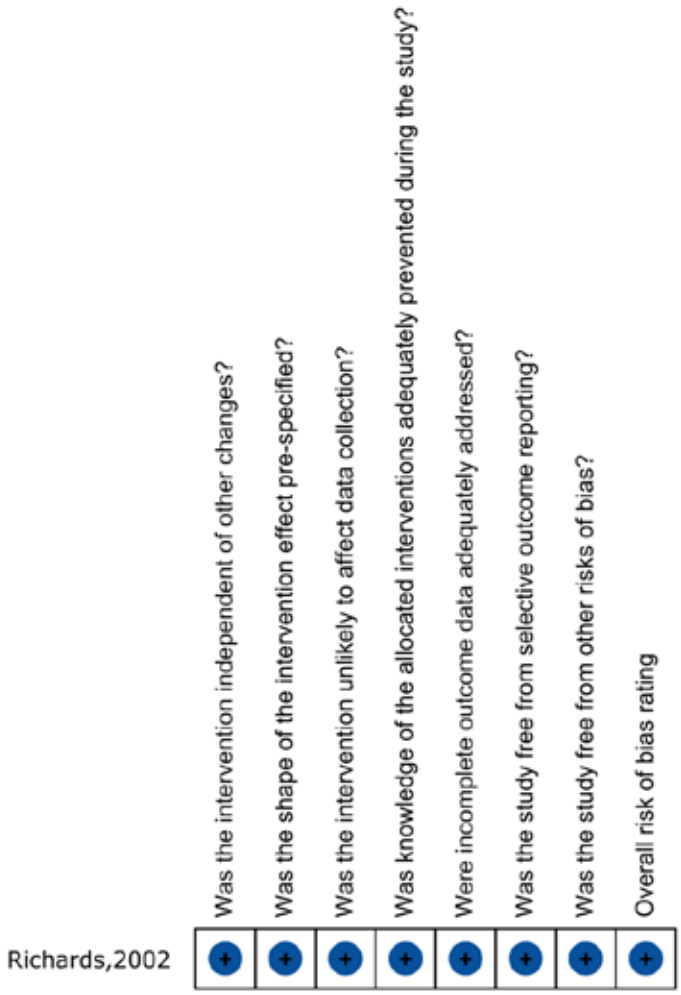
ROB ratings are shown in Figure 12. The interrupted time-series study was rated low ROB and is shown in Figure 13. The pattern of ROB assessments across studies is shown in Figure 14.

Figure 11. Risk of Bias Ratings for the Included EPOC Studies[a]



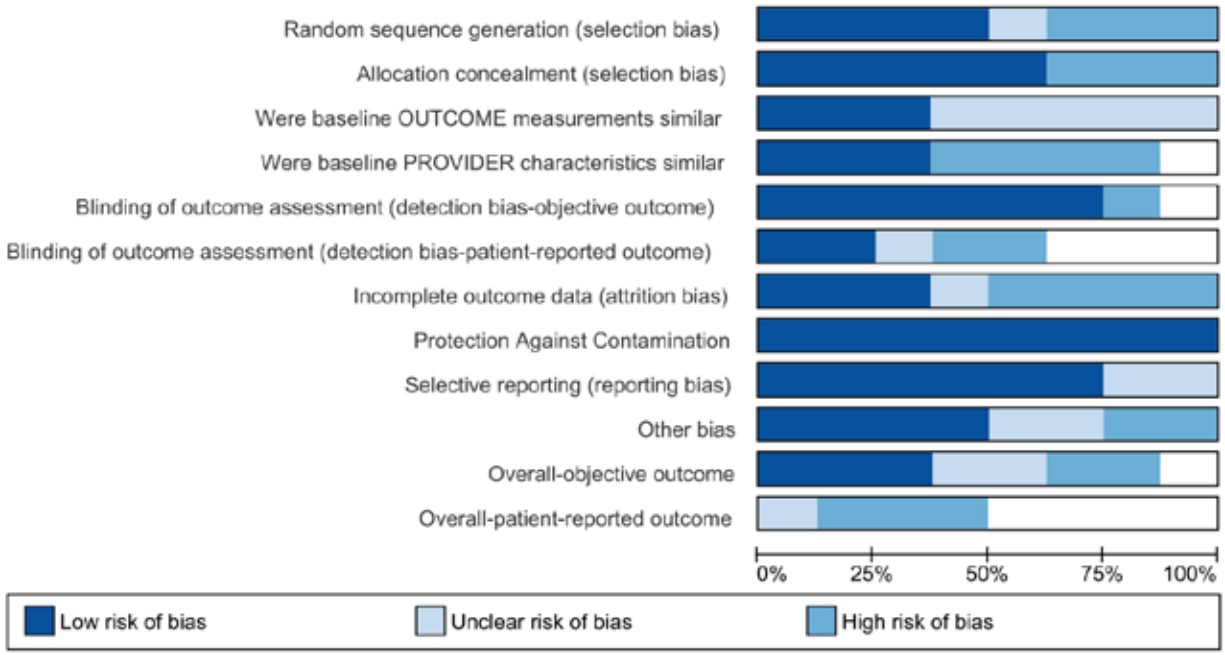
[a] White indicates items that were not applicable. Dark blue/positive indicates items that were rated low ROB. Light blue/question mark indicates items that were rated unclear ROB. Medium blue/negative indicates items that were rated high ROB.

Figure 12. Risk of Bias Ratings for the Included Interrupted Time-Series Study[a]



[a] White indicates items that were not applicable. Dark blue/positive indicates items that were rated low ROB.

Figure 13. Risk of Bias Assessment Across Included EPOC Studies[a]



[a] White indicates items that were not applicable.

KEY QUESTION 2: What are the identified best practices that impact the planning, execution, and evaluation of remote triage for adults seeking clinical care advice in a large-scale health system such as the VA?

Characteristics of Included Studies

We identified 32 studies addressing considerations for the planning, execution, and evaluation of remote triage in adults seeking care in a large health system. Six of the included studies were EPOC criteria studies and also included in KQ 1. Seventeen were qualitative, 4 were mixed-methods, 1 was an organizational case study, and 4 were systematic reviews.

Themes

Thematic synthesis of the abstracted data identified 11 themes across all KQ 2 studies that conceptualized consideration for best practices that impact the planning, execution, and evaluation of remote triage for adults seeking clinical care advice in a large-scale health system such as the VA. Table 11 defines the themes.

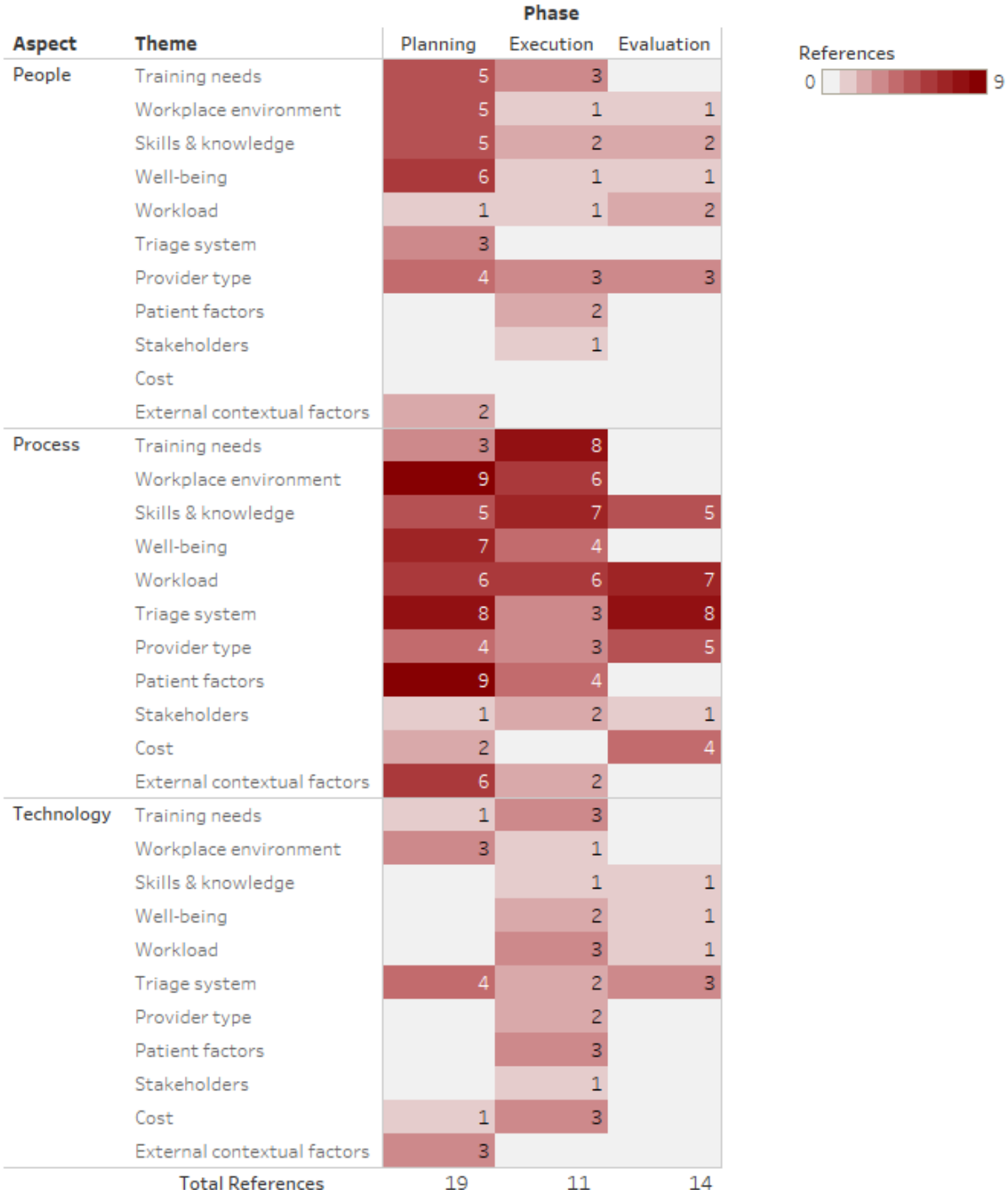
Table 11. Themes of Best Practice Considerations for Remote Triage

Theme	Definition
Training needs	Considerations of any educational requirement to conduct remote triage
Workplace environment	Considerations of the cultural and physical work space on ability to implement remote triage

Theme	Definition
Skills and knowledge	Ability for the triage provider to ask the right questions to elicit the appropriate information from the patient and to use critical thinking to apply the content knowledge to make a clinical decision
Well-being	Considerations to address the physical, emotional, and mental health of the individual doing remote triage work
Workload	Consideration for how the use of remote triage impacts the workload/burden and workflow of providers and others in the clinic setting
Triage system	Considerations of different decision support protocols, remote triage mode, and technologies, or lack thereof, on the ways that triage is implemented
Provider type	Considerations of the interaction of triage provider type (*eg*, nurse, physician) on the remote triage task
Patient factors	Characteristics of the patient (*eg*, disease complexity, mental health, disposition) that may impact remote triage
Stakeholders	Considerations pertaining to the involvement of stakeholders in implementing remote triage systems
Cost	Cost considerations pertaining to standing up a remote triage system (*eg*, staffing, technologies, training, space)
External contextual factors	Local factors that impact the remote triage system, including legal or ethical concerns

Figure 15 shows a heat map of the 11 themes at the intersection of best practice phase and aspect. Overall, the planning phase contained the greatest number of studies (n=19), followed by evaluation (n=14), with the execution phase having the fewest number of included studies with relevant findings (n=11). The intersection of execution/process contained the largest percentage of studies (78%), and the intersection of execution/technology had the smallest percentage (25%).

Figure 14. Heat Map: Number of Studies by Phase, Aspect, and Theme



Aspect	Theme	Phase: Planning	Phase: Execution	Phase: Evaluation
People	Training needs	5	3	
	Workplace environment	5	1	1
	Skills & knowledge	5	2	2
	Well-being	6	1	1
	Workload	1	1	2
	Triage system	3		
	Provider type	4	3	3
	Patient factors		2	
	Stakeholders		1	
	Cost			
	External contextual factors	2		
Process	Training needs	3	8	
	Workplace environment	9	6	
	Skills & knowledge	5	7	5
	Well-being	7	4	
	Workload	6	6	7
	Triage system	8	3	8
	Provider type	4	3	5
	Patient factors	9	4	
	Stakeholders	1	2	1
	Cost	2		4
	External contextual factors	6	2	
Technology	Training needs	1	3	
	Workplace environment	3	1	
	Skills & knowledge		1	1
	Well-being		2	1
	Workload		3	1
	Triage system	4	2	3
	Provider type		2	
	Patient factors		3	
	Stakeholders		1	
	Cost	1	3	
	External contextual factors	3		
	Total References	19	11	14

Remote Triage Best Practices: Key Points

- The execution of remote triage influences the entire health care system.
  - At the individual level, considerations must be made for individuals serving as remote triage staff, including a work environment that supports physical and emotional well-being, patients who use triage, and ancillary staff who assist in the daily functioning of triage.
  - At the clinic level, considerations must be made for how remote triage influences the clinic workflow, scheduling and availability of appointments, and workload among clinical and nonclinical call handlers.
  - At the system level, considerations must include how remote triage is influenced by, and also influences, the availability and accessibility of health care services (*ie*, clinic appointments, ambulance services). Attention must be paid to the health care resources in the external environment that impact both remote triage decisions and the patient's ability to adhere to advice.
- Purposeful planning prior to, and throughout the implementation of, remote triage is important in ensuring the success of remote triage.
- Educating patients and their family members on the purpose of remote triage may promote appropriate use of remote triage services.
- Involving call handlers with clinical experience in the planning, execution, and evaluation of remote triage services may facilitate future implementation and use by ensuring that remote triage programs enhance the patient-provider relationship.
- Implementing a remote triage system is perceived as safe, has the potential to reduce medical workload, and can produce a high rate of call resolution. It remains unclear whether a reduction in workload is actual or only a delay in the provision of health care services.

