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Patient facing online triage tools and clinician decision-making: a systematic review

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Title: Patient facing online triage tools and clinician decision-making: a systematic review

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ABSTRACT

Objective: to evaluate the role of using outputs from patient facing online triage tools in clinical decision-making in primary care

Design: Systematic review

Data sources: Medline, Embase, CINHAL, Web of Science and Scopus were searched for literature published between 1 January 2002 and 31 December 2022, and updated for literature published up to end of November 2024.

Eligibility criteria for selecting studies: studies of any design are included where the study investigates how primary care clinicians make clinical decision in response to patient concerns reported using online triage tools.

Data extraction and synthesis: Data was extracted and quality assessment conducted using the mixed methods appraisal tool. Narrative synthesis was used to analyse the findings.

Results: Fourteen studies were included, which were conducted in the UK (n=9), Sweden (n=3) and Spain (n=2). There were no studies that examined clinical decision-making as an outcome. Outcomes relating to the impact on clinical decision-making were grouped in three categories: patient clinical outcomes (n=9), primary care practitioner experience (n=11) and healthcare system outcomes (n=14). Studies reported faster clinical decisions made in response to patient concerns. Other studies reported clinicians offering unnecessary urgent appointments as patients learnt to 'game' the system. Clinicians felt confident managing patient requests as they can access additional information (such as a photo attachment). Moreover, clinicians time was freed up from appointments with limited clinical value. Contrarily, online triage was perceived as an additional step in the workflow.

Conclusion: Clinicians should be aware that their decision-making processes are likely to differ when using online triage tools. Developers can use the findings to improve the usability of the tools to aid clinical decision-making. Future research should focus on patient facing online triage tools in general practice and the process of clinical decision-making.

PROSPERO registration number: CRD42022373944

Strengths and limitations of this study:

- This is the first systematic review to focus on outcomes relating to clinical decision-making from triaging patients who completed an online form to contact their primary care service.
- This review compares the tools usage across different countries with universal healthcare coverage, enabling insights from early adopters of the technology.
- This review covers a 20-year period, to enable evaluation of older literature. However, the number of included studies was very small, because this topic is not sufficiently studied yet.
- The review was limited to studies published in English, which may have led to some evidence being overlooked.

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BACKGROUND

Patient facing online triage tools in primary care facilitate contact between the patient and their primary care service provider. The tools gather information about patients’ clinical needs to enable triage decisions on the appropriate next steps. A triage decision is usually focussed on how best to meet the identified patient healthcare needs. Patient’s needs might be resolved over a telephone consultation, by issuing a repeat prescription, require the patient to be seen by a healthcare professional (e.g. a general practitioner (GP) or a nurse), or require escalation to secondary care [1]. In short, triage is a prioritisation process that has long been proposed as a solution to management of the demand for primary care services [2-5].

Both NHS England [6] and the Royal College of General Practitioners (RCGP) [7], have taken an interest in encouraging use of patient facing online triage tools in primary care. Online triage is part of the digital transformation that ensures better patient access to primary care [8]. Online triage tools allow the patient, their carer or non-clinical reception staff at the general practice to complete a form outlining the reason for contacting their primary care general practice. Clinicians then review the submitted form and use it to prioritise patients based on their clinical needs. There are reported challenges facing the adoption of remote triage across Northern Europe [9, 10]. These challenges include primary care clinicians’ workload, in particular whether the tools create additional work or reduce workload [11, 12]. Some online tools are now using artificial intelligence (whether rules based or using machine learning) to enable these tools to flag key complaints and simplifying the reviewing of forms by the clinician [13].

Clinical decision-making is the process where a clinician combines the information reported by the patient with their expert judgement to make the best decision on the patient’s clinical journey [14]. The clinical decision-making process using reports from online triage tools is influenced only by information reported on the triage form, and lacks visual and verbal cues (e.g. eye contact, patient voice and the patient context) present when patients consult in person [15, 16]. Clinicians are often guided by “gut-feelings” which might only occur if the triage clinical decision leads to a telephone or an in person follow-up rather than a written response [17]. However, outcomes like safety-netting [18, 19] (e.g. when a doctor asks the patients to book another consultation if their symptoms do not improve in a few weeks) are possible in online triage.

Previous systematic reviews have examined this topic with a focus [20, 21] on examining patient safety, timeliness, efficiency, equitability and patient-centeredness as outcomes of using online communication tools in primary care. Darley et al. [20] review included a wide range of digital and online tools and outcomes and analysed the literature from the perspectives of patients, clinicians, tool developers and policymakers without analysis of the impact on clinical decision making. Additionally, the review focused on implementation at practice level not clinical application of patient facing online triage tools. The other systematic review by Mold et al. [21] focused on tools where patients respond to their primary care provider using secure email and messaging or video links in primary care. Mold et al review differs from this systematic review in that the patient facing online triage tools examined in this study require the patients to initiate the contact with their primary care provider.

This review examines how primary care clinicians make clinical decisions when using outputs/reports from patient facing online triage tools, given they have become more widely adopted by general practices in recent years.

METHODS

This systematic review examines how primary care clinicians use outputs from patient facing online triage tools for clinical decision-making in primary care and the associated clinical, patient and health system outcomes.

This systematic review is reported according to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) framework [22] and following the completed PRISMA checklist attached in Appendix 1.

Patient and public involvement

No patient and public involvement (PPI) directly fed into the development or conduct of this review.

Eligibility criteria

The population, interventions, comparators, outcomes and study design (PICOS) principles were used to develop the eligibility criteria:

Population: primary care clinicians using output or reports from patient facing online triage tools to make a clinical triage decision, where the patients completed the triage requests and were adult patients.

Interventions: studies that assessed web or app-based tools used in primary care setting where the patient, their carer or general practice receptionist completes a form for a clinician to review and triage. Including but not limited to tools that are using AI (artificial intelligence).

Studies were excluded where the intervention tools being assessed met at least one of the following criteria: being used only outside of primary care settings, used to assess specific symptoms and features rather than providing triage (e. g. symptoms of diabetes, BMI check), they were a digital symptom checker platforms, providing likely diagnosis, do not inform the triage, they provided access to a direct primary care consultation, or were still under development.

Comparators: studies were not required to have a comparator, and any comparator group was considered.

