Alberta Health Services

RAPID REVIEW

SPECIALISTS REFERRAL

SCIENTIFIC OFFICE
Primary Health Care Integration Network

Interventions to Improve the Efficiency or Effectiveness of Referrals between Primary and Specialist Care: A Rapid Review

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This Report was produced

by

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Executive Summary

The demand for access to specialist care in Canada is growing and wait times to consult a specialist remain long. Poor access to specialist care is associated with increased use of emergency department services, extended hospital stays, and increased mortality rates. Furthermore, patients, primary care physicians and specialists in Canada have expressed dissatisfaction with the current process of referral and prolonged wait times may result in poor patient outcomes and increased costs within the healthcare system. Together, these prompt a need to explore and trial interventions targeted at improving the efficiency or effectiveness of referral.

To guide the development of future strategies to improve specialist referral within Alberta Health Services, a rapid review of literature pertaining to referral processes and outcomes between primary and specialist care was conducted. The purpose of the review was to identify the evidence base of interventions aimed at improving the efficiency or effectiveness of referrals between primary and specialist care.

Databases of peer-reviewed studies were searched and relevant records were included. A previously published framework was used to classify intervention types into four main categories: general practitioner (GP) education, process change, system change, and patient education. Outcomes measured in studies were summarized to identify evidence gaps in the literature. Conclusions stated by the authors of individual studies or reviews were extracted and tabulated.

In total, 70 studies (14 reviews and 56 original articles) were included. The reviews were conducted in multiple countries and included many interventions to facilitate referral. Due to the diverse intervention types and varying outcomes measured across the studies, few authors were able to make any clear conclusions about the effectiveness of the various strategies under investigation. Across the 56 original articles, the most commonly studied intervention was eConsults (57% of studies). Other commonly studied interventions included guidelines, direct access to testing, referral management centres, and specialist outreach. Many studies evaluating eConsults noted a reduction in referrals (and thus, shorter wait times for patients that needed to be referred) and higher rates of user satisfaction. Studies of GP education reported an increase of primary care physician knowledge and positive change in practice and process measures. The effect of interventions on health outcomes, patient-reported measures, or downstream healthcare utilization is unknown due to a paucity of evidence and variation in intervention types.

Key findings from this review include:

- There are a variety of interventions targeted toward referral; the most commonly studied is the eConsult.
- Outcomes varied and were often focused on the referral process or outcomes (i.e., reduction in referrals) rather than health outcomes.
- Gaps suggest future research should address harms or consequences through avoiding referrals, intervention costs, and patient experience measures.

Question(s)

This rapid review provides a high-level summary of the evidence on the interventions affecting the nexus between primary and specialist care with a focus on the referral pathway from primary to specialist care and back.

After an initial scan of the literature, and in consultation with members of the Primary Health Care Integration Network, we narrowed the scope and focused of this review to the following review question:

"What is the evidence base of interventions aimed at improving the efficiency or effectiveness of referrals between primary and specialist care?"

Why is this Issue Important?

Canadians enjoy universal access to a publicly funded health care system.[1,2] Within this system, primary care providers (PCPs)[a] are the first point of contact for most Canadians and provide comprehensive patient care (i.e., from prevention to treatment) for different medical conditions beyond one specific disease.[2] A unique role of PCPs is the coordination of patient care including access to diagnostic tests and referrals of appropriate patients to specialist care when necessary.[2] This care structure is often described as a gated or demand managed system.[1-5] Access to and advice from specialist care is associated with improved outcomes and greater adherence to guidelines.[6-8] In contrast, poor access to specialist care is associated with increased use of emergency department services, extended hospital stays, and increased mortality rates.[9,10] Therefore, an effective (i.e., appropriate, necessary) and efficient (i.e., timely, well-communicated) referral pathway between the two levels of care is critical.[11-16]

Similar to many other countries, the demand for access to specialist care in Canada is growing and wait times to consult a specialist remain long.[17,18] National surveys demonstrated physician and specialist dissatisfaction with the current process of referral.[19] Further, patients have expressed dissatisfaction with their wait time in Canada.[20] For example, one-third of patients waiting to see a gastroenterology specialist reporting their wait time as too long. Reasons for this dissatisfaction include having to miss work or school

[a] Although primary care providers (PCPs) include several different providers who are part of the primary health care team (e.g., nurse practitioners and physician assistants) in this report PCPs refers to family physicians only.

due to symptoms, an increased worry about their health condition, and an overall impairment of social function and activities of daily living.[20]

In a recent Commonwealth survey, Canada had the longest wait time to see a specialist (>50% of Canadians waited more than four weeks) among the 11 developed countries with similar economic standpoints that participated in the survey.[21] Further, in a recent landmark report on Canadian health care, access to elective care including specialist care was seen as one of three urgent challenges facing the national health care system.[22] Evidence suggests that the referral process from primary to secondary care is suboptimal with missed opportunities for improvement. In addition to excessive wait time to consult a specialist face-to-face, there are a number of additional issues that have been raised with respect to the referral process between PCPs and specialists. These include: inappropriateness of referral,[23] unnecessary or duplication of testing or procedures[24] and generally poor care coordination.[25]