Detailed Findings

No studies identified best practices specifically, but we identified multiple considerations for emerging practices when implementing a remote triage system in a large-scale health system such as the VA. We synthesize the findings for each theme organized by the phase (*ie*, planning, execution, evaluation) of remote triage implementation. We highlight findings that are applicable to a large health care setting such as the VA.

Training Needs

Planning

Remote triage requires purposeful planning for initial and ongoing training. Dedicated time for such training increased the confidence of triage staff in their ability to engage in remote triage and their perception of a supportive environment.[61,62] This training can be tailored to each provider type, such as nurses or physicians, and the training should build upon each individual's content knowledge.[38,61,63-65] Initial training sessions should include skills inherent to remote

triage, and ongoing training sessions should build upon the initial skills to increase the professional development of the staff. [61,64] Overall, training should include clinical knowledge, CDSS skills, and professional development in order to assist triage staff in addressing new responsibilities related to their role.[38,65]

Execution

Implementing remote triage requires training both patients and staff on the purpose of remote triage. Training for patients should educate the patient on the purpose, process, and goals of remote triage.[23,66] Training for staff should focus on their role in remote triage, as defined within their professional scope of practice.[23,38,66] Training needs for staff should include communication skills to elicit information from the caller about relevant symptoms[64,66-71]; strategies to help address challenges encountered during the call[38,70]; and communication strategies when faced with different patient characteristics (*eg,* verbose patients, hostile patients, patient's expectations and knowledge).[64,70,71] Training needs specific to technology should include educating call handlers (*ie,* clinical and nonclinical) on how to use the CDSS[23,38,72]; helping them use the CDSS along with their clinical judgement to make appropriate decisions[38]; and applied training in how to effectively use the CDSS and remote triage in practice.[38,72] Relevant training enables remote triage staff to make an accurate diagnosis, which in turn influences the patient's compliance and satisfaction with the remote triage decision.

Evaluation

There were no studies related to evaluation of remote triage for training needs.

Workplace Environment

Planning

Planning for remote triage includes an awareness of positive and negative social interactions in the workplace. Purposeful attention at the individual and organizational levels includes addressing the physical space as a means to help create a positive workplace environment through the cultivation of positive social interaction. Likewise, awareness of potential reasons for negative interactions can lessen the frequency and impact of negative social interactions.

Ensuring a positive workplace environment leads to higher job satisfaction and perception of a supportive environment.[61,62] A positive environment was cultivated with skills training for engaging in remote triage[61,64]; identification of resources (*ie,* medical records, technical support) to assist the triage staff during patient calls[38,61,73]; managerial support[61]; performance feedback[61,64]; and supportive interactions with colleagues.[61,63,64] The creation of a protocol for remote triage that includes how calls are prioritized, the order of return class, and the assigned provider can positively impact the workplace environment.[65,74,75] Positive considerations in regard to the physical environment include the ability for the workspace to be comfortable and adjustable to staff needs.[61]

Negative interactions at the individual level include disrespect, criticism, or misunderstanding of the role[61,63]; triage fatigue[61]; and calls with difficult or hostile patients.[63,64] Negative interactions at the organizational level include low staffing numbers[61]; limited local resources[74,76]; limited to no access to medical records[74]; limited career opportunities[61]; lack of confidence in remote triage assessment abilities[64]; workload[38,61,64]; nightshift[65]; unclear remote triage processes[61];

organizational culture[63]; and social isolation.[61,64] Negative considerations regarding the physical space include a smaller workspace and the amount of time spent sitting down.[64] Negative considerations about the use of the CDSS include being aware of necessary collaborations, because seeking out collaborations may increase time spent on the triage call.[38,61]

Execution

Implementing remote triage requires implementing strategies to sustain positive factors and improve negative factors that influence the workplace environment. An awareness of strategies that influence the positive and negative factors at the individual level (*ie*, the remote triage staff) and organizational level (*ie*, engaging in remote triage) can influence the workplace environment during the implementation of remote triage.

Factors that positively influence the workplace environment during remote triage at the individual level include the opportunity for staff to develop skills by interacting with colleagues who share knowledge and expertise[64]; call variety[38]; and management support.[38] Factors that negatively influence the workplace environment at the individual level include barriers to ongoing training due to retention and heavy workloads[64]; a small workspace[64]; increased time in front of a computer[64]; repetitive and impersonal calls[64]; limited feedback on performance[64]; increased pressure and stress due to a focus on meeting call targets[71]; and the intensity and emotional labor of the remote triage calls.[71]

Factors that influence the workplace environment at the organizational level include the addition of another staff member to assist with the high volume of calls[38]; developing management-specific strategies to assist triage staff in adjusting to and completing remote triage (*eg*, regular meetings, listening to calls, thanking, acknowledging challenges)[38]; obtaining community support for using remote triage in the delivery of health services[77]; communication-specific strategies to help the triage provider address challenging callers (*eg*, callers who are unable to articulate the problem)[68,70]; and the availability of tools for the triage provider (*ie*, medical records, ability to update the caller's primary care provider).[71] Factors of the workplace environment related to the use of technology include providing training on how to use the CDSS[72]; developing the CDSS in conjunction with stakeholders (*eg*, ambulance service managers, triage staff, department of health)[72]; and developing a protocol that clearly articulates the role and responsibilities of the triage provider.[64]

Evaluation

Evaluation of remote triage indicates that workplace identity may be improved by integrating remote triage services because it provides an opportunity to be dynamic and introduce change in the practice.[38]

Skills and Knowledge

Planning

Remote triage requires identifying and employing staff who have the appropriate skills and knowledge to effectively engage in remote triage. Essential skills for remote triage staff include nonverbal and verbal communication skills to obtain accurate information from the caller (*eg*, active listening, writing accurate reports about the triage call)[63,64,67,78]; clinical knowledge[63,64]; collegiality (*eg*, ability to work well with others, being open to feedback on performance)[65,78];

and knowledge of how to optimally use the CDSS.[38] Clinical knowledge was beneficial for staff because a wide range of clinical backgrounds among all the team members, including experiences with both inpatient and outpatient settings, were noted to be helpful in addressing the variety of problems encountered in remote triage.[64,79] Knowledge of the patients served (*ie*, within one's own practice) can impact a provider's comfort level with remote triage.[63] Challenges for skilled and knowledgeable staff include conflicts between clinical knowledge and explicit training to adhere to the CDSS,[78] and cognitive fatigue.[61,64,65]

Execution

Implementing remote triage requires staff to apply skills and training in an effective manner. In the absence of a face-to-face assessment, staff developed a picture of the caller in order to obtain information on the patient's symptoms and problems. The remote triage call handler's clinical knowledge (*eg*, the ability to critically think through illnesses and symptom patterns)—or lack of clinical knowledge (*ie*, lack of knowledge of disease processes and symptom patterns)—influences both accuracy of referrals (*ie*, being referred to the correct service)[23] and adequacy (*ie*, under referral)[23,66] of resources. The application of clinical knowledge and use of critical thinking skills enabled the provider to ask appropriate questions to elicit information from the caller[64,66-70]; provide the appropriate advice or service referral[64,66-70]; and assess the urgency of the caller's situation by eliciting the right information.[64,66-69] However, 1 study said that triage providers with clinical experience "overrode" the CDSS when they did not agree with the recommended treatment.[71] Triage providers who did not have clinical knowledge or clinical experience relied on the CDSS to guide their questions to probe the caller for additional information.[71] Of note, implementing the CDSS enabled providers to learn new skills, apply their critical thinking skills in new ways, and learn to write meaningful clinical summaries in order for callers to be appropriately and accurately treated.[38]

Evaluation

Evaluation of remote triage is important in assessing the application and use of the provider's skills and knowledge. Studies reported that remote triage by telephone resulted in acceptable levels of patient satisfaction.[23] However, patient satisfaction with remote triage was lower when patients perceived the telephone-based advice as a barrier to in-person medical care. One study reported an inconsistent relationship between the profession of the provider (*eg*, nurse-led vs physician-led) and appropriateness of remote triage decisions.[66] Yet, evidence supported no significant difference in adverse events in nurse-led triage compared with face-to-face triage by a physician.[66] Nurses' skills and knowledge were seen to be superior to other professions in addressing remote triage concerns.[38] A critical area of skills-building is communication, and 1 study sought to develop a valid, reliable, and practical instrument to assess the communication skill of triage staff. RICE (Reason for calling; Information gathering; Conclusion; and Evaluation) was deemed to have acceptable reliability and may be a tool to consider using when evaluating the triage staff member's communication skills.[80]

Skills and knowledge affected remote triage in 2 main pathways: appropriateness of remote triage advice and patient satisfaction. Overall, the appropriateness of advice given was highly variable (44%-98%) when compared with some standard (*eg*, subsequent treatment, patient validations, adverse event rate).[36,66,81] Variability in rates of appropriateness was likely due to a lack of consistency in the definition of "appropriateness."[23,66] Appropriateness of remote triage was measured using audits of real or simulated calls and assessment of the medical record.[36] Yet

a substantial proportion of calls could be handled by telephone advice only. Of note, 1 study assessed the impact of the CDSS technology and found that it served as a good training tool.[38]

Well-being

Planning

An important point of planning for remote triage should be the interaction between maintaining both physical and mental well-being while minimizing the impact of the remote triage processes on providers. Engaging in remote triage can be enjoyable[38] and can impact the provider's confidence.[79] Planning for the well-being of staff should occur for both day and night shifts.[65] Factors that positively influence the well-being of the remote triage staff included call variety[64]; wellness training and breaks[61]; a comfortable physical environment (*ie*, ability to sit or stand at their computer as desired)[61]; support[65]; and the ability to focus on one patient at a time and have the ability to call patients back if needed.[61] Factors that negatively influence well-being of the staff included fear or anxiety about making an error due to the complexity of patients[61]; fatigue due to high workload[61]; stress or pressure related to engaging in remote triage[38,62,64,65]; isolation[61,64]; lack of visual cues when communicating with patients[63,64]; the provider's unfamiliarity with the caller[63]; and a lack of follow-up information about the caller's outcome.[63] Factors that negatively influence the physical well-being of staff included small workspaces and prolonged periods of sitting.[64]

Execution

Implementing remote triage requires employing strategies to promote the well-being of the triage provider. Importantly, remote triage influences the clinician's psychological well-being by altering the traditional medical provider-patient relationship (*ie*, some medical providers want to see only their patients) or the clinician's role within the practice as related to patient care (*ie*, remote triage changed the role and responsibilities).[38] Strategies that positively impact staff included feeling autonomous and flexible and able to help individuals[64] or the ability to gain new knowledge and clinical skills to care for patients.[38,64,72] The well-being of staff was negatively impacted when they first learned about the remote triage process[71]; felt as if they were not functioning at their potential[71]; experienced stress about being a gatekeeper for health services[64,71]; felt conflicted about being a care provider and a gatekeeper[64]; felt conflicted with their personal beliefs and the use of the CDSS (*ie*, having to ask inappropriate or numerous questions)[38,69]; experienced lengthy call times[38]; read unhelpful summaries written by the previous call handler[72]; or stressed while making decisions during the remote triage call.[70,71]

Evaluation

Evaluation of the provider's well-being indicated that learning new skills and enabling them to increase their responsibilities had a positive impact.[38] However, the use of the CDSS may negatively impact provider's well-being due to conflict between the CDSS and the provider's clinical judgement.[38]

Workload

Planning

Remote triage requires purposeful planning to address staff workload and organization workflow. Workload factors that should be considered when planning include ensuring the

appropriate amount of time is allocated for each call[38,41,44,62]; developing a protocol for patient (*ie*, hostile, language barriers)[64] or system (limited access to health services, varying scheduling patterns) challenges[64,77]; ensuring the provider has the appropriate skills and knowledge to manage the call[38]; reducing duplication of efforts (*ie*, documentation of personal histories, asking similar questions)[38]; and having staff assist with the CDSS. Workflow factors to consider include a plan for handling call allocations during peak call times and creating dedicated time for needed callbacks.[38]