Outcomes: studies that assessed clinical decision-making as an outcome, or studies that assessed at least one outcome related to clinical decision-making. The outcomes related to clinical decision-making are defined as any outcome that may be impacted by change in the quantity and quality of information available to the clinician, due to change of information source (in-person vs patient facing online triage tool) when making a clinical decision, if everything else remains the same (tools to process the information, and the clinician level of expertise). Therefore, the following outcomes relating to clinical decision-making were used as a guide: 1) Clinical outcomes such as diagnosis, severity of diagnosis, time to treatment, time to first investigation, time to referral, alignment with professional guidance on investigation, treatment, or referral. 2) Primary care practitioner experience such as confidence in diagnosis, and comfort with decision-making. 3) Healthcare system outcomes such as frequency of primary care appointments via different modes, clinical workload, number of Emergency Department (ED) attendances, and emergency admissions. Outcomes relating to clinical decision-making were included whether assessed at an individual clinician level or system level (e.g. general practice). Studies that examined hypothetical clinician experience and that focus on patient satisfaction of using the tools, were excluded. The outcomes outlined are a guide to what is expected to find in search results and allow the authors to group the data. This ensures that any outcome that is relevant to the question will be included. The outcomes were selected based on input from subject matter experts (BH and JD) in primary care.

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Study design: All empirical study designs were eligible for inclusion: qualitative (case studies, interviews, focus groups, observational notes, open-ended surveys), quantitative (cohort studies, case reports, secondary data analysis), and mixed methods studies. Systematic reviews were excluded.

Search: There was no restriction on country of study. and only studies published in English were eligible for inclusion. The decision to include non-UK based publications was taken to identify the similarities and differences in outcomes from different countries in relation to the diverse models of primary care service delivery, for example the variation in the role of GPs and patients access to healthcare services in different countries.

The initial search was limited to articles published between 2002 and 2022 reflecting that the tools of interest emerged over the last 15 years. The updated search was carried out for articles published up to end of November 2024.

Search strategy

The search strategy was designed with the support from a subject librarian.

Various keywords and search terms and their combinations that define 'primary health care', 'family doctor', 'digital tool', 'triage' were used. The search terms were combined using Boolean strategies of 'AND' and 'OR'. The search was limited only to studies published in the last 20 years and no other restriction criteria was applied. The search terms and strategy were amended as required when using different search databases. Medline (Ovid SP), Embase (Ovid SP), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science and SCOPUS search databases were used in this review. Search terms for all five databases can be seen in Appendix 2. Reference hand searches were conducted for all included full texts. Additionally, citations in relevant systematic reviews were searched.

Data management and screening

Results from searches were imported and managed in Rayyan software. The articles were de-duplicated before study selection.

To identify studies that potentially met the inclusion criteria, all titles and abstracts of the references were screened by AP, and second screening was carried by three reviewers (PP, DV and MC) independently. Consensus was reached by discussion or via input of a third reviewer where necessary. At the second stage, full-text of the articles were assessed by two reviewers (AP and PP) independently. Subsequently the reviewers discussed to resolve any discrepancies. The final list of included studies was identified following the two stages screening.

The updated search results were screened by titles, abstracts by AP, and second screening was carried out by two reviewers (HA and JP). Full-text screening was assessed by two reviewers (AP and JP). All discrepancies were discussed and resolved.

The data from the included studies were extracted using a customised data extraction form that includes study details (author, country and setting where study was carried out, design of study, date of publication), participant characteristics (type of health care staff using the tools), inclusion and exclusion criteria of the participants to the research, details of the intervention tools (tool name, country of use) and comparator if relevant, relevant outcomes, sources of funding. This was completed by AP and these were checked for accuracy by PP.

Backwards and forwards citation checking was also used.

Risk of bias and quality assessment

Quality assessment of studies that meet the inclusion criteria were carried out using the Mixed Methods Appraisal Tool version 2018 [23]. The tool was developed to suit assessment of studies of different designs (qualitative, quantitative and mixed methods) for the quality assessment. Quality of the studies was used for contextualisation of the results only. Critical appraisal was performed by AP and a proportion were checked for accuracy by PP with any disagreements resolved via discussion.

Strategy for data synthesis

The results of data extraction and critical appraisal are summarised and analysed using narrative synthesis presented using tables and text. This approach was chosen because the included studies were heterogeneous in design, participant type (patients, primary health care staff, administrative staff) and outcomes [24].

Based on the data extracted, the included studies were categorised and analysed using the prespecified outcome groupings. Where studies included varying elements, only relevant findings and key themes were extracted and analysed in the review.

Studies were categorised based on type (quantitative, qualitative and mixed-methods), outcome measures (patient outcomes, clinician outcomes and healthcare system outcomes). Findings were summarised using key themes identified across different studies.

RESULTS

The initial search resulted in 10,145 records, after removing duplicates, there were 6,825 records screened at title and abstract stage; and 86 records were included for full text screening, out of which 14 studies were included in the review. The updated search resulted in 3,462 records, after removing duplicates, there were 2,344 records screened at title and abstract stage; and 23 records were included for full text screening, out of which no studies were included in the review. See Figure 1 for PRISMA flowchart.

INSERT FIGURE 1 HERE

The design of studies included qualitative ($n=5$) [9, 16, 25-27], mixed-methods ($n=6$) [28-33] and quantitative ($n=3$) [34-36]. Qualitative designs included semi-structured interviews, case studies and focus groups. Quantitative studies included analysis of survey responses, and analysis of routinely collected data such as electronic healthcare records, log data from tool use, website analytics data and publicly available data.

Studies were mainly conducted in the UK ($n=9$) [16, 26-30, 32-34], with small numbers from Sweden ($n=3$) [9, 25, 31] and Spain ($n=2$) [35, 36]. Studies from the UK were mostly conducted in the southwest region of England ($n=6$) [16, 26-28, 30, 32, 34] with one study in Scotland [29]. One study was conducted in the UK Defence Primary Healthcare services [33].

Most studies were examining identifiable online triage platforms: eConsult ($n=7$) [16, 28-30, 32-34], eConsulta ($n=2$) [35, 36], Flow ($n=1$) [9], Digital Primary Healthcare Service ($n=1$) [31] while others involved 'unnamed' platforms ($n=3$) [25-27]. The summary of included studies is in Appendix 3.

No studies were included with clinical decision-making as the main outcome. Outcomes relating to clinical decision-making were within studies examining the wider use of online triage tools, and the outcomes relating to clinical decision-making are reported here. Outcomes examined in the studies

were categorised into three groups: patient clinical outcomes ($n=9$) [9, 16, 26, 28-30, 32-34], primary care practitioner experience outcomes ($n=11$) [9, 16, 25-33] and healthcare systems outcomes ($n=14$) [9, 16, 25-36]. The outcomes and key themes are presented in Table 1.

Table 1. Findings identified in the included studies

Outcomes relating to clinical decision-making	Key themes of findings related to clinical decision-making	Effect on clinical decision-making	References
Patient clinical outcomes	Treatment		
	Clinicians are comfortable to adjust medication for an ongoing issue (e.g. in response to patient reporting side-effects)	positive	[16, 28, 29, 33, 34]
	Clinicians are able reduce the time to make a decision in response to patient completing a form with their concerns	positive	[9, 28, 33, 34]
	Clinicians may delay decision to treatment/referral (e.g. when patient is downplaying their symptoms to avoid calling emergency)	negative	[28, 29, 32]
Primary care practitioner experience	Clinicians offering urgent appointments unnecessarily (e.g. when patients are gaming the systems)	negative	[9, 29, 32, 33]
	Confidence in information supplied and impact on decision-making		
	Clinicians were able to make decisions remotely using photos attached to the patient completed form.	positive	[9, 25, 31, 33]
	Increased confidence in managing request (e.g. clinician has time to read and plan appropriate action)	positive	[9, 16, 28, 29]
	Clinical decisions are limited to textual information provided by the patients and their medical records	negative	[16, 26, 28, 31, 32]
	Clinical decision-making is more challenging without in-person appointment cues	negative	[9, 16, 33]
	Clinical decisions are challenged as clinicians find it difficult to identify patient key concern due to incomplete information given by the patient and clinician finding it difficult to identify patient expectations	negative	[9, 16, 25, 30, 31]
	Level of detail and quality of information provided by the patient / patients complaints did not necessarily fit the specified form leading clinicians to hesitate to make any clinical decision without calling the patient or arranging an appointment	negative	[16, 25-27, 30, 31]
Health care system outcomes	Clinicians feel reduced confidence in prescribing drugs remotely (e.g. antibiotics or addictive drugs)	negative	[31, 33]
	Workload		
	Reduced face-to-face and telephone appointments particularly in interactions with limited clinical value	positive	[16, 35, 36]
	Replaced short (five minutes) telephone appointments such as prescription review	positive	[9, 29, 33]
	Reduced administrative burden (some clinical decisions are instructed to admin staff to communicate	positive	[9, 16, 26-31, 34]

Outcomes relating to clinical decision-making	Key themes of findings related to clinical decision-making	Effect on clinical decision-making	References
	with the patient directly; clinicians can start filling the consultation notes ahead of the appointment)		
	Empowering the patient by allowing them to take more active role and reduce the workload of the clinician (patients responsible to articulate their issues independently freeing up time of the clinicians to focus on making clinical decisions)	positive	[9, 25-28, 33]
	Additional stage of workflow (most patients need telephone or face-to-face follow-up; staff needs manually transfer information from the patient form to the patient records)	negative	[9, 16, 26-28, 30, 33, 34]
	Double workload (patients using multiple routes (e.g., both telephone and the online form) concurrently for the same issue) leading to cases potentially being left unattended or attended twice	negative	[9, 25, 30]
	Triage algorithm inappropriately highlights urgent need leading to escalated clinical decision for minor issue (e.g. safeguarding issues)	negative	[26]
	Frequency of primary care appointment		
	Improved continuity of access for patients with long term conditions, and frequent attenders (potentially freeing up waiting time for appointment)	positive	[25, 33]
	Increased demand as triage is an additional point of access to primary care (patients raising concerns they might have not raised using traditional appointment system)	negative	[16, 28, 33]

Nine out of the 14 included studies were checked for quality score accuracy by PP. There were disagreements on seven of the quality scores. Disagreements resolved via discussion. Following assessment of study quality, most studies were given a high ($n=5$) [9, 16, 25, 26, 34] or medium quality rating ($n=7$) [28, 30-33, 35, 36], while two studies were rated as low quality [27, 29]. Higher quality studies were mostly qualitative while mixed methods and quantitative studies were more variable. Reasons for lower quality included lack of information on qualitative and quantitative components, integration process and results interpretation in mixed methods studies, lack of information of confounding factors in quantitative studies. One qualitative study was downgraded from medium to low quality as there was not enough information on recruitment strategy and data collection. The results of quality assessment are included in (Appendix 4).

Findings relating to patient clinical outcomes

Nine studies discussed patient clinical outcomes relating to clinical decision-making. The findings relating to patient clinical outcomes were: when responding to an online request from a patient, clinicians are comfortable to adjust prescription appropriately for an ongoing issue for example in response to change in blood pressure ($n=5$) [16, 28, 29, 33, 34], faster clinical decision time in response to patient concern ($n=4$) [9, 28, 33, 34], delay in urgent referrals (e.g. because patient

downplaying their symptoms to avoid calling emergency services) (*n*=3) [28, 29, 32], and decisions to give patients unnecessary access to urgent primary care appointments were influenced by patients using the systems (*n*=4) [9, 29, 32, 33].

Findings of primary care practitioner experience outcomes

Eleven studies discussed the experiences of primary care practitioners and their confidence in decision-making when using online triage tools. Five negative impacts on clinical decision-making were identified in the studies: challenged clinical decision-making without in-person appointment cues (e.g. inability to probe the patient for further information or reading body language) (*n*=3) [9, 16, 33], difficulties in identifying patient key concerns due to one of two reasons: incomplete information given by the patient completing the form or the clinician finding it difficult to identify patient expectations (*n*=5) [9, 16, 25, 30, 31], hesitation in prescribing specific drugs such as antibiotics, and addictive drugs (*n*=2) [31, 33], limitations due to reliance on textual information provided by the patients (*n*=5) [16, 26, 28, 31, 32], and lack of quality of information, or mismatched free text information with the disease form chosen by the patient, leading clinicians to hesitate to make any clinical decision without calling the patient or arranging an appointment (*n*=6) [16, 25-27, 30, 31]. Two positive impacts were identified in the studies: patients are able to send photos for skin problems enabling clinicians to make decisions faster (*n*=4) [9, 25, 31, 33] and clinicians are more confident in managing patients requests (e.g. as they have time to read and plan appropriate action) (*n*=3) [9, 16, 28, 29].

Findings of healthcare system outcomes

The findings of healthcare system outcomes in relation to their impact on clinical decision-making were divided into two -groups: workload (*n*=13) [9, 16, 25-31, 33-36], and frequency of primary care appointments (*n*=10) [9, 16, 25, 26, 28, 29, 31-34].

Studies suggested that clinical decision-making is affected by clinicians' workload, as freeing up time may allow more focused clinical decisions on complex cases or cases with high priority. From this perspective there are benefits from using the online triage tools on workload: reduction in face-to-face and telephone appointments particularly in interactions with limited clinical value such as management of test results, repeat prescriptions, and sick notes (*n*=3) [16, 35, 36], the forms replace short telephone appointments such prescription review (*n*=3) [9, 29, 33], reduction of administrative burden from the clinicians as some of the clinical decisions are instructed to non-clinical administrators to complete the consultation and communicated with the patient (*n*=9) [9, 16, 26-31, 34] and empowering the patients to take more active role leading to reduce some of the workload from the clinicians (e.g. patients are able to research their concerns and submit articulate complaints freeing up time of the clinicians to focus on making clinical decisions, also some patients, such as patients with mental health issues, are able to spend time phrasing their complaints in a private setting) (*n*=6) [9, 25-28, 33].