Execution

Implementing remote triage requires consideration to address workload and workflow concerns at the individual, clinic, and health care system levels. Remote triage had a negative impact on workload during high-demand times and limited the availability of training for the remote call handlers.[38,64,71] Call length influenced workload because it depends on the caller's description of the problem and needs (*ie*, lengthy and unclear description of symptoms or clear description of symptoms with a timeline)[23,64,66,68,69,71]; the provider's professional role (*ie*, nurse, physician)[38]; when the interaction was lengthy and the CDSS was not prompting the provider to ask the correct questions[38,72]; or when the provider with clinical knowledge found the summaries in the CDSS unhelpful and then restarted the consultation from the beginning.[38] However, staff workload was positively impacted when patients had positive or neutral perceptions of remote triage[23]; relevant information was easy to locate within the CDSS[38]; and the information in the CDSS was helpful and appropriate for the caller's situation.[38]

Remote triage affects the workload at the clinic level (*ie*, both providers and non-providers and the health care system (*ie*, ambulance services, urgent caseloads). At the clinic level, workload factors included the allocation of staff (*ie*, nurses, GPs, receptionists) to complete the remote triage duties such as appointments, paperwork, and addressing scheduling concerns (*ie*, scheduling patients, adjusting the clinic appointments)[38,64]; considerations of clinic size[38,64,71]; and plans for staffing during peak demand times (*ie*, evenings, weekends)[38,64,71]; or when providers are trained in using the CDSS.[72] Patient preferences also influence allocation of staffing as when patients want to see specific providers (*ie*, some female patients only wanted to see the female physician)[38]; some non-providers saw more patients because other providers were engaged in triage call handling[38]; when patients had insufficient time to travel to the clinic for an appointment if it was scheduled during the remote triage call[38]; and when regular clinic practice hours and the available appointments coincided with the provider's remote triage responsibilities.[38] Workload in the health care system increased because the CDSS algorithm did not prompt the provider to discern between emergent and non-emergent situations.[71]

Evaluation

Evaluation of the workload pertained to staffing during the implementation of remote triage[38,81] and the workload processes during remote triage.[21,23,36,38,39,43,81] Implementation of a remote triage system has the potential to reduce the workload in primary care,[23,43] but it remains unclear whether this reduction is actual or only a delay in the provision or type of services.[21,36] Physicians felt less stretched, in-person appointments were thought to be more appropriate, and there were fewer interruptions of physicians by administrative staff. Nurse triage was perceived to be effective and sustainable in reducing physician appointments. Nurse triage may be more effective if conducted by a nurse practitioner or a primary care nurse and when nurses can prescribe selected medications for commonly presented conditions. However, remote triage can

have unintended consequences on workload due to unpredictable demand[38]; high stress during peak volumes[38]; differences in length of call by triage provider[38]; and provider discomfort with engaging in remote triage.[38,81] Rate of call resolution was high across studies, but there was considerable variability in the impact of these services on utilization of primary care and emergency services.[21,39]

Triage System

Planning

Specific components of the triage system itself are key factors to consider during the planning phase for remote triage.[38,41,44,61,62,65,73-76,79,82] Careful consideration should be given in selecting the CDSS.[38,41,61,65] A well-designed CDSS should have appropriate questions and be user friendly,[38,73] have usable outputs (*eg*, summaries),[38] and be customizable for the specific setting.[38,73] In addition, documentation of the calls, particularly regarding sensitive information, should be a consideration.[76] Providers of remote triage want a system that allows for the ability to call patients back if needed.[61] Yet it is important to note that the triage CDSS can impact the experience of staff involved in triage. Prior staff experience with remote triage influences the utility of the CDSS; staff with less remote triage experience may benefit more from CDSS than those with greater experience.[38,44] Recommendations of the CDSS may contradict nurse's clinical judgement,[79,82] or it may be at odds with how the clinicians would prefer the situation be handled.[38] Yet, across remote triage systems, decision support protocols were used when the triage staff was not a physician.[82] The way the system is designed can affect the end user's experience and is a planning consideration.[74,75] One study found that patients using one triage system voiced concerns when routed to a nonclinical triage staff first.[74] Patients expected to speak to a clinician first and did not fully trust the capabilities of the nonclinical personnel. Last, planning for continuous support for the remote triage technology is recommended.[61]

Execution

During the implementation of a remote triage system, use of the CDSS was seen as beneficial for training inexperienced triage providers[38]; enabled the providers to gain new skills[38,72]; enabled the providers to obtain confirmation when they made a right decision; triggered the providers to ask specific questions; the layout enabled quick identification of relevant information; and helped educate and teach callers about self-management.[38] The CDSS was also useful in standardizing treatment decision plans to decrease risk when treating patients remotely.[71]

Negative instances of using the CDSS that should be monitored during implementation occurred when the technology was not specific enough for some diseases, situations, or complexity of patients using the service; was not sensitive to all of the problems that callers desired (*ie*, information on medication interactions, medications in general); prompted the triage provider to ask inappropriate questions; increased the length of the call due to the number of questions; prompted a call back to the caller at an inconvenient time[38,67,71]; and the decision support algorithm was complicated.[72] The CDSS increased demand in other portions of the health system and placed burdens on other services (*eg*, ambulances, urgent care).

Evaluation

There are multiple dimensions to consider when evaluating a remote triage system. The remote triage system can impact patient compliance with advice, clinical outcomes, and

safety.[21,23,36,38,43,65,66,72,81,82] When medical advice is given to a patient over via remote triage, results imply it is essential to assess patients' willingness to comply with recommended actions.[23,66] Evaluating patients' willingness to comply with given advice and assessing understanding of advice given were seen as critical to patient compliance issues with remote triage.

The mode of remote triage (*eg*, telephone, email) may be an important consideration to evaluate; yet the predominant mode explored across included studies was telephone. The single study that assessed the impact of remote triage via email highlighted some considerations that modes other than telephone may present.[81] Overall, providers struggled with ascertaining the patient's key reason for messaging due to limited information in the email consultation form and the asynchronous mode of communication. Email remote triage appeared to work well for a straightforward request (*eg*, slight changes to medications for an ongoing condition). Yet for new or complex requests, most clinicians struggled to ascertain the patient's main concern for consultation. Ultimately, most remote triage interactions initiated via email required a telephone conversation before action could be taken. Thus, the remote triage mode had an impact on the ability to make clinical decisions.

Provider Type

Planning

How the provider interacts with the remote triage system impacts system functions and ultimately how to plan for what type of provider to use. Health systems interested in planning for remote triage need to determine which level of provider (*eg*, physician, nurse, nonclinical call handler), or combination of triage staff,[71] is appropriate for delivering remote triage based on provider characteristics, including role and tasks required.[38,44,71,79] Yet much of the existing literature on remote triage is based on nurse triage. When considering nurses as the primary triage staff, several emerging practices where highlighted in the literature. These included recommendations for varied clinical experience of nurses prior to taking on a triage role[79]; preferences for prior triage experience[38]; and length of experience and background of nurses as factors to consider in staff planning.[79] For some systems, multiple different provider types were needed to support specific aspects of remote triage.[71] For example, call advisors completed the initial assessment using a protocol and then prioritized the workload for the clinical advisors.[71] Regardless of provider type, communication skills,[65,74] clinical or triage experience,[65,75] and a professional manner[74] were general characteristics seen as important for triage staff.

Execution

When implementing remote triage, there are 3 types of call handlers to consider: individuals with clinical knowledge (*eg*, a physician, nurse), individuals who have some familiarity with health care clinics (*eg*, receptionists),[38] or individuals with no clinical knowledge.[23,66] The triage provider's level of clinical knowledge influences the use of the CDSS. Individuals with medical training used their clinical knowledge and skills to visualize the caller's problem, guide questioning, and guide and decision-making during the call.[67,70,71] Individuals with clinical knowledge found the CDSS technologies helpful in teaching callers self-management skills and training new triage providers. Some providers with clinical knowledge, however, felt the technologies were not specific enough.[38] Individuals with no medical training (*eg*, nonclinical call handler) relied on the CDSS during the remote triage call to guide questioning and decision-

making.[71] Nonclinical call handlers trusted the technology because it was perceived as evidence-based, and as a result, these individuals gained skills, status, and authority.[72]

Evaluation

There have been 2 main evaluations of provider type in the literature: provider discipline (*eg*, nurse, physician) or organizational relationship of provider to patient panel (*eg*, local practice panel management vs call center–routed to regional triage service).[38,44,66] Compared with physician-led triage, nurse-led triage was seen as effective and acceptable to practice staff and patients.[38] Yet findings were inconsistent, with some studies supporting differential accuracy of triage decisions between nurses and physicians.[66] The impact of nurse-led triage may be enhanced if conducted by a nurse practitioner or a primary care nurse.[38] Several factors impacted the perceived effectiveness of physician-led triage; doctor's confidence and competence, past experiences with telephone triage or consultation, and if the physician's self-concept of good patient care included a commitment to in-person contact.[38] Remote triage provided by a nurse with a protocol or by a physician were both seen as safe across a variety of metrics (*eg*, deaths, hospitalizations within 24 hours of call, advice to attend the emergency department).

When exploring the comparison of organizational relationship of provider to patient panel, local physicians were more willing to resolve cases over the telephone and less likely to prescribe medications.[23,44] No difference was seen in hospital referral rates for these 2 types of physicians.[44] There were slight increases in primary care contacts for non-local remote triage providers when compared with local providers observed in some studies.[21,38]

Patient Factors

Planning

The characteristics of patients being served by the remote triage system need to be considered when planning for remote triage.[38,62,63,74-76,83] Patient complexity can impact triage.[38] For example, mental health issues or a substance abuse history increased complexity in addressing calls.[61] Age of the patient is also a factor. When children were the patients, vague presenting symptoms were a common challenge, while advice-seeking calls relating to children were considered to be easier to handle via remote triage.[63] Another study looked at the experiences of older adults using triage. Older patients preferred to have an existing relationship with the triage provider, preferred to interact with staff who have a patient-centered approach, and have the call answered from a quiet environment to minimize distractions.[75] Older adults also favored a system that addresses technology challenges as well as potential physical limitations such as the ability to press buttons or hear the remote triage staff.[75]

Patients had some concerns related to remote triage – for example, concern about activating the remote triage system if the condition was not severe, or concern about not wasting resources.[74] There was also a risk that patients may not understand the remote triage instructions,[62,65] which can impact triage outcomes.

Execution

Patient factors such as the reason for the remote triage call, demographics (*ie*, age, income), and satisfaction with triage decision influenced compliance with the remote triage decision.[23,66] The ability of the patient to clearly communicate details about symptoms affected the remote triage

call.[68,69] The ability of the patient to remember and understand the decisions during the call also impacted triage compliance.[66] The presence of another individual with the patient was found to help the patient describe or complete activities during the remote triage call.[68,69] One study noted that a lack of knowledge about remote triage, and when to use remote triage (*ie*, for what diagnoses), resulted in non-remote triage-related patient calls.[71]

Patient perceptions of remote triage influences the patient's compliance with remote triage decisions, expectations of remote triage, and overall satisfaction with remote triage. Patients experienced dissatisfaction with remote triage when they felt remote triage was a barrier to face-to-face care;[23] the questions were deemed inappropriate; they were stressed while waiting for a return remote triage call[38]; and they experienced difficulty navigating the technology.[72]

Evaluation

There were no studies related to patient factors for evaluation.

Stakeholders

Planning

The concerns and needs of the multiple stakeholders involved in remote triage are a key consideration during planning. Yet only 1 study explicitly addressed how to work with stakeholders when in the planning phase of a remote triage system.[38] This study explored the key role of management communicating with staff stakeholders during the planning process. These communications should recognize that the staff struggles in trying to plan for the remote triage system and should offer praise to the staff when possible.