There were negative impacts of triage tool use on clinicians' workload putting pressure on clinicians and reducing the time spent on making clinical decisions. The platforms added extra stages in the workflow (reading the form, follow-up (telephone/in person), and then transferring information from the form to patients records) (*n*=8) [9, 16, 26-28, 30, 33, 34]. Moreover, patients raising the same issue concurrently using the tools and other routes leading to duplicate work where different general practice clinicians are dealing with the same issue. This lead to multiple clinical decisions communicated to the patient at once or in some cases leaving patient concerns unattended where clinicians perceive that a clinical decision has been taken via another route (*n*=3) [9, 25, 30]. Also, the

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3 triage tools incorrectly highlighting cases as urgent leading to escalated clinical decision for a minor
4 issue ($n=1$) [26].
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6 There are additional benefits relating to the frequency of primary care appointments. The tools
7 provided continuity of access for patients with long term conditions, and frequent attenders
8 (potentially freeing up appointments) improving related clinical decisions ($n=2$) [25, 33]. However,
9 the tools are perceived by clinicians as an additional point of access as the type and nature of
10 concerns raised using the online tools differ from traditional appointments, such as patients who are
11 familiar with their condition or need straightforward advice from a doctor tend to contact their
12 general practice using the online tools. Additionally, patients who might be embarrassed or anxious
13 to discuss their health issue in person, were able to articulate their concerns using the online tools.
14 Therefore, clinicians expect to make clinical decisions differently from what they are used to in
15 traditional appointments ($n=3$) [16, 28, 33].
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19 **DISCUSSION**

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21 This systematic review evaluated the evidence on how patient facing online triage tools in primary
22 care affect clinical decision-making. Fourteen studies were included covering a range of different
23 designs, population and tools.
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25 **Summary of the main findings**

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27 The review examined patient clinical outcomes, primary care practitioners experience and
28 healthcare system outcomes in relation to clinical decision-making.
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30 For instance, clinicians reduced the time to make clinical decisions in response to patient concerns,
31 such as issuing repeat prescriptions remotely. On the other hand, some clinicians were concerned
32 with patients learning to game the system to access urgent appointments or to avoid being
33 forwarded to emergency services.
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35 Moreover, primary care clinicians felt confident in managing patients requests as they spend more
36 time planning their decision, and would have access to additional information such as patient
37 records, or a photo attached to the form.
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39 Additionally, clinicians time is freed up from face-to-face and telephone appointments with limited
40 clinical value. However, online triage is perceived as an additional step in the workflow of clinical
41 decision-making, as large number of online triage lead to telephone or face-to-face consultation.
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44 **Comparison with the previous literature**

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46 This systematic review found that clinical decision-making is challenging without in-person cues, as it
47 was limited to information provided by the patients in the online form. Similarly, previous literature
48 on using online consultation tools in UK primary care has shown that missing face-to-face interaction
49 meant that clinicians did not find remote consultations as adequate replacement to in-person
50 consultations [12, 21, 37]. In this systematic review, it was found that clinicians have reported
51 difficulty in identifying patient concerns and expectations due to incomplete information shared on
52 the online form. This agrees with previous studies on using online consultation tools in UK primary
53 care that showed clinicians reporting concerns on the increased risk of missing information [11, 12,
54 21, 37]. While the findings in this systematic review were similar, it should be notes that the online
55 consultation tools examined in previous studies had different functionalities compared to those
56 discussed this review.
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Although the previous systematic review by Darley et al. [20] examined the broader context of using the online consultation tools, it found limited evidence on how they influence clinical decision-making. Darley et al.'s review highlighted an evidence gap as the studies reviewed did not provide information on the process of clinical decision-making. There were some concerns that were discussed in Darley et al.'s review, in particular in relation to the loss of information compared to in person or telephone consultations, which may lead to misdiagnosis. Additional concerns were related to the ability of the tools to identify when a patient is not suitable for an online query.

Furthermore, this review found that clinicians benefited from the additional details sent by the patient using the online form, e.g. attaching photos to the form, and there was an increased confidence in managing requests as the clinician has time to read and plan appropriate action. On the contrary, Mold et al.'s systematic review [21] found limited evidence that clinicians with access to patient notes together with the information shared by the patient using online means such as secure email and messaging or video links improved the potential for shared decision-making, where the patient can influence clinical decisions.

Strengths and limitations

This is the first systematic review to analyse outcomes relating to clinical decision-making from triaging patients who completed an online form to contact their primary care service. A strength of this review is that it evaluates outcomes of tools usage across different countries . However, it was limited to studies published in English, and this may have led to missing some evidence from countries with universal healthcare coverage that might have been early adopters of the primary care patient online triage (such as the Netherlands and the Scandinavian countries). As the review only included published studies, there is a risk that relevant studies may have been excluded where these are published in the grey literature.

The search strategy for this systematic review was carefully planned with input from subject matter experts, and an expert librarian. This included carefully planning the search terms, synonyms, related concepts, and MeSH terms based on the research question. Moreover, the search was conducted on five databases.

The application of patient facing online triage is very recent leading to a relatively small number of included studies, and this was particularly driven by the focus on the clinical decision-making, which has not been sufficiently studied until now. Some of the included studies are pilot and feasibility studies (e.g. one study was based on a masters dissertation with very small sample size [27] in which the piloted sites ceased offering the tools to their patients at the end of the study). The recent adoption of the tools might indicate that the benefits are not observed long enough to evidence their sustainability, and the implementation was not sufficiently long to identify solutions to some of the issues resulted from using the tools.

The majority of the included studies were evaluating one tool (eConsult) and based in the UK, which limits generalisability to primary care in other healthcare systems. Additionally, a few studies included tools without clear description of their functionality (such as [36] and [35]), limiting the comparability of evaluated outcomes.

Implications (for research and practice)

Patient facing online triage tools are becoming more widely used, and policy makers are creating the conditions to make their use the standard for patients contacting their general practice [38]. This review has identified impacts on clinicians experience when using outputs from patient facing online

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3 triage tools. Therefore, the findings from this review can be used to increase awareness of clinicians
4 on how their decision-making processes are likely to differ. Additionally, developers can use the
5 findings to improve the usability of the tools outputs.
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8 None of the identified studies were directly about the clinical decision-making process, but rather
9 examine outcomes related to the clinical decision-making process. Therefore, gaps in the literature
10 have been identified, particularly a need to assess the impact of using patient facing online triage
11 tools in general practice on the process of clinical decision-making, and qualitative analysis of
12 clinicians' experiences in making clinical decisions when using outputs from the tools. Additionally,
13 there should be an analysis of large patient datasets (particularly linking outputs from the tools and
14 subsequent referral to other health and care service) to provide data driven evidence.
15

16
17 This review highlights that associations between patient characteristics (such as patients with mental
18 health issues or patients able to do their own research before completing a form) and the
19 experience of clinicians and the quality of clinical decision-making have not been explored in depth.
20 As the tools continue to be used by patients and clinicians, data will be available to examine the
21 quality of clinical decisions made using outputs from the tools with different medical conditions
22 (e.g. cancer and mental health). Additionally with more detailed data, tool developers would be able
23 to identify recurring clinical decisions such as responding to routine enquiries, test results and repeat
24 prescriptions. Therefore, developers might be able to integrate the straightforward elements of the
25 clinical decisions into the tool reports to the clinician.
26

27
28 None of the included studies explored the interoperability of the tools with general practice
29 electronic health records. It is expected that some elements of interoperability will enable tools to
30 report a more comprehensive summary of the patient concerns and any relevant patient history
31 from their records. Research will help developers to identify areas from patient history that are
32 needed for clinical decision-making in relation to different patient concerns.
33

34
35 Lastly, this review included few studies integrating findings from routine data with qualitative
36 research. Mixed methods research will help to better understand clinician experiences and support
37 any qualitative findings with evidence from data.
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40

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46

47
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49 Jeremy Dale, Gary A Abel and Benedict Hayhoe. Armina Paule conducted searches, screening, data
50 extraction, and quality assessment. Armina Paule conducted the narrative synthesis with support
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53

54
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57 involved in the design or conduct of the research (beyond specifying the broad research area), and
58 analysis is conducted independently of eConsult. All other authors have no completing interest to
59 declare.
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Patient consent for publication: Not applicable.

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FIGURE LEGENDS

Figure 1 PRISMA flow chart. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta Analyses. Initial search: for literature published between 1 January 2002 and 31 December 2022, and updated search for literature published up to 24 November 2024.

All 56 (first search) and 7 (second search) excluded articles based on the intervention are articles that discuss interventions that did not meet the specific inclusion criteria, or met at least one of the exclusion criteria: (Not primary care tool, Used to assess specific symptom (e.g. dermatology), Digital symptom checker, Screening or providing likely diagnosis, Do not inform triage by human clinician, Provide access to direct consultation (without human triage), or Were under development.)

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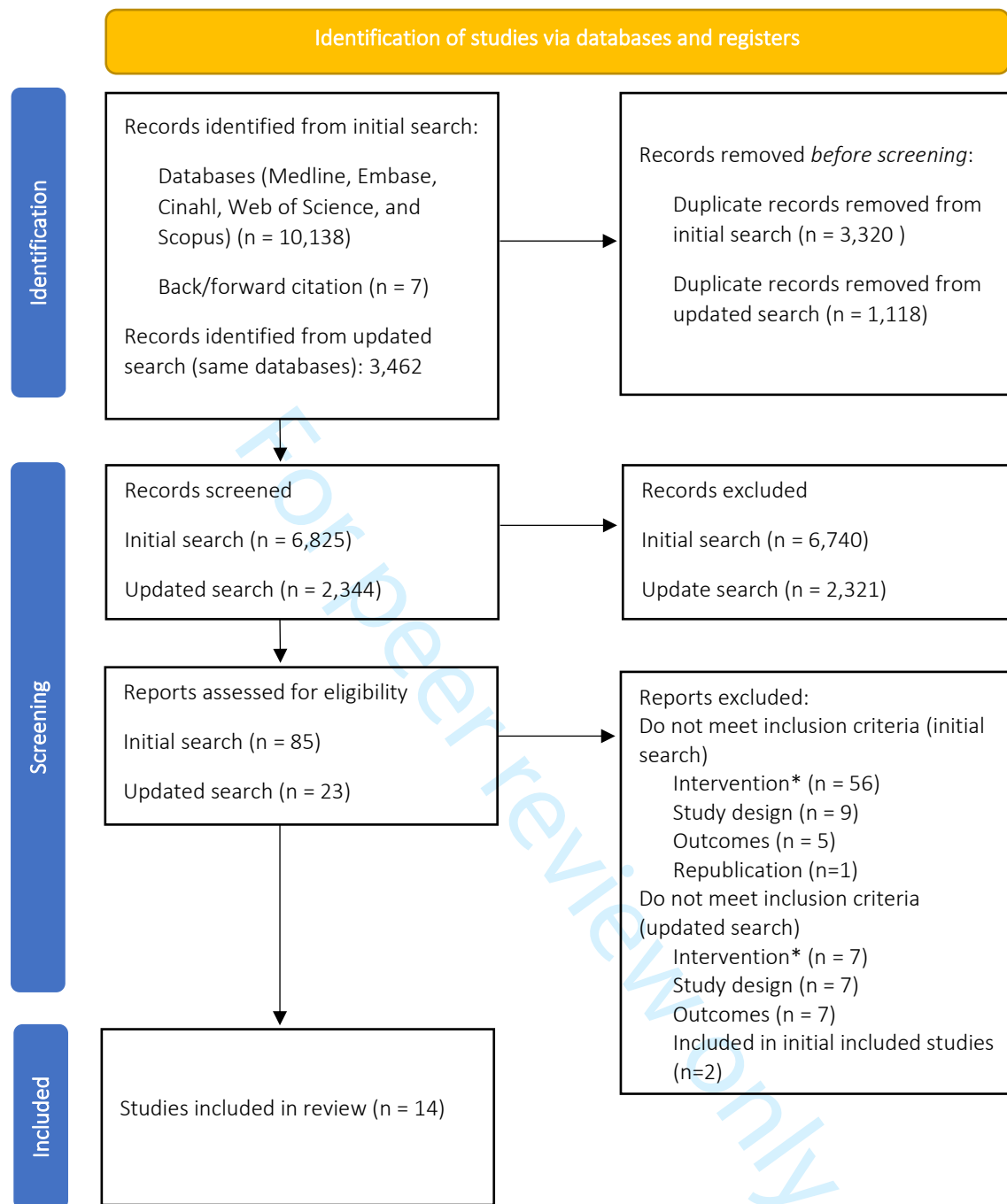


Figure 1 PRISMA flow chart. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta

Analyses. Initial search: for literature published between 1 January 2002 and 31 December 2022, and updated search for literature published up to 24 November 2024.

All 56 (first search) and 7 (second search) excluded articles based on the intervention are articles that discuss interventions that did not meet the specific inclusion criteria, or met at least one of the exclusion criteria: (Not primary care tool, Used to assess specific symptom (e.g. dermatology), Digital symptom checker, Screening or providing likely diagnosis, Do not inform triage by human clinician, Provide access to direct consultation (without human triage), or Were under development.)



PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	2
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	2
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	3
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	4
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	4 Appendix 2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	4
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	4
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	4
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	4
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	5
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	n/a
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	5
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	n/a
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	5
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	5
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	n/a
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	n/a
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	n/a



PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	n/a
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	5
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	n/a
Study characteristics	17	Cite each included study and present its characteristics.	5-9 Appendix 3
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	7 Appendix 4 MMAT rating
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	5-9 & (Appendix 3 and table 1)
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	7 Appendix 4
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	n/a
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	n/a
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	n/a
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	n/a
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	n/a
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	9-10
	23b	Discuss any limitations of the evidence included in the review.	10
	23c	Discuss any limitations of the review processes used.	10
	23d	Discuss implications of the results for practice, policy, and future research.	11
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	1
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	1
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	n/a
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	12
Competing interests	26	Declare any competing interests of review authors.	12



PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	n/a

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

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Appendix 2: Search terms used for databases

Medline search

Category	Search terms
Primary care clinician	family physician*.mp. or exp Physicians, Family/ OR family practitioner*.mp. OR exp General Practitioners/ or general practitioner*.mp. OR clinician*.mp. OR family clinician*.mp. OR family doctor*.mp.
Online tool	telemedicine.mp. or exp Telemedicine/ OR telehealth.mp. OR exp Digital Technology/ or digital.mp. OR electronic.mp. OR exp Mobile Applications/ or mobile.mp. OR app.mp. OR software.mp. OR (online adj4 tool*).mp. OR patient portal*.mp. or exp Patient Portals/ OR online portal.mp. OR web portal.mp. OR (eConsult or webGP or askmygp or accurx or Egton Online Triage or patchs or AskFirst or AskNHS or klinik or HealthHero or My Health or Doctorlink or Ada or Apotheka Patient).mp.
Triage	exp Triage/ or triag*.mp. OR (digital adj2 assessment).mp. OR (electronic adj2 assessment).mp. OR (online adj2 assessment).mp. OR exp Remote Consultation/ or (remote adj2 assessment).mp. OR (digital adj2 diagnosis).mp. OR (electronic adj2 diagnosis).mp. OR (online adj2 diagnosis).mp. OR (remote adj2 diagnosis).mp. OR (digital adj3 consultation).mp. OR (electronic adj3 consultation).mp. OR (online adj6 consultation).mp. OR (remote adj3 consultation).mp. OR (digital adj2 access).mp. OR (electronic adj2 access).mp. OR (online adj2 access).mp. OR (remote adj2 access).mp.
Setting	GP.mp. or exp Family Practice/ or exp General Practice/ OR exp Primary Health Care/ or general practice*.mp. OR (primary adj2 care).mp. OR family medicine.mp. OR family practice.mp. or Family Practice/

Embase search

Category	Search terms
Primary care clinician	exp general practitioner/ or family physician*.mp. OR family practitioner*.mp. OR general practitioner*.mp. OR exp clinician/ or exp physician/ or clinician*.mp. OR family clinician*.mp. OR family doctor*.mp.
Online tool	telemedicine.mp. or exp telemedicine/ OR telehealth.mp. or exp telehealth/ OR digital.mp. or exp digital technology/ or exp digital divide/ OR electronic.mp. OR mobile.mp. or exp mobile application/ OR app.mp. OR software.mp. OR (online adj4 tool*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR patient portal*.mp. OR online portal.mp. OR web portal.mp. OR (eConsult or webGP or askmygp or accurx or Egton Online Triage or patchs or AskFirst or AskNHS or klinik or HealthHero or My Health or Doctorlink or Ada or Apotheka Patient).mp. [mp=title, abstract, heading word, drug trade name, original title, device

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	manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]
Triage	triag*.mp. OR (digital adj2 assessment).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (electronic adj2 assessment).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (online adj2 assessment).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (remote adj2 assessment).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (digital adj2 diagnosis).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (electronic adj2 diagnosis).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (online adj2 diagnosis).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (remote adj2 diagnosis).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (digital adj3 consultation).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (electronic adj3 consultation).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (online adj6 consultation).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (remote adj3 consultation).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (digital adj2 access).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR (electronic adj2 access).mp. [mp=title, abstract, heading word, drug trade

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Setting	GP.mp. OR exp primary medical care/ or exp general practice/ or general practice*.mp. OR (primary adj2 care).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] OR family medicine.mp. or exp family medicine/ OR family practice.mp.

Web of Science search

Category	Search terms
Primary care clinician	ALL=("GP") OR ALL=("general practice*") OR ALL=("primary NEAR/1 care") OR ALL=("family medicine") OR ALL=("family practice")
Online tool	ALL=("telemedicine") OR ALL=("telehealth") OR ALL=("digital") OR ALL=("electronic") OR ALL=("mobile") OR ALL=("app") OR ALL=("software") OR ALL=("online NEAR/3 tool*") OR ALL=("patient portal*") OR ALL=("online portal") OR ALL=("web portal") OR ALL=("eConsult or webGP or askmygp or accurx or Egton Online Triage or patchs or AskFirst or AskNHS or klinik or HealthHero or My Health or Doctorlink or Ada or Apotheka Patient")
Triage	ALL=("triag*") OR ALL=("electronic NEAR/1 assessment") OR ALL=("online NEAR/1 assessment") OR ALL=("remote NEAR/1 assessment") OR ALL=("digital NEAR/1 diagnosis") OR ALL=("electronic NEAR/1 diagnosis") OR ALL=("online NEAR/1 diagnosis") OR ALL=("remote NEAR/1 diagnosis") OR ALL=("digital NEAR/2 consultation") OR ALL=("electronic NEAR/2 consultation") OR ALL=("online NEAR/5 consultation") OR ALL=("remote NEAR/2 consultation") OR ALL=("digital NEAR/1 access") OR ALL=("electronic NEAR/1 access") OR ALL=("online NEAR/1 access") OR ALL=("remote NEAR/1 access")
Setting	ALL=("family physician*") OR ALL=("family practitioner*") OR ALL=("general practitioner*") OR ALL=("clinician*") OR ALL=("family clinician*") OR ALL=("family doctor*")