Execution

During the execution phase, prior commitment to implementing the change by all stakeholders was seen essential to successful implementation. Involving the clinic staff stakeholders (*ie*, physicians, nurses, nonclinical staff) in the introduction of, communication about, and implementation of remote triage was seen as key to successful implementation.[38] The implementation of the CDSS was positively affected when multiple stakeholders (*ie*, Department of Health, ambulance managers, triage providers) supported the use and implementation of the technology.[72] As with other innovations, identification of a champion to drive change and address problems was seen as critical. Yet, inadequate stakeholder engagement was seen as contributing to challenges in implementing remote triage, such as inadequate alignment and adaptation to the local context (*ie*, number of providers, availability of services in the area).[77]

Evaluation

Preparatory assessments of capacity and needs of the triage staff are likely helpful in positioning a triage system for successful implementation.[38] Also, hearing the first-hand accounts of others who have successfully implemented similar systems can serve as an important motivator, drive change, and improve clinical preparedness.[38]

Cost

Planning

The amount of initial and/or ongoing financial investment to an organization is a planning consideration when considering a remote triage system. Two studies addressed planning cost.[38,41] When planning for the start-up costs of the system, 2 main categories of expenses should be considered: staffing costs and technology costs. Costs related to technology included set-up costs, software licensing, and training.[38] Additional costs included the number of times a patient was assessed during the course of triage and the telecommunication fees.[38]

Execution

Use of the CDSS necessitated an increase in information technology support and resources at the beginning of implementation.[23] In some instances, the increased number of questions prompted by the technologies resulted in a longer call.[38,72]

Evaluation

While most studies suggested a net cost benefit of remote triage by telephone,[23] results were not consistent.[23,36,38,40] Across included studies, cost assessments were seen as anemic and did not include all relevant factors such as training, salary, or costs of follow-up care.[36]

External Contextual Factors

Planning

The influence of factors outside the remote triage system itself can impact setting up a remote triage system. These include potential ethical and legal concerns. In a study on malpractice factors, nurses identified the workplace, repetitive telephone call types during epidemics, lower experience level, lack of direct interaction with the patients, and misunderstandings as potentially leading to legal troubles.[65] To address these issues, nurses learned to recognize their own limits, try to speak directly to the client, use open-ended questions, verified understanding, and addressed psychological trauma associated with errors.[65] The managers noted inexperience and inadequate communication as factors contributing to malpractice risk.[65] The managers learned they need to employ more training, adjust work environment/schedules as needed, create comprehensive policies/procedures, and use a mentor system to mitigate malpractice risks.[65] For nursing staff, use of verification questions, consultation with a colleague, and adhering to protocols were used to minimize legal risk.[64] Triage providers also denoted ethical challenges when speaking with a caller (*eg*, family member) in lieu of the patient, such as how much information could be shared from prior encounters, and conflicts between caller and the patient, which may be affected by cultural differences such as autonomy.[76] In addition, providers of triage felt a sense of conflict when balancing patient and organizational needs.[63]

Another key external contextual factor is the health care environment in which the patient lives. This impacts a caller's ability to access health care resources and remote triage advice given.[64] One paper discussed the challenges in trying to adapt a national service to a rural setting when the system was not flexible in meeting the needs of the location context such as distance needed to travel,[77] resources available to the patient, and transportation considerations.[74,77] Physician practice variation, even within the same system, is also an important contextual consideration for remote triage staff.[38,71,73]

Execution

During implementation, external contextual factors that influence the remote triage system included incongruence with occurrences in the local health care context, a CDSS that did not include adequate health services information for the local area (*eg*, rural communities), not understanding how the local community provided health care services, or not knowing the different levels of access for individuals in the community.[71,77]

Evaluation

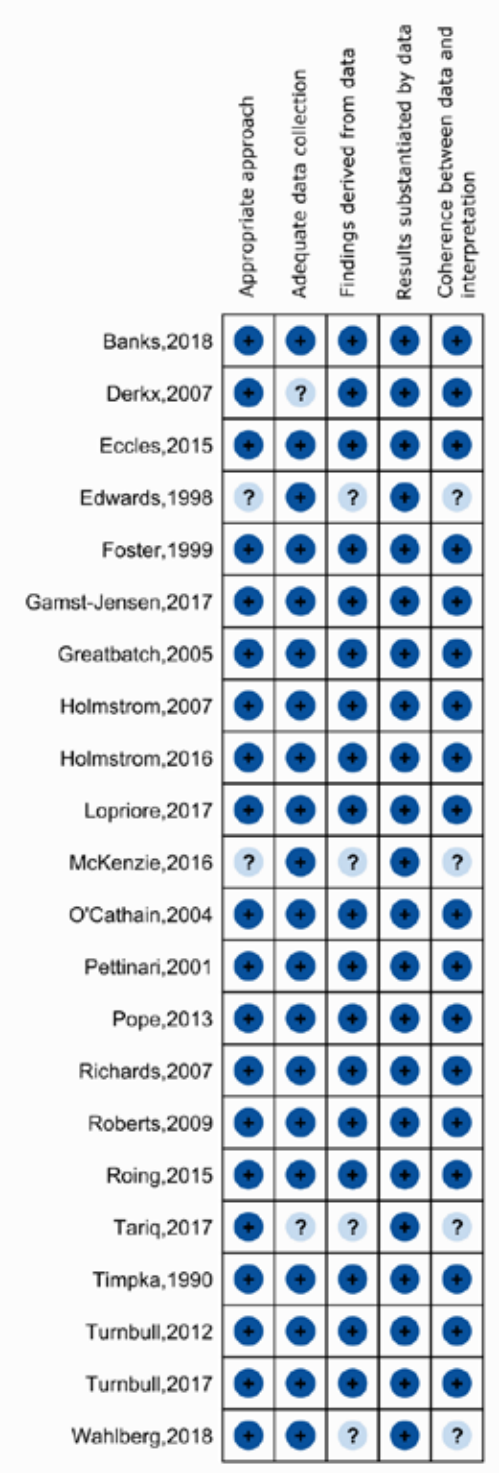
There were no studies related to external contextual factors for evaluation.

Quality of Evidence for Key Question 2

There were 32 studies included for KQ 2. Of these, 8 studies were EPOC designs and were also included in KQ 1 (shown in Figures 8-10).[37-40,42-45] The tools used to assess ROB for the 22 descriptive qualitative studies did not provide for the calculation of summary scores for individual papers.[61-63,65,67-84] Among these studies, the ROB was relatively consistent with the overwhelming majority of studies having low ROB across metrics of qualitative rigor. The only metric of rigor that was more common were for biases related to findings derived from the data and coherence between data and interpretation across the same 4 studies.[61,67,73,84] We also assessed the rigor of the 4 systematic reviews (1 good quality,[21] 1 fair,[23] 2 poor[36,66]) and 1 good quality meta-ethnography[64] included in KQ 2. Overall, the systematic reviews were downgraded for inadequate search strategy, possible selection bias, lack of duplicate study selection and abstraction methods, and no mention of assessments of publication bias, and no statements about conflicts of interest.

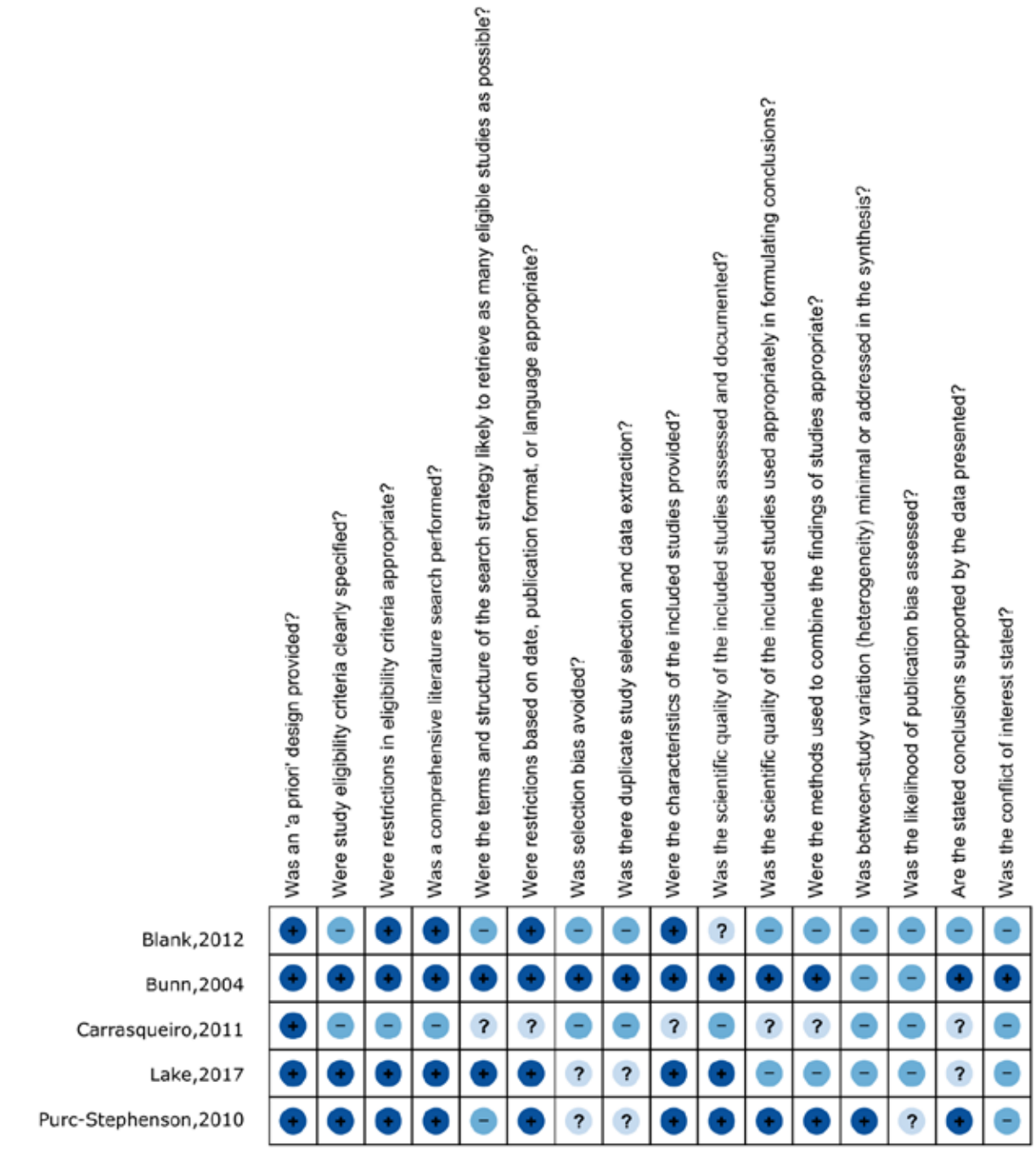
Figures 16-19 show the ROB ratings for the studies include in KQ 2.

Figure 15. Risk of Bias Ratings for the Included Qualitative Studies[a]



[a] Dark blue/positive indicates items that were rated low ROB. Light blue/question mark indicates items that were rated unclear ROB. Medium blue/negative indicates items that were rated high ROB.

Figure 16. Risk of Bias Ratings for the Included Systematic Review[a] Studies[b]



[a] One meta-ethnogragphy was evaluated for ROB using the adapted AMSTAR tool as it fit most closely with the methods used.

[b] Dark blue/positive indicates items that were rated low ROB. Light blue/question mark indicates items that were rated unclear ROB. Medium blue/negative indicates items that were rated high ROB.

Figure 17. Risk of Bias Assessment Across Included Qualitative Studies[a]

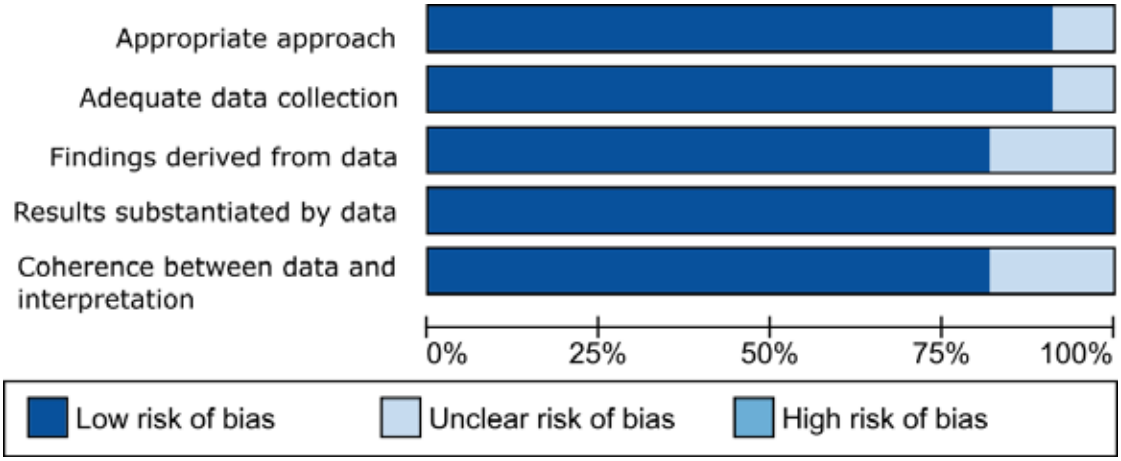
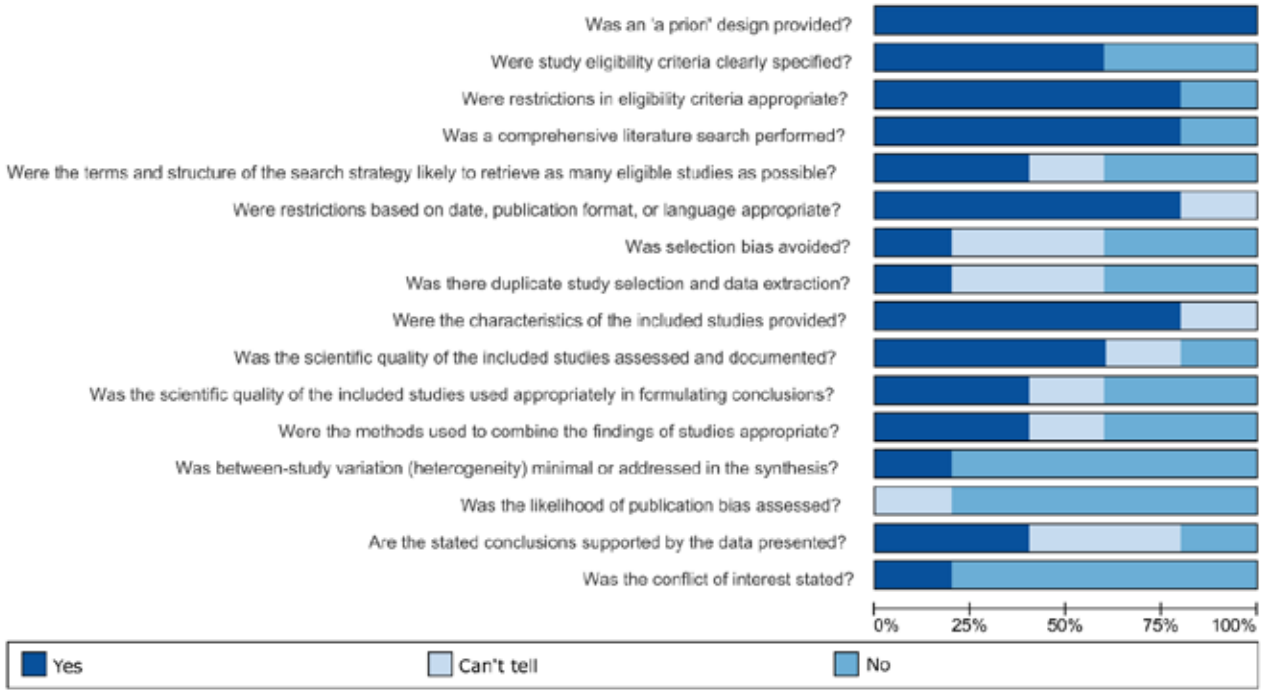


Figure 18. Risk of Bias Assessment Across Included Systematic Review Studies[a]



KEY QUESTION 3: What are the types of outcomes used to assess the impact of remote triage?