CINAHL search

Category	Search terms
Primary care clinician	(MM "Physicians, Family/AM/EC/OG") OR ""family physician*"" OR ""family practitioner*"" OR ""general

	practitioner* OR "clinician*" OR "family clinician*" OR "family doctor*"
Online tool	(MH "Telemedicine/AM/ST/UT") OR "telemedicine" OR (MH "Telehealth/AM/SN/UT") OR "telehealth" OR (MH "Digital Technology/AM/UT") OR (MH "Digital Health/UT") OR "digital" OR "electronic" OR "mobile" OR "app" OR "software" OR "online N3 tool*" OR (MH "Patient Portals/AM/UT/SN") OR "patient portal*" OR "online portal" OR "web portal" OR "eConsult or webGP or askmygp or accurx or Egton Online Triage or patchs or AskFirst or AskNHS or klinik or HealthHero or My Health or Doctorlink or Ada or Apotheka Patient"
Triage	(MH "Triage/AM/SN/UT") OR "triag*" OR "digital N1 assessment*" OR "electronic N1 assessment*" OR "online N1 assessment*" OR "remote N1 assessment*" OR "digital N1 diagnosis*" OR "electronic N1 diagnosis*" OR "online N1 diagnosis*" OR (MH "Remote Consultation/AM/SN/UT") OR "remote N1 diagnosis*" OR "digital N2 consultation*" OR "electronic N2 consultation*" OR "online N5 consultation*" OR "remote N2 consultation*" OR "digital N1 access*" OR "electronic N1 access*" OR "online N1 access*" OR "remote N1 access"
Setting	"GP" OR (MH "Family Practice/OG/SN/UT") OR "general practice*" OR (MH "Primary Health Care/AM/UT/SN") OR "primary N1 care*" OR "family medicine*" OR "family practice"

SCOPUS search

Category	Search terms
Primary care clinician	("family physician*" OR "family practitioner*" OR "general practitioner*" OR clinician* OR "family clinician*" OR "family doctor*" OR gp)
Online tool	(telehealth OR digital OR electronic OR mobile OR app OR software OR "online pre/3 tool*" OR "patient portal*" OR "online portal" OR "web portal" OR econsult OR webgp OR askmygp OR accurx OR "egton online triage" OR patchs OR askfirst OR asknhs OR klinik OR healthhero OR "my health" OR doctorlink OR ada OR "apotheka patient")
Triage	(triag* OR "digital pre/1 assessment" OR "electronic pre/1 assessment" OR "online pre/1 assessment" OR "remote pre/1 assessment" OR "digital pre/1 diagnosis" OR "electronic pre/1 diagnosis" OR "online pre/1 diagnosis" OR "remote pre/1 diagnosis" OR "digital pre/2 consultation" OR "electronic pre/2 consultation" OR "online adj5 consultation" OR "remote pre/2 consultation" OR "digital pre/1 access" OR "electronic pre/1 access" OR "online pre/1 access" OR "remote pre/1 access")
Setting	("general practice*" OR "primary pre/1 care" OR "family medicine" OR "family practice")

Appendix 3: Characteristics of included studies (14 studies)

Study	Type of study	Country (region)	Time of study	Participants/Data of interest	Tool features	Research objective	Relevant outcome measures
Banks et al (2018)	Qualitative (semi structured interviews)	UK (West of England)	June 2016 to August 2016	23 interviews with a range of practice staff (including reception and administrative staff, practice managers, and GPs) at 5 urban and 1 rural general practices	eConsult: asynchronous web based tool that provides patients with access to the general practice for help and advice.	To evaluate whether eConsult pilot improves the ability of practice staff to manage workload and access.	<ul style="list-style-type: none"> • Patient clinical outcome • Primary care practitioner experience • Healthcare system outcomes
Carter et al (2018)	Mixed-methods	UK (Northern, Eastern and Western Devon)	February 2016 to July 2016	1) Consultation data extracted from practice database 2) 61 case reports from 20 GPs 3) 10 interviews (five GPs and five admin staff) All from 6 general practices using webGP	WebGP (now eConsult): asynchronous web based tool that provides patients with access to the general practice for help and advice.	To evaluate the feasibility, acceptability and effectiveness of eConsult as piloted by six general practices.	<ul style="list-style-type: none"> • Patient clinical outcome • Primary care practitioner experience • Healthcare system outcomes
Casey et al (2017)	Qualitative (narrative interviews) Reported as mixed methods study	UK (England)	Not reported	Narrative interviews with 2 GPs and 2 administrative staff from 1 general practice	Tele-Doc (pseudonym used in a paper): asynchronous web based tool that provides patients with access to the general practice for help and advice.	To explore the introduction of one online consultation system and how it shapes working practices.	<ul style="list-style-type: none"> • Primary care practitioner experience • Healthcare system outcomes

Study	Type of study	Country (region)	Time of study	Participants/Data of interest	Tool features	Research objective	Relevant outcome measures
Cowie et al (2018)	Mixed-methods	UK (Scotland)	17 April to 17 August 2017	1) Log data from eConsult use 2) 44 interviews with general practice staff 3) one focus group with 4 general practice staff 11 general practices from mix of urban/rural areas in Scotland	eConsult: asynchronous web based tool that provides patients with access to the general practice for help and advice.	The paper discusses and reflects on the experiences and proposes recommendations for electronic self-care and consultation tools.	<ul style="list-style-type: none">• Patient clinical outcome• Primary care practitioner experience• Healthcare system outcomes
Edwards et al (2017)	Quantitative study	UK (South West England)	April 2015 to June 2016	Routinely available data from Public Health England, website analytics data, random sample of patient data (users of e-consultations) 8 general practices who participated in eConsult pilot in South West	eConsult: asynchronous web based tool that provides patients with access to the general practice for help and advice.	Evaluation of a pilot study of an online consultation system in primary care. Discussion of who used the system, when and why, and the NHS costs associated with its use.	<ul style="list-style-type: none">• Patient clinical outcome• Healthcare system outcomes
Eldh et al (2020)	Qualitative (semi-structured interviews)	Sweden (Southeast)	Not reported	21 health care staff at five primary care centres ((1) a manager, (2) at least one district nurse or registered nurse, or (3) a district or	Flow: provides access to advice via personal link with secure personal identification. A triage nurse responds within 2	To describe health care staff's experience with a digital communication system intended for patient-staff	<ul style="list-style-type: none">• Patient clinical outcome• Primary care practitioner experience• Healthcare system outcomes