Key Point

- The types of outcomes used to assess the impact of remote triage were consistent with the 6 categories. Nine studies reported metrics that fell into at least 1 category.

Detailed Findings

Of the 9 studies that met inclusion criteria for KQ 1, all reported at least 1 outcome used to assess or evaluate the impact of remote triage for KQ 3.[37-45] We grouped these outcomes based on the 6 categories adapted from Carrasqueiro et al.[34] These categories include (1) enhanced access to care; (2) change in rates or trends of services use or change in professionals' workload; (3) adverse events (deaths, emergency department attendance, hospital admissions) and delayed care; (4) clinical outcomes after triage; (5) patient satisfaction measured via Likert scales; and (6) savings from avoided services use and triage costs. Carrasqueiro et al reported 2 other categories—adequacy of the advised level of care and patient compliance with triage advice—however, none of the 9 studies reported outcomes or metrics that fit these categories.

- Four studies evaluated the impact of remote triage using metrics for enhanced access to care.[40,41,43,44] Measures consisted of the number of calls and the percentage of people triaged to primary care or to ED.
- Six studies reported outcomes measuring the change in rate or trends of services use or changes in professionals' workload.[39-41,43-45] Measures included call volume, call resolution rate, abandonment rate, speed of answering telephone, nurse productivity, practitioner time, after-hours consultations, time from request to arrival of doctor, and proportion receiving a prescription.
- Seven studies referenced adverse events.[38-43,45] Measures consisted of the number of hospital admissions, total deaths, and ED attendance. Specifically, metrics evaluated the number of admissions within a given time period and the change in attendance before and after triage service implementation.
- Six studies referenced clinical outcomes after triage; the only measure reported was the number of primary care contacts.[38-42,44]
- Four studies evaluated the impact of triage services on patient satisfaction using a Likert scale.[37,38,42,44] Measures consisted of overall patient satisfaction, patient perceptions of the encounter, and percentage of patients who would use telephone contact again. The specific metrics included patient questionnaires, the Patient Enablement Instrument (PEI),[60] and an overall satisfaction tool.[85]
- Four studies referenced savings from avoided services' use.[38,40,41,44] Measures consisted of the total costs of services and the mean cost of prescriptions

Table 12 summarizes the metrics for the 9 studies included in KQ 3.

Table 12. Description of Metrics for KQ 3

Study	Metrics Type[a]	Metric Used
Enhanced access to care		
Richards, 2004[40]	Triaged to primary care	Number of calls triaged to primary care services
Richards, 2002[41]	Triaged to primary care	Patients referred for GP appointment, nurse appointment or home visit after their telephone call
Lattimer, 1998[43]	Triaged to primary care	Number of patients who attended
Cragg, 1997[44]	Triaged to ED	Percentage of callers instructed to go to the ED
	Triaged to primary care	Proportion of after-hours callers triaged to a home visit plus consultation at surgery plus consultation at an after-hours center
Change in rates or trends of services use; changes in professionals' workload		
Turner, 2013[39]	Call volume	Monthly data submission to form minimum dataset submitted from each region
	Abandonment rate	Don't directly specify but can be calculated from Table 2 at 1.7%. Other definitions of abandonment are offered, however.
	Speed of answering telephone	Percentage answered in 60 seconds (95%)
Richards, 2004[40]	Call resolution	Final point of contact was nurse telephone call
	Call volume	Number of triage contacts represented by the n enrolled
	Abandonment rate	Number of patients that could not be re-contacted after the initial call
	Nurse productivity	Time spent on triage
Richards, 2002[41]	Call volume	Number of calls received
	Practitioner time	Total time spent by nurses or GPs per call (standardized diary)
	After- hours consultations	Number of after-hours consultations
	Call resolution	Resolved with telephone consultation by nurse or GP
Lattimer, 1998[43]	Call resolution	Calls managed with GP advice over the telephone
	Call volume	Number of calls
Cragg, 1997[44]	Call volume	Number of calls over a given timeframe
	Time from request to arrival of doctor	Minutes
	Prescription patterns	Proportion of callers receiving prescription, proportion receiving antibiotic, proportion receiving generic prescription, proportion receiving prescription within predefined formulary, mean cost of prescription
	Call resolution	Proportion of callers whose concern was managed during telephone call
Munro, 2000[45]	Call volume	Changes in monthly call volume
	Call resolution	Resolved via self-care

Study	Metrics Type[a]	Metric Used
Adverse events (deaths, emergency department attendance, hospital admissions) and delayed care		
Campbell, 2014[38]	Hospital admissions	Number of emergency hospital admissions in 7 days following triage
	Total deaths	Total deaths per 1000 patients within 7 days
	ED attendance	The average number of ED contacts in 28 days after index triage contact
Turner, 2013[39]	ED attendance	Change in ED attendance before and after for NHS 111 compared to ED attendance before and after for NHS Direct; measured as ED visits per 1000 calls
Richards, 2004[40]	ED attendance	Number of ED within 1 month of telephone triage
Richards, 2002[41]	ED attendance	Mean number of ED visits per group per call
McKinstry, 2002[42]	ED attendance	Number of patients who required subsequent ED contact after the index contact from time 0 to 2 weeks.
Lattimer, 1998[43]	Death	Death within 7 days of call
	Hospital admission	Hospital admission within 24 hrs of call
	Hospital admission	Hospital admission within 3 days of call
	ED attendance	ED attendance within 3 days of call
Munro, 2000[45]	ED attendance	Change in monthly contacts over 12 months post-triage implementation
Clinical outcomes after triage		
Campbell, 2014[38]	Primary care contacts	Total primary care contacts within 28 days
Richards, 2004[40]	Primary care contacts	Number of practice visits within 1 month of telephone triage
Turner, 2013[39]	Primary care contacts	Change in utilization of GP after-hours, walk-in center, and urgent care, before and after for NHS 111 compared to care utilization before and after for NHS Direct; measured percent change in monthly activity
Richards, 2002[41]	Primary care contacts	Mean number of after-hours consultations per call plus mean number of return consultations per call
McKinstry, 2002[42]	Primary care contacts	Number of patients who required subsequent primary care contact after the index contact from time 0 to 2 weeks.
Cragg, 1997[44]	Primary care contacts	Use of primary care in 2 weeks post-telephone call
Patient satisfaction measured via Likert scales		
Knowles, 2016[37]	Patient satisfaction questionnaire	Overall satisfaction: % rating excellent or very good attained via questionnaire
Campbell, 2014[38]	Patient satisfaction	Overall satisfaction
McKinstry, 2002[42]	Patient perceptions of the encounter	Patient Enablement Instrument (PEI)[b]
	Would use telephone contact again	Percentage of patients who would use telephone resolution of a similar problem in the future.

Study	Metrics Type[a]	Metric Used
Cragg, 1997[44]	Patient satisfaction assessed with a questionnaire	Overall patient satisfaction tool[c]
Savings from avoided services' use; triage costs		
Campbell, 2014[38]	Cost	Total costs of services
Richards, 2004[40]	Cost	Total cost difference
Richards, 2002[41]	Cost	Mean total cost per group per call
Cragg, 1997[44]	Cost of prescription	Mean cost of prescription

[a] Carrasqueiro, 2011[34]
[b] Howie, 1997[60]
[c] Baker, 1990[85]
Abbreviations: ED=emergency department; GP=general practitioner; NHS=National Health Service

SUMMARY AND DISCUSSION

The promise of remote triage is to expand health care access and decrease barriers associated with distance, cost, and both provider and patient time.[23] Further, increasing access to timely primary care advice may also decrease use of scarce and costly ED and urgent care visits.[86] There are many unanswered questions about the impact of remote triage on key health care outcomes, how best to implement a remote triage system, and key metrics to evaluate these impacts. Thus, we sought to evaluate the effectiveness of remote triage innovations (KQ 1A) and explore differences by triage mode (KQ 1B). We also sought to summarize the published best practices for the implementation of a remote triage system (KQ 2) and to curate a list of possible metrics to evaluate a remote triage system (KQ 3).

To assess the effectiveness of remote triage, we examined the impact of remote triage on outcomes that were meaningful to VHA operations stakeholders and vetted with our panel of technical experts. Our systematic review is innovative in that it included remote triage by any mode and sought to assess effectiveness of both objective and patient-reported outcomes through inclusion of high-quality designs best suited to evaluate organizational-level interventions. Our systematic review evaluated both qualitative and quantitative studies to address the concept of "best practices" for implementing remote triage systems. We identified 9 comparative studies (5 RCT, 3 controlled before-after, 1 interrupted time-series) addressing the effectiveness of remote triage (KQ 1) and metrics used to measure those outcomes (KQ 3), and 32 studies (4 RCTs, 1 controlled before-after, 1 time series, 21 qualitative or mixed-methods, 1 meta-ethnography, 4 systematic reviews) that addressed best practice considerations (KQ 2). No studies specifically addressed Veterans or were conducted in VHA.

Key Question 1 Summary

We assessed the impact of remote triage on utilization of health care, case resolution, patient safety, patient satisfaction, and costs. Studies were too heterogeneous to conduct meta-analysis. We conducted narrative synthesis, focusing on larger and higher quality designs. Overall, these studies tested 3 major comparisons: (1) mode of interaction between patient and practitioner (*ie*, telephone vs in-person consultation); (2) triage conducted by staff of different professional types (*eg*, nonclinical call handler, nurse, general practitioner [GP]); and (3) level of triage organization (*eg*, national triage systems, local in-practice triage systems). None of the studies that met KQ 1 eligibility criteria addressed modalities of triage delivery other than in-person and telephone. As a result, we were unable to address KQ 1B on the impact of remote triage by different modalities such as video, web, and SMS.

Overall, the majority of included studies *did not* demonstrate a decrease in primary care or ED use; however, the current evidence is limited and of marginal quality. Only 1 high ROB study found a significant decrease in primary care utilization when comparing a national telephone triage system to a more local telephone triage system,[45] and no study found a decrease in ED utilization. Instead, 4 studies reported a significant increase in utilization.[38,39,41,42]

Evidence from 2 studies suggested that local, practice-based telephone triage services have higher case resolution outcomes and refer fewer patients to emergency or primary care services compared with regional/national telephone-based remote triage.[40,43,44] Yet only 1 of these studies assessed the rate of referral to emergency services; both local and regional/national telephone-based remote triage services referred very low numbers of patients to emergency services.[44]

We also explored safety outcomes including ED visits, emergent hospitalization, and death; patient satisfaction with the provide remote triage service; and cost of providing remote triage. Only 2 studies[38,43] addressed safety outcomes, and neither identified statistically significant differences in safety outcomes among study arms. No clear pattern emerged about the effects of remote triage on patient satisfaction. Some evidence supports that patient satisfaction is affected to the degree that patients perceive the service they receive to differ from the service they expected (*eg*, seeking same-day appointment vs after-hours advice). Last, we addressed the comparative costs of a telephone triage system. Two studies evaluated the costs of in-person primary care to either GP-led or nurse-led telephone triage and found no difference in overall cost of care.[38,41] A third study compared a national telephone triage system to a local triage system, finding that overall cost was not different when controlling for the final point of contact.[40]

Our stakeholders identified health care utilization, patient safety, and patient satisfaction as the outcomes critical to decision-making. Thus, these are the outcomes for which we conducted certainty of evidence (COE) ratings. These assessments reflect the degree of confidence we have in our summary findings. We focused on rating the COE for the randomized study designs, since the nonrandomized studies had consistently discordant confidence ratings from the randomized designs.[87] For each outcome of interest, we present the COE by the 3 comparisons of remote triage services: mode of triage delivery (*ie*, telephone, in-person), triage professional type (*eg*, nonclinical call handler, nurse, GP) and organizational level of triage system (*eg*, national triage systems, local in-practice triage systems). These ratings are summarized below, with supporting information provided in Table 13.