Study	Type of study	Country (region)	Time of study	Participants/Data of interest	Tool features	Research objective	Relevant outcome measures
				registered nurse and at least one physician, and (4) at least one secretary)	hours during work hours.	encounters via a digital route in primary care	
Eriksson et al (2022)	Qualitative (semi-structured interviews and focus groups)	Sweden (Southeast)	September 2019 and ending in February 2020	18 general practice staff participated: 14 individual interviews (5 GPs, 7 nurses and 2 administrative staff); 4 participated in one focus group (3 GPs and 1 nurse)	Patient facing online triage/consultation tool (tool name is not specified)	To explore the experiences of healthcare staff working with and being part of the implementation of a digital platform for patient-provider consultation across quality dimensions of access, efficiency, and patient safety.	<ul style="list-style-type: none"> • Primary care practitioner experience • Healthcare system outcomes
Farr et al (2018)	Mixed-methods	South West England	Dates are not specified for qualitative part Dates for the quantitative data: April 2015 to June 2016	1) Semi-structured interviews with 23 practice staff in 6 practices (10 GPs, 1 nurse, 6 practice managers, and 6 administrators) 2) Anonymised patients' records for 485 e-consultations from 8 practices	eConsult: asynchronous web based tool that provides patients with access to the general practice for help and advice.	To examine patient and staff views, experiences and acceptability of a UK primary care online consultation system and ask how the system and its implementation may be improved.	<ul style="list-style-type: none"> • Primary care practitioner experience • Healthcare system outcomes
Johansson et al (2020)	Mixed-methods	Sweden	February and March 2019	1) quantitative questionnaire survey	Digital Primary Healthcare Service (DHPC), patient	To explore physicians' experiences and	<ul style="list-style-type: none"> • Primary care practitioner experience

Study	Type of study	Country (region)	Time of study	Participants/Data of interest	Tool features	Research objective	Relevant outcome measures
				2) qualitative interview From 6 general practitioners	completes medical history, cause of contact, disease and current inconvenience. General practitioner decides next action: counselling, medical prescription, examinations and/or triage to another care level. All communication are written dialogues	satisfaction of digital primary health care.	• Healthcare system outcomes
Jones et al (2022)	Mixed-methods	UK (Devon and Cornwall)	Interviews during June 2018 eConsult data from June 2018 to March 2021 GP websites usability between January 2020 and	1) Routinely collected consultation meta-data 2) Semi structures interviews with 32 staff from 7 general practices	eConsult: asynchronous web based tool that provides patients with access to the general practice for help and advice.	To explore use and usability of general practitioner (GP) online services.	• Patient clinical outcome

Study	Type of study	Country (region)	Time of study	Participants/Data of interest	Tool features	Research objective	Relevant outcome measures
			September 2021				
López Seguí et al (2020)a	Quantitative	Spain (Catalonia)	Linked self-reported ratings with administrative data of health provider organisation April 2016 to August 2018	Quantitative: 18 GPs classified 2268 cases managed with eConsulta and indicated whether the teleconsultation reduced the number of face-to-face visits.	eConsulta : an asynchronous teleconsulting service designed to complement face-to-face contact with Primary Care Teams (PCT) in Catalonia.	To assess the ability of using eConsulta to reduce the number of face-to-face visits to Primary Care Teams	<ul style="list-style-type: none"> Healthcare system outcomes
López Seguí et al (2020)b	Quantitative	Spain (Catalonia)	Linked self-reported ratings with administrative data of health provider organisation September 2015 to September 2019	20 GPs retrospectively annotated a random sample of 5382 cases managed by eConsulta	eConsulta : an asynchronous teleconsulting service designed to complement face-to-face contact with Primary Care Teams (PCT) in Catalonia.	To annotate a random sample of teleconsultations from eConsulta, and to evaluate the level of agreement between health care professionals with respect to the annotation.	<ul style="list-style-type: none"> Healthcare system outcomes
Turner et al (2020)	Qualitative (semi structured interviews)	UK (South West and North West of England)	February 2019 to January 2020	18 general practice staff from 8 general practices	A few different patient facing online triage/consultation tools (tools names are not specified)	To identify and understand the unintended consequences of online consultations in primary care.	<ul style="list-style-type: none"> Primary care practitioner experience Healthcare system outcomes

Study	Type of study	Country (region)	Time of study	Participants/Data of interest	Tool features	Research objective	Relevant outcome measures
Willman et al (2023)	Mixed-methods	UK Defence Primary Healthcare	Not reported	Survey; 135 primary care clinicians (118 GPs and 17 other health care professionals)	eConsult: asynchronous web based tool that provides patients with access to the general practice for help and advice.	To examine the views of primary care clinicians using eConsult.	<ul style="list-style-type: none">• Patient clinical outcome• Primary care practitioner experience• Healthcare system outcomes

Appendix 4: Quality Assessment

	Qualitative Studies	Banks et al (2018)	Eldh et al (2020)	Eriksson (2022)	Turner et al (2020)	Casey et al (2017)
Screening questions	S1. Are there clear research questions?	Yes	Yes	Yes	Yes	Yes
	S2. Do the collected data allow to address the research questions?	Yes	Yes	Yes	Yes	Yes
Quality criteria	1.1. Is the qualitative approach appropriate to answer the research question?	Yes	Yes	Yes	Yes	Can't tell
	1.2. Are the qualitative data collection methods adequate to address the research question?	Yes	Yes	Yes	Yes	No
	1.3. Are the findings adequately derived from the data?	Yes	Yes	Yes	Yes	Yes
	1.4. Is the interpretation of results sufficiently substantiated by data?	Yes	Yes	Yes	Yes	Yes
	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?	Yes	Yes	Yes	Yes	Can't tell
	Quality score	High (5/5)	High (5/5)	High (5/5)	High (5/5)	Low (2/5)

	Quantitative Studies	Edwards et al (2017)	López Seguí et al (2020) ^a	López Seguí et al (2020) ^b
Screening questions	S1. Are there clear research questions?	Yes	Yes	Yes
	S2. Do the collected data allow to address the research questions?	Yes	Yes	Yes
Quality criteria	4.1. Is the sampling strategy relevant to address the research question?	Yes	Can't tell	Yes
	4.2. Is the sample representative of the target population?	Yes	Yes	Yes
	4.3. Are the measurements appropriate?	Yes	Yes	Can't tell
	4.4. Is the risk of nonresponse bias low?	Can't tell	Yes	Yes
	4.5. Is the statistical analysis appropriate to answer the research question?	Yes	Can't tell	Can't tell
	Quality score	High (4/5)	Medium (3/5)	Medium (3/5)

	Mixed Methods Studies	Carter et al (2018)	Farr (2018)	Willman 2023	Cowie et al (2018)	Johannsen et al (2020)	Jones et al (2022)
Screening questions	S1. Are there clear research questions?	Yes	Yes	Yes	Yes	Yes	Yes
	S2. Do the collected data allow to address the research questions?	Yes	Yes	Yes	Yes	Yes	Yes
Quality criteria	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?	Yes	Yes	Yes	Yes	Yes	Yes
	5.2. Are the different components of the study effectively integrated to answer the research question?	No	Can't tell	Yes	Can't tell	Yes	Yes
	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	Yes	Yes	No	Can't tell	No	Can't tell
	5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	No	Can't tell	Can't tell	No	Can't tell	No
	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	Yes	Yes	Yes	Yes	Yes	Yes
	Quality score	Medium (3/5)	Medium (3/5)	Medium (3/5)	Low (2/5)	Medium (3/5)	Medium (3/5)