- We found *moderate* COE to support that remote triage has no effect on ED utilization among the studies comparing in-person and phone modalities and call professional type.
- We found *moderate* COE for no effect on ED utilization among the studies comparing between local in-practice triage and regional/national triage call centers.
- We found *moderate* COE for an *increase* primary care visits among the studies comparing between in-person and phone modalities.
- There is *low* COE that remote triage operated by different call professionals *increases* primary care utilization.
- We found *low* COE to support that remote triage has no effect on primary care visits among the studies comparing between local in-practice triage and regional/national triage call centers.
- There is *low or very low* COE that remote triage has no effect on reducing patient deaths or improving patient satisfaction.
- Of the included studies, only 3 were high-quality, randomized studies that were rated with an overall low ROB that reported each of these outcomes.

Table 13. Certainty of Evidence for Primary Outcomes of Effect of Remote Triage

Outcome	Number of Studies (Triage Encounters)	Range of Effects	Certainty of Evidence (Rationale)
Utilization			
ED utilization **Mode: telephone vs in-person**	2 randomized (21,378)	Range: 0.0 to 0.0 emergency department visits	**No effect on emergency department utilization – Moderate certainty** (rated down for serious risk of bias)
ED utilization **Call professional**	2 randomized (35,482)	0.0 fewer emergency department visits; equivalence trial limits: (313 to 489)[a]	**No effect on emergency department utilization – Moderate certainty** (rated down for serious risk of bias)
ED utilization **Organizational Level**	1 randomized (4,718)	0.01 (95% CI -0.01 to 0.02) more emergency department visits	**No effect on emergency department utilization – Moderate certainty** (rated down for serious inconsistency)
Primary care utilization **Mode: telephone vs in-person**	2 randomized (21,378)	Range: 0.20 more to 0.91 more primary care visits	**Increase in primary care utilization – Moderate certainty** (rated down for serious risk of bias)
Primary care utilization **Call professional**	1 randomized (20,990)	0.16 (95% CI 0.10 to 0.22) more primary care visits	**Increase in primary care utilization – Low certainty** (rated down for serious ROB and inconsistency)
Primary care utilization **Organizational level**	2 randomized (6,870)	Range: 2.30 fewer to 0.06 more primary care visits	**No effect on primary care utilization – Low certainty** (rated down for serious risk of bias and inconsistency)
Patient Safety: Deaths			
Mode: telephone vs in-person	1 randomized (20,990)	Rage: 2.08 increase to 5.44 increase in relative risk of death	**No effect on deaths – Very low certainty** (rated down for serious risk of bias and for imprecision)
Call professional	2 randomized (35,482)	Range: 0.38 fewer to 0.88 fewer deaths	**No effects on deaths – Very low certainty** (rated down for serious risk of bias and for imprecision)
Patient Satisfaction			
Mode: telephone vs in-person	2 randomized (21,378)	Range: 0.61 lower to 3.94 higher patient satisfaction score	**No effect on patient satisfaction – Very low certainty** (rated down for very serious ROB and serious inconsistency)

Outcome	Number of Studies (Triage Encounters)	Range of Effects	Certainty of Evidence (Rationale)
Call professional	1 randomized (20,990)	2.61 (95% CI 0.59 to 4.63) higher patient satisfaction score	**Decrease in patient satisfaction – Low certainty** (rated down for serious ROB and inconsistency)
Organizational level	1 randomized (2,152)	8.90 (95% CI -12.08 to -5.72) lower patient satisfaction score	**Decrease in patient satisfaction – Very low certainty** (rated down for serious ROB and inconsistency)

[a] The equivalence limits are shown here for the non-inferiority trial. The number of ED admissions in the intervention arm was 414 and fell within the equivalence limits (313 to 489).
Abbreviations: CI=confidence interval; ED=emergency department; MD=mean difference; NR=not reported; NA=not applicable; RR= relative risk; SMD=standardized mean difference; ROB=risk of bias

Key Question 2 Summary

No studies identified best practices but brought forth multiple considerations for promising practices when implementing a remote triage system in a large-scale health system such as the VA. Thematic synthesis of the abstracted data identified 11 themes across all KQ 2 studies that conceptualized considerations for best practices that impact the planning, execution, and evaluation of remote triage services for adults seeking clinical care advice. Overall, the planning phase contained the greatest number of studies (n=19), followed by evaluation (n=14), with execution phase having the fewest number of included studies with relevant findings (n=11). Across aspects of remote triage implementation, the process domain contained the largest (78%) and technology domain had the smallest (25%) volume of included studies.

Implementing a remote triage service is a multifactorial process. There are several key findings for emerging practices for the implementation of a remote triage system that may improve efficiency and outcomes. First, the decision to implement a remote triage system influences the entire health care system. At the individual level, considerations must be made for individuals serving as remote triage staff, including (1) adequate initial and ongoing training and (2) a work environment that supports physical and emotional well-being, patients who use triage, and ancillary staff who assist in the daily functioning of triage. At the clinic level, considerations must be made for how remote triage influences the clinic workflow, scheduling and availability of appointments, and workload among clinical and nonclinical call handlers. At the system level, considerations must include how remote triage is influenced by, and also influences, the availability and accessibility of health care services (*ie*, clinic appointments, ambulance services). Attention must be paid to the health care resources in the external environment that impact both remote triage decisions and patients' ability to adhere to advice. Purposeful planning prior to, and throughout the implementation of, remote triage is important in ensuring the success of remote triage. Next, educating patients and their family members on the purpose of remote triage may promote appropriate use of remote triage services. Third, involving call handlers with clinical experience in the planning, execution, and evaluation of remote triage services may facilitate future implementation and use by ensuring that remote triage programs enhance the patient-provider relationship. Last, implementing a remote triage system is perceived as safe, has the potential to reduce medical workload, and can produce a high rate of call resolution. Yet, it

remains unclear whether a reduction in workload is actual or only a delay in the provision of health care services.

Key Question 3 Summary

There are multiple considerations for how to evaluate a remote triage system. We sought to curate a list of possible metrics for operations leaders to consider when assessing the implementation of such a system in the VHA. Thus, we curated the outcomes from the comparative studies in KQ 1. We grouped these metrics based on the 6 categories adapted from Carrasqueiro et al.[34] These categories include (1) enhanced access to care; (2) change in rates or trends of services use or change in professionals' workload; (3) adverse events (deaths, emergency department attendance, hospital admissions) and delayed care; (4) clinical outcomes after triage; (5) patient satisfaction measured via Likert scales; and (6) savings from avoided services use and triage costs.

Prior Systematic Reviews

Most prior literature reviews of telephone triage have included primarily observational studies,[23,66,88] with only 1 (completed for the Cochrane Database) limiting the studies reviewed to those meeting EPOC criteria. Like our review, none found sufficient homogeneity to allow for meta-analysis.[89] Overall, few conclusions can be drawn from the prior systematic reviews. The most consistent findings appear to be that telephone triage did not decrease emergency room visits,[89] a finding that is consistent with what we report. There was evidence that telephone triage may reduce GP workload in the near term, although some studies suggested these visits may just be delayed.[88,89] In contrast, we report no positive impact on decreasing primary care utilization and found 4 studies that reported increase rates of primary care use in patients experiencing remote triage.

Across previous reviews, low power to detect effects and heterogeneity in study designs, interventions, and outcomes limited the conclusions that could be drawn about key constructs including cost, safety, access to care, patient satisfaction, or differences in effectiveness of triage by different health care professionals.[23,66,88,89] Several reviews concluded that the approach to outcome evaluation critically impacted the results and the conclusions that were drawn.[23,66,89] For example, observational studies, studies that surveyed patients, or studies that reviewed medical records were likely to conclude that remote triage was safe with no significant increase in adverse events (AEs). Studies using high-risk simulated patients, however, suggested that about 50% of patients were likely to receive unsafe advice, significantly increasing the risk of AEs.[23,66] In our review, we only included EPOC designs and objective measures of safety (*ie*, accident and emergency visits, emergent hospitalization, death). Only 2 studies addressed these outcomes and neither identified statistically significant differences in safety outcomes among study arms.[38,43] Finally, 1 review concluded that the safety and quality of remote triage appeared to be linked to the properties of the broader system in which the triage was rooted, including policy priorities, health care costs, demographic and cultural factors, and technical infrastructure.[23] We were unable to address this contextual finding in our review.

CLINICAL AND POLICY IMPLICATIONS

Remote clinical triage centers are an increasingly prevalent feature of health care delivery, particularly among large health care organizations. Their growing popularity is matched by a myriad of applications that can vary by contact modalities, staffing models, technologies,

expected users, and outcomes, among other features. In the VHA, remote clinical triage centers are similarly fragmented in that there is no standard model for such a center, and any particular process is often based on local decisions, needs, and resources. A stated goal of the VHA is to develop a model for a 24/7 clinical contact center that allows for a variety of contact options. The multi-modal contact feature is important and is meant to include telephone, chat, text, and video. Existing programs in the VHA provide patient-to-clinician communication. For example, My Health*e*Vet (https://www.myhealth.va.gov/mhv-portal-web/home**)** is a web-based portal that, in addition to other characteristics, allows patients to send secure messages to their clinicians or clinical teams (*eg*, patient aligned care team or PACT). While My Health*e*Vet is available and functions VHA-wide, telephone contact with those same clinicians and clinical teams often follows local mechanisms as prescribed by the clinic or local telephone triage agreements. One goal of our review is to synthesize the evidence and best practices that VHA can use in developing and optimizing a multi-modal clinical contact center model with the potential for national rollout. Our review, however, mostly only focuses on telephone triage, at that is the predominate modality in the literature.

An important goal for remote clinical triage centers is the ability to provide case resolution in the first contact. Such resolution means that a telephone call is managed without triage for other services, or a caller is connected with the appropriate individual with only one call transfer. On call case resolution reflects how well the initial contact serves the needs of the caller by matching care with medical need. In the 2 studies comparing regional or national triage systems to local in-practice triage systems, the practice-based triage system resulted in a greater percentage of case resolution with initial contact.[40,44] A third study found the opposite result but was comparing remote triage with a same-day in-person appointment mechanism.[41] This situation illustrates an important policy consideration: should the remote triage system goal be to resolve cases without triage to in-person services as opposed to determining the appropriate triage destination for that patient?

Designing a remote triage system has implications related to staffing (clinical vs nonclinical staff), setting caller expectations, and other considerations. For example, having a clinician (*eg*, RN) as the first point of contact could allow for dispensing of medical advice, reducing the need for further triage. An alternative staffing model might involve training non-clinicians to make triage decisions (at sites of care that do engage clinical staff). These different design options come with implications for first-contact outcomes and staffing costs. Findings from our exploration of the best practices provides insights into considerations for implementing staffing structures to optimize outcomes.

Lastly, multi-modal contact is another important consideration for the VHA when designing a remote triage system. The ability to enter the triage system by a means other than a telephone call will be important to study and understand. In particular, smartphone-based mechanisms such as texting, messaging, and chat as alternatives to telephone calls may be a preferred means of contact for many Veterans. While the mode that Veterans use to contact the system may be transparent to the recipient, it is nonetheless important to also consider how the recipient receives these requests and what the expectations are for processing requests. Unfortunately, our review identified only 1 non-telephone-delivered study, and so we were not able to provide evidence to support the development of multi-modal contact centers.

LIMITATIONS

Our review has a number of strengths, including a protocol-driven design, a comprehensive search, inclusion of EPOC designs best suited to assess organizational-level interventions, and careful quality assessment. For KQ 2, in addition, we conducted rigorous qualitative synthesis that combined thematic analysis and matrix analysis. Both our review and the literature, however, have limitations. Our review was limited to English-language publications, but the likelihood of identifying relevant data unavailable from English-language sources is low. The number of identified studies for many outcomes was small, and most of the comparative literature for KQ 1 and KQ 3 had design limitations that affected study quality. Other limitations are detailed below.

Publication Bias

Given the small number of studies, statistical methods to detect publication bias are not useful. Other strategies, such as searching ClinicalTrials.gov for completed but unpublished studies is not a particularly effective way to identify publication bias.[90] Thus, we did not conduct formal publication bias analysis.

Study Quality

We were also limited by the existing literature. We identified relatively few comparative EPOC studies, with 50% assessed as unclear or high ROB for objective outcomes. Inadequate or unclear balance of baseline outcomes across groups, outcome assessments that were not clearly blinded to intervention assignment, or incomplete outcome data contributed to judgments of higher risk. Further, interventions were often described incompletely and it was difficult to gain details into key aspects of the comparative literature such as the use of a protocol or type of clinical decision support software used. The tools used to assess the ROB for the studies included in KQ 2 did not allow for the calculation of summary scores. However, we assessed all studies for ROB. Among these studies, ROB was relatively consistent with the overwhelming majority of studies having low ROB across metrics of qualitative rigor.

Heterogeneity

Remote clinical triage is a complex, organizational intervention, which has inherent heterogeneity. Overall, our review included a wide variety of study designs (*ie*, EPOC designs, organizational case studies, qualitative studies, systematic reviews) across key questions. For KQ 1, our review also included 3 major comparisons: (1) mode of interaction between patient and practitioner (*ie*, telephone vs in-person consultation); (2) triage professional type; and (3) level of triage organization. We addressed this heterogeneity by clustering our narrative synthesis by comparison type and focused first on the randomized, higher quality designs. For the studies in KQ 2, we addressed the study diversity by first coding findings by level of best practice consideration (planning, executing, evaluation) and then by aspect (*ie*, people, process, technology).

Applicability of Findings to the VA Population

None of the included studies were conducted in VHA or specifically with Veterans. However, we limited eligibility to studies conducted in OECD countries, which improves applicability to VHA. All comparative studies were conducted in the United Kingdom. Further, we limited

studies to those conducted in larger health care systems. Across included studies, there were limited data on patient characteristics to compare to the overall VHA population. Yet the findings presented here likely have applicability to any large health care system seeking to implement a remote clinical triage center by telephone.

RESEARCH GAPS/FUTURE RESEARCH

This comprehensive review of the literature identified several gaps in the current evidence that warrant future investigation. We used the framework recommended by Robinson et al[91] to identify gaps in evidence and classify why these gaps exist (Table 14). This approach considers the population, intervention, comparator, outcome, timing, and setting (PICOTS) to identify gaps and classifies them as due to (1) low strength of evidence or imprecise information, (2) biased information, (3) inconsistency or unknown consistency, and (4) not the right information. VA and other health care systems should consider their clinical and policy needs when deciding whether to invest in research to address gaps in evidence.

Table 14. Evidence Gaps and Future Research

Evidence Gap	Reason	Type of Studies to Consider
Population		
· No studies that actively recruited Veterans · No studies conducted with US populations	Insufficient information	· RCTs · Quasi-experimental studies · Prospective cohort studies
Interventions		
· Beyond telephone, what other modes of remote triage enhance access and improve clinical outcomes and workflow? · What is the impact that access to the electronic medical record has on remote triage? · What are the critical elements needed to support remote triage implementation? · Does triage staff experience (*eg*, years conducting remote triage) matter more than triage staff type (*eg*, MD or RN)? · What are the critical elements of the clinical decision support software that optimize efficiency, safety, and clinical judgment? · How should triage systems and researchers measure health care utilization to account for appropriate use of services? · How do expectations of remote triage services impact patient satisfaction? · How to prime patients for the appropriate use of remote triage to optimize utilization and safety outcomes?	Insufficient information	· Comparative effectiveness trials of different types of interventions · Dismantling studies · Longitudinal studies · Qualitative studies

Evidence Gap	Reason	Type of Studies to Consider
Comparators		
· Few head-to-head comparisons of different triage staff types, modalities, organizational levels, or remote triage features	Insufficient information	· Cluster RCTs · Comparative effectiveness trials
Outcomes		
Limited information on: · Health care utilization · Case resolution · Patient safety · Patient satisfaction · Costs	Insufficient information	· Cluster RCTs · Prospective cohort studies · Nonrandomized controlled before-and-after studies
Setting		
· Limited evidence from US setting, VA Healthcare System, or other large health care systems	Insufficient information	· Cluster RCTs · Hybrid implementation designs · Prospective or retrospective cohort studies · Nonrandomized controlled before-and-after studies

Abbreviations: MD=medical doctor; RCT=randomized controlled trial; RN=registered nurse; VA=Veterans Affairs

CONCLUSIONS

The US health care system faces several challenges, including an aging population, patients with multiple chronic conditions, and an uneven distribution of primary care providers across the country. These conditions create a shortfall in access to primary care, pushing some patients to seek care in urgent or ED settings. Remote clinical triage systems have the potential to reduce medical workload, improve access to primary care advice, and reduce inappropriate use of urgent care and ED services. Our review provides evidence that the remote triage systems we studied may be falling short of these goals, although the identified literature was sparse and of variable quality. We found limited evidence to support that remote triage reduces the burden on primary care utilization or subsequent use of ED services. However, remote triage by telephone can produce a higher rate of call resolution than regional or national systems, and appears to be safe in the 2 studies that assessed these outcomes. Yet it remains unclear whether this rate of case resolution results in an actual reduction in use of primary and ED services or only a delay in the provision of services. Last, our study underscores several key considerations for implementing a remote clinical triage system, including the careful consideration of organizational and stakeholder buy-in prior to remote triage launch, physical and psychological workplace environment, staff training and ongoing support, and careful consideration of what metrics best assess the effectiveness and efficiency of remote triage implementation. Further study is needed to assess the promise of remote triage in optimizing health care outcomes while maintaining patient-reported satisfaction.

REFERENCES

1. Population Reference Bureau. Fact Sheet: Aging in the United States. Report. Available at: https://www.prb.org/aging-unitedstates-fact-sheet/. Accessed December 6, 2018.
2. Ailes EC, Gilboa SM, Honein MA, et al. Estimated number of infants detected and missed by critical congenital heart defect screening. *Pediatrics*. 2015;135(6):1000-8.
3. Centers for Disease Control and Prevention (CDC). National Center for Chronic Disease Prevention and Health Promotion. Multiple Chronic Conditions. Available at: https://www.cdc.gov/chronicdisease/about/multiple-chronic.htm. Accessed December 6, 2018.
4. Agency for Healthcare Research and Quality. The Distribution of the US Primary Care Workforce. Available at: https://www.ahrq.gov/research/findings/factsheets/primary/pcwork3/index.html. Accessed December 6, 2018.
5. Bodenheimer T, Pham HH. Primary care: current problems and proposed solutions. *Health Aff (Millwood)*. 2010;29(5):799-805.
6. Kullgren JT, McLaughlin CG, Mitra N, et al. Nonfinancial barriers and access to care for US adults. *Health Serv Res*. 2012;47(1 Pt 2):462-85.
7. Douthit N, Kiv S, Dwolatzky T, et al. Exposing some important barriers to health care access in the rural USA. *Public Health*. 2015;129(6):611-20.
8. Pitts SR, Carrier ER, Rich EC, et al. Where Americans get acute care: increasingly, it's not at their doctor's office. *Health Aff (Millwood)*. 2010;29(9):1620-9.
9. Agency for Healthcare Research and Quality. Healthcare Cost and Utilization Project (HCUP). Trends in Hospital Emergency Department Visits by Age and Payer, 2006-2015. Statistical Brief #238. March 2018. Available at: https://www.hcup-us.ahrq.gov/reports/statbriefs/sb238-Emergency-Department-Age-Payer-2006-2015.jsp. Accessed December 6,2018.
10. Galarraga JE, Pines JM. Costs of ED episodes of care in the United States. *Am J Emerg Med*. 2016;34(3):357-65.
11. Gindi RM, Black LI, Cohen RA. Reasons for Emergency Room Use Among US Adults Aged 18-64: National Health Interview Survey, 2013 and 2014. *Natl Health Stat Report*. 2016(90):1-16.
12. O'Malley AS. After-hours access to primary care practices linked with lower emergency department use and less unmet medical need. *Health Affairs*. 2013;32(1):175-183.
13. Critical Appraisal Skills Programme (CASP). CASP Qualitative Checklist. Available at: http://www.casp-uk.net/casp-tools-checklists. Accessed May 17, 2018.
14. Jue JS, Spector SA, Spector SA. Telemedicine broadening access to care for complex cases. *J Surg Res*. 2017;220:164-170.
15. Mechanic OJ, Kimball AB. Telehealth Systems. *StatPearls*. Treasure Island (FL); 2018.
16. Shih J, Portnoy J. Tips for Seeing Patients via Telemedicine. *Curr Allergy Asthma Rep*. 2018;18(10):50.
17. Saliba V, Legido-Quigley H, Hallik R, et al. Telemedicine across borders: a systematic review of factors that hinder or support implementation. *Int J Med Inform*. 2012;81(12):793-809.
18. van Galen LS, Car J. Telephone consultations. *BMJ*. 2018;360:k1047.
19. Reed M, Graetz I, Gordon N, et al. Patient-initiated e-mails to providers: associations with out-of-pocket visit costs, and impact on care-seeking and health. *Am J Manag Care*. 2015;21(12):e632-9.

20. Brady M, Northstone K. Remote clinical decision-making: a clinician's definition. *Emergency Nurse*. 2017;25(2):24-28.
21. Bunn F, Byrne G, Kendall S. Telephone consultation and triage: effects on health care use and patient satisfaction. *Cochrane Database Syst Rev*. 2004(4):Cd004180.
22. Ismail SA, Gibbons DC, Gnani S. Reducing inappropriate accident and emergency department attendances: a systematic review of primary care service interventions. *Br J Gen Pract*. 2013;63(617):e813-20.
23. Lake R, Georgiou A, Li J, et al. The quality, safety and governance of telephone triage and advice services - an overview of evidence from systematic reviews. *BMC Health Serv Res*. 2017;17(1):614.
24. Ross J, Stevenson F, Lau R, et al. Factors that influence the implementation of e-health: a systematic review of systematic reviews (an update). *Implement Sci*. 2016;11(1):146.
25. Newbould J, Abel G, Ball S, et al. Evaluation of telephone first approach to demand management in English general practice: Observational study. *BMJ (Online)*. 2017;358.
26. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med*. 2009;6(7):e1000097.
27. Cochrane Effective Practice and Organisation of Care (EPOC). Suggested risk of bias criteria for EPOC reviews. EPOC Resources for review authors, 2017. Available at: http://epoc.cochrane.org/resources/epoc-resources-review-authors Accessed May 17, 2018.
28. Evidence Partners Inc. DistillerAI website. Available at: https://www.evidencepartners.com/distiller-ai/. Accessed October 12, 2018.
29. Hong QN, Pluye P, Fàbregues S, et al. Mixed Methods Appraisal Tool (MMAT), version 2018. Registration of Copyright (#1148552), Canadian Intellectual Property Office, Industry Canada. Available at: http://mixedmethodsappraisaltoolpublic.pbworks.com/w/page/127425845/Download%20the%20MMAT. Accessed October 11, 2018.
30. Shea BJ, Bouter LM, Peterson J, et al. External validation of a measurement tool to assess systematic reviews (AMSTAR). *PLoS One*. 2007;2(12):e1350.
31. Gale NK, Heath G, Cameron E, et al. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol*. 2013;13:117.
32. Thomas J, Harden A. Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Med Res Methodol*. 2008;8:45.
33. Averill JB. Matrix analysis as a complementary analytic strategy in qualitative inquiry. *Qual Health Res*. 2002;12(6):855-66.
34. Carrasqueiro S, Oliveira M, Encarnacao P. Evaluation of telephone triage and advice services: a systematic review on methods, metrics and results. *Stud Health Technol Inform*. 2011;169:407-11.
35. Balshem H, Helfand M, Schunemann HJ, et al. GRADE guidelines: 3. Rating the quality of evidence. *J Clin Epidemiol*. 2011;64(4):401-6.
36. Carrasqueiro S, Oliveira M, Encarnaço P. Evaluation of telephone triage and advice services: A systematic review on methods, metrics and results. 2011: 407-411.
37. Knowles E, O'Cathain A, Turner J, et al. Effect of a national urgent care telephone triage service on population perceptions of urgent care provision: controlled before and after study. *BMJ Open*. 2016;6(10):e011846.

38. Campbell JL, Fletcher E, Britten N, et al. Telephone triage for management of same-day consultation requests in general practice (the ESTEEM trial): a cluster-randomised controlled trial and cost-consequence analysis. *Lancet*. 2014;384(9957):1859-1868.
39. Turner J, O'Cathain A, Knowles E, et al. Impact of the urgent care telephone service NHS 111 pilot sites: a controlled before and after study. *BMJ Open*. 2013;3(11):e003451.
40. Richards DA, Godfrey L, Tawfik J, et al. NHS Direct versus general practice based triage for same day appointments in primary care: cluster randomised controlled trial. *BMJ*. 2004;329(7469):774.
41. Richards DA, Meakins J, Tawfik J, et al. Nurse telephone triage for same day appointments in general practice: multiple interrupted time series trial of effect on workload and costs. *BMJ*. 2002;325(7374):1214.
42. McKinstry B, Walker J, Campbell C, et al. Telephone consultations to manage requests for same-day appointments: a randomised controlled trial in two practices. *Br J Gen Pract*. 2002;52(477):306-10.
43. Lattimer V, George S, Thompson F, et al. Safety and effectiveness of nurse telephone consultation in out of hours primary care: randomised controlled trial. The South Wiltshire Out of Hours Project (SWOOP) Group. *BMJ*. 1998;317(7165):1054-9.
44. Cragg DK, McKinley RK, Roland MO, et al. Comparison of out of hours care provided by patients' own general practitioners and commercial deputising services: a randomised controlled trial. I: The process of care. *BMJ*. 1997;314(7075):187-9.
45. Munro J, Nicholl J, O'Cathain A, et al. Impact of NHS Direct on demand for immediate care: Observational study. *British Medical Journal: BMJ*. 2000;321(7254):150-153.
46. Kreuter MW, McQueen A, Boyum S, et al. Unmet basic needs and health intervention effectiveness in low-income populations. *Prev Med*. 2016;91:70-75.
47. Buja A, Toffanin R, Rigon S, et al. Determinants of out-of-hours service users' potentially inappropriate referral or non-referral to an emergency department: a retrospective cohort study in a local health authority, Veneto Region, Italy. *BMJ Open*. 2016;6(8):e011526.
48. Nyamtema A, Mwakatundu N, Dominico S, et al. Introducing eHealth strategies to enhance maternal and perinatal health care in rural Tanzania. *Matern Health Neonatol Perinatol*. 2017;3:3.
49. Thomson GA, Fernando DJ, Bushby P, et al. A comprehensive e-education engine for a virtual diabetes centre. *J Telemed Telecare*. 2006;12 Suppl 1:48-50.
50. Olden M, Wyka K, Cukor J, et al. Pilot Study of a Telehealth-Delivered Medication-Augmented Exposure Therapy Protocol for PTSD. *J Nerv Ment Dis*. 2017;205(2):154-160.
51. Wang TT, Li JM, Zhu CR, et al. Assessment of Utilization and Cost-Effectiveness of Telemedicine Program in Western Regions of China: A 12-Year Study of 249 Hospitals Across 112 Cities. *Telemed J E Health*. 2016;22(11):909-920.
52. Grustam AS, Severens JL, Van Nijnatten J, et al. Cost-effectiveness of telehealth interventions for chronic heart failure patients: A literature review. *Int J Technol Assess Health Care*. 2014;30(1):59-68.
53. Raymond M, Harrison MC. The structured communication tool SBAR (Situation, Background, Assessment and Recommendation) improves communication in neonatology. *South African Medical Journal*. 2014;104(12):850-852.
54. McKinley RK, Manku-Scott T, Hastings AM, et al. Reliability and validity of a new measure of patient satisfaction with out of hours primary medical care in the United Kingdom: development of a patient questionnaire. *BMJ*. 1997;314(7075):193-8.

55. Holly J, Bledsoe J, Black K, et al. Prospective evaluation of an ED observation unit protocol for trauma activation patients. *Am J Emerg Med*. 2012;30(8):1402-1406.
56. Mollerup A, Harboe G, Johansen JD. User evaluation of patient counselling, combining nurse consultation and eHealth in hand eczema. *Contact Dermatitis*. 2016;74(4):205-16.
57. De Rosa M, Rinaldi E, Ortali M, et al. Virtual Consultation System To Enable Rare Diseases Diagnosis. *Value Health*. 2015;18(7):A366.
58. Lear SA, MacKinnon D, Farias-Godoy A, et al. Rapid access to cardiology expertise: an innovative program to provide telephone support for family physicians. *Healthc Q*. 2010;13(4):56-60.
59. Joschko J, Liddy C, Moroz I, et al. Just a click away: Exploring patients' perspectives on receiving care through the Champlain BASE™ eConsult service. *Fam Pract*. 2018;35(1):93-98.
60. Howie JG, Heaney DJ, Maxwell M. Measuring quality in general practice. Pilot study of a needs, process and outcome measure. *Occas Pap R Coll Gen Pract*. 1997(75):i-xii, 1-32.
61. Wahlberg AC, Bjorkman A. Expert in nursing care but sometimes disrespected - telenurses' reflections on their work environment and nursing care. *J Clin Nurs*. 2018.
62. Eccles G, Edwards A. Evaluating a service improvement intervention in GP out-of-hours: impact of 'expert triage model'. *Qual Prim Care*. 2015;23(1):9-17.
63. Foster J, Jessopp L, Dale J. Concerns and confidence of general practitioners in providing telephone consultations. *Br J Gen Pract*. 1999;49(439):111-3.
64. Purc-Stephenson RJ, Thrasher C. Nurses' experiences with telephone triage and advice: a meta-ethnography. *J Adv Nurs*. 2010;66(3):482-94.
65. Röing M, Holmström IK. Malpractice claims in Swedish telenursing: lessons learned from interviews with telenurses and managers. *Nurs Res*. 2015;64(1):35-43.
66. Blank L, Coster J, O'Cathain A, et al. The appropriateness of, and compliance with, telephone triage decisions: a systematic review and narrative synthesis. *J Adv Nurs*. 2012;68(12):2610-21.
67. Edwards B. Seeing is believing--picture building: a key component of telephone triage. *J Clin Nurs*. 1998;7(1):51-7.
68. Gamst-Jensen H, Lippert FK, Egerod I. Under-triage in telephone consultation is related to non-normative symptom description and interpersonal communication: a mixed methods study. *Scand J Trauma Resusc Emerg Med*. 2017;25(1):52.
69. Pettinari CJ, Jessopp L. "Your ears become your eyes": managing the absence of visibility in NHS Direct. *J Adv Nurs*. 2001;36(5):668-75.
70. Timpka T, Arborelius E. The primary-care nurse's dilemmas: a study of knowledge use and need during telephone consultations. *J Adv Nurs*. 1990;15(12):1457-65.
71. Turnbull J, Prichard J, Pope C, et al. Risk work in NHS 111: the everyday work of managing risk in telephone assessment using a computer decision support system. *Health, Risk & Society*. 2017;19(3/4):189-208.
72. Pope C, Halford S, Turnbull J, et al. Using computer decision support systems in NHS emergency and urgent care: ethnographic study using normalisation process theory. *BMC Health Serv Res*. 2013;13:111.
73. Tariq A, Westbrook J, Byrne M, et al. Applying a human factors approach to improve usability of a decision support system in tele-nursing. *Collegian*. 2017;24(3):227-236.
74. Richards SH, Pound P, Dickens A, et al. Exploring users' experiences of accessing out-of-hours primary medical care services. *Qual Saf Health Care*. 2007;16(6):469-77.

75. Holmström IK, Nokkoudenmäki MB, Zukancic S, et al. It is important that they care - older persons' experiences of telephone advice nursing. *J Clin Nurs*. 2016;25(11-12):1644-1653.
76. Holmström I, Höglund AT. The faceless encounter: Ethical dilemmas in telephone nursing. *J Clin Nurs*. 2007;16(10):1865-1871.
77. Roberts A, Heaney D, Haddow G, et al. Implementation of a national, nurse-led telephone health service in Scotland: assessing the consequences for remote and rural localities. *Rural Remote Health*. 2009;9(2):1079.
78. Turnbull J, Prichard J, Halford S, et al. Reconfiguring the emergency and urgent care workforce: mixed methods study of skills and the everyday work of non-clinical call-handlers in the NHS. *J Health Serv Res Policy*. 2012;17(4):233-40.
79. O'Cathain A, Nicholl J, Sampson F, et al. Do different types of nurses give different triage decisions in NHS Direct? A mixed methods study. *J Health Serv Res Policy*. 2004;9(4):226-233.
80. Derkx HP, Rethans JJ, Knottnerus JA, et al. Assessing communication skills of clinical call handlers working at an out-of-hours centre: development of the RICE rating scale. *Br J Gen Pract*. 2007;57(538):383-7.
81. Banks J, Farr M, Salisbury C, et al. Use of an electronic consultation system in primary care: a qualitative interview study. *Br J Gen Pract*. 2018;68(666):e1-e8.
82. Greatbatch D, Hanlon G, Goode J, et al. Telephone triage, expert systems and clinical expertise. *Sociol Health Illn*. 2005;27(6):802-30.
83. Lopriore S, LeCouteur A, Ekberg S, et al. Delivering healthcare at a distance: Exploring the organisation of calls to a health helpline. *Int J Med Inform*. 2017;104:45-55.
84. McKenzie R. Consumer awareness, satisfaction, motivation and perceived benefits from using an after-hours GP helpline - A mixed methods study. *Aust Fam Physician*. 2016;45(7):512-7.
85. Baker R. Development of a questionnaire to assess patients' satisfaction with consultations in general practice. *Br J Gen Pract*. 1990;40(341):487-90.
86. Friedman BW, Mulvey L, Davitt M, et al. Predicting 7-day and 3-month functional outcomes after an ED visit for acute nontraumatic low back pain. *Am J Emerg Med*. 2012;30(9):1852-1859.
87. Schunemann HJ, Cuello C, Akl EA, et al. GRADE guidelines: 18. How ROBINS-I and other tools to assess risk of bias in nonrandomized studies should be used to rate the certainty of a body of evidence. *J Clin Epidemiol*. 2019;111:105-114.
88. Downes MJ, Mervin MC, Byrnes JM, et al. Telephone consultations for general practice: a systematic review. *Syst Rev*. 2017;6(1):128.
89. Bunn F, Byrne G, Kendall S. The effects of telephone consultation and triage on healthcare use and patient satisfaction: a systematic review. *Br J Gen Pract*. 2005;55(521):956-61.
90. Adam GP, Springs S, Trikalinos T, et al. Does information from ClinicalTrials.gov increase transparency and reduce bias? Results from a five-report case series. *Syst Rev*. 2018;7(1):59.
91. Robinson KA, Saldanha IJ, McKoy NA. Development of a framework to identify research gaps from systematic reviews. *J Clin Epidemiol*. 2011;64(12):1325-30.
92. Campbell JL, 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(13):1-212, vii-viii.
93. Holt TA, Fletcher E, Warren F, et al. Telephone triage systems in UK general practice: analysis of consultation duration during the index day in a pragmatic randomised controlled trial. *Br J Gen Pract*. 2016;66(644):e214-8.
94. Warren FC, Calitri R, Fletcher E, et al. Exploring demographic and lifestyle associations with patient experience following telephone triage by a primary care doctor or nurse: secondary analyses from a cluster randomised controlled trial. *BMJ Qual Saf*. 2015;24(9):572-82.
95. Calitri R, Warren FC, Wheeler B, et al. Distance from practice moderates the relationship between patient management involving nurse telephone triage consulting and patient satisfaction with care. *Health Place*. 2015;34:92-6.
96. Murdoch J, Varley A, Fletcher E, et al. Implementing telephone triage in general practice: a process evaluation of a cluster randomised controlled trial. *BMC Fam Pract*. 2015;16:47.
97. Varley A, Warren FC, Richards SH, et al. The effect of nurses' preparedness and nurse practitioner status on triage call management in primary care: A secondary analysis of cross-sectional data from the ESTEEM trial. *Int J Nurs Stud*. 2016;58:12-20.
98. Holt TA, Fletcher E, Warren F, et al. Telephone triage systems in UK general practice: Analysis of consultation duration during the index day in a pragmatic randomised controlled trial. *Br J Gen Pract*. 2016;66(644):e214-e218.
99. Anonymous. Same-day GP and nurse-led telephone triage v usual care. *Primary Health Care*. 2014;24(8):15-15.
100. Mayor S. Primary care telephone triage does not reduce workload, study finds. *BMJ: British Medical Journal*. 2014;349(7970):2-2.
101. McKinley RK, Cragg DK, Hastings AM, et al. Comparison of out of hours care provided by patients' own general practitioners and commercial deputising services: a randomised controlled trial. II: The outcome of care. *BMJ*. 1997;314(7075):190-3.
102. Lattimer V, Sassi F, George S, et al. Cost analysis of nurse telephone consultation in out of hours primary care: evidence from a randomised controlled trial. *BMJ*. 2000;320(7241):1053-7.
103. Savings outweigh costs of nurse telephone consultation in out of hours primary care. *BMJ*. 2000;320(7241):E.
104. Southard EP, Neufeld JD, Laws S. Telemental health evaluations enhance access and efficiency in a critical access hospital emergency department. *Telemed J E Health*. 2014;20(7):664-8.
105. O'Cathain A, Knowles E, Turner J, et al. Acceptability of NHS 111 the telephone service for urgent health care: cross sectional postal survey of users' views. *Fam Pract*. 2014;31(2):193-200.
106. Richards DA, Meakins J, Godfrey L, et al. Survey of the impact of nurse telephone triange on general practitioner activity. *Br J Gen Pract*. 2004;54(500):207-210.
107. Ernesater A, Holmstrom I, Engstrom M. Telenurses' experiences of working with computerized decision support: supporting, inhibiting and quality improving. *J Adv Nurs*. 2009;65(5):1074-83.
108. O'Cathain A, Sampson FC, Munro JF, et al. Nurses' views of using computerized decision support software in NHS Direct. *J Adv Nurs*. 2004;45(3):280-6.

109. Turnbull J, Pope C, Rowsell A, et al. Health Services and Delivery Research: The work, workforce, technology and organisational implications of the '111' single point of access telephone number for urgent (non-emergency) care: a mixed-methods case study. 2014.
110. Bjorkman A, Engstrom M, Olsson A, et al. Identified obstacles and prerequisites in telenurses' work environment - a modified Delphi study. *BMC Health Serv Res*. 2017;17(1):357.
111. Hultcrantz M, Rind D, Akl EA, et al. The GRADE Working Group clarifies the construct of certainty of evidence. *J Clin Epidemiol*. 2017;87:4-13.