The factors contributing to the bottleneck in the pathway from primary and specialist care in Canada are multifactorial and complex.[17,18] One contributing factor is the demand and supply mismatch between an aging population with increasing complex care needs[26] and a shortage of physicians. According to recent estimates from the Organization for Economic Co-operation and Development (OECD), Canada has a lower physician-to-population ratio compare to its counterparts (physicians density of 2.5 physicians per 1000 people in Canada compare to the OECD average of 3.4 doctors per 1000 people).[27] Another factor is the urban rural divide.[22] Although rural populations are in decline, 18.9% of Canadians are rural/remote residents (20% in Alberta) while most of the specialists are practising in tertiary centres concentrated in urban metropolitan cities.[28] This disparity in access has shown that patients living with chronic diseases in rural Alberta experience suboptimal care; a higher risk of adverse health outcomes; and higher cost in terms of time, inconvenience, and out-of-pocket expenses. For example, patients with inflammatory bowel disease living in rural Alberta where gastroenterologists were lacking, compared to their counterparts living in Calgary, experience a higher hospitalization rate (53.4 vs. 27.2 per 100 patients with Crohn's disease)[29]. This is compounded by the geography of Canada, the second largest country by landmass in the world, which is sparsely populated (population density of 4 people per sq. km vs. the United Kingdom: 275 per sq. km)

therefore residents of remote communities may experience additional barriers such as increased travel time to receive specialty care.[22,28]

Improving the primary-specialty care interface is a key priority area both provincially and nationally.[30] In Alberta, to facilitate more timely specialist care, Alberta Health Services (AHS) recently launched and pilot tested the electronic advice request pilot project to help PCPs in Alberta obtain advice from specialists for non-urgent cases.[31] The advice request portal is hosted on Alberta Netcare, the provincial electronic health record system.[31] Multidisciplinary teams and a centralized referral system have also been used to reduce wait times for orthopedic specialist consultation.[32] Similar initiatives to improve access to specialist care are being implemented in other provinces and jurisdictions.[33] Despite these promising approaches, there is a need to understand the different types of interventions that are available to address this priority area and whether these strategies have been shown to improve the efficiency and/or effectiveness of the referral process. With this in mind, we conducted a rapid literature review to summarized the evidence on interventions affecting the nexus between primary and specialist care with a focus on the referral pathway from primary to specialist care and back.

Objectives of review

The aims of this rapid review were to identify and summarize original studies or reviews that explore the effectiveness, efficiency, or harms of interventions related to the referral process between primary and secondary care. As this was a rapid review, our aims were not to synthesize or meta-analyze the information, nor to interpret findings and generate recommendations based on the literature.

Rapid Review Process

This rapid review contextualizes and integrates research evidence from a large body of knowledge on a priority topic (i.e., the referral pathway between primary and specialist care) in the province of Alberta. The review was led by Dr. Paul Ronksley (University of Calgary) and supported by two graduate students: Meaghan Lunney (University of Calgary) and Mohamed Osman (University of Alberta). Dr. Aminu Bello (University of Alberta) was consulted as the content expert advisor.

To provide the Primary Health Care Integration Network (PHCIN) and AHS leadership with timely results, a rapid review approach was collectively agreed on with an 8-week

timeframe for completion. Rapid reviews are one form of knowledge synthesis methods in which the systematic review process is adapted and simplified to produce information that is relevant to decision-maker needs in an expedited fashion.[34] Rapid reviews are commonly used to synthesize non-pharmacological interventions, and typically authors do not make recommendations.[35] Although, rapid reviews are useful tools for health decision-makers in knowledge translation activates, their ability to produce sufficient quality evidence to inform recommendations has yet to be established.[35,36]

In this rapid review, the streamlined steps included: a) dividing the screening and data abstraction between two independent reviewers; b) limiting included studies to quantitative study designs; c) restricting publications to English language only; (d) limiting the literature search to a 5-year timeframe (2013-December 2018) based on our prior knowledge of the comprehensiveness of the systematic reviews (included in this review) conducted on this topic before 2013, and e) restricting the scope to studies conducted in high income countries.

Timeline

This rapid review was prepared within an 8-week timeframe and was divided into three stages:

- Stage 1: Question refinement, protocol development and conducting the search;
- Stage 2: Conducting the review by selecting, screening and synthesizing relevant research evidence;
- Stage 3: Summarizing and reporting the results.

Information sources and literature search

To identify potentially relevant studies for inclusion, an electronic search of the literature was conducted using several databases including MEDLINE, EMBASE and Cochrane Database of Systematic Reviews (CDSR). MEDLINE and EMBASE were searched from January 1 2013 to December 20, 2018 and the CDSR database was searched up to an including December 20, 2018. Search strategy development was assisted by an experienced librarian (Dr. Zahra Premji, research and learning librarian, University of Calgary) in consultation with the research team. Our literature search was supplemented by a manual online search based on consultations with experts for relevant published articles. The final search strategy is presented in Appendix 1.

Inclusion criteria

The following PICOD (population, intervention, comparator, outcome, study design) statement was developed a priori to guide the screening process (**Panel 1**):

Panel 1: Selection criteria of the study

	Include	Exclude
Study design	All quantitative study designs	Qualitative only studies and grey literature
Publication date	2013 – present (MEDLINE, EMBASE)	Pre-2013 (MEDLINE, EMBASE)
Language	English	Non English studies
Population	Primary care physicians, specialists and their patients	Pediatric populations
Intervention	Strategies that aim to improve the efficiency and/or effectiveness of the referral pathway from primary care physicians to specialists (and back).	Content/structure of the referral letter
Comparator	Usual care No comparator/control necessary	None
Outcome	All outcomes relating to referral will be considered, including referral rate, referral quality, appropriateness of referral, impact on existing service provision, costs, mortality and morbidity outcomes, safety, effectiveness, patient satisfaction, patient experience	None
Setting	High income countries	Non high income countries

Population:

Studies investigating interventions in adult populations were eligible. If a review or study included both pediatric and adult populations it was eligible; however, if limited to a pediatric setting only, it was excluded. Although PCPs include multiple providers (e.g., nurse practitioners and physician assistants) in this review PCPs were defined as family physicians only and specialists as any physician specialist. However, similarly, if a review or study defined PCPs as both physicians and nurses, it was considered eligible for inclusion.

Intervention:

All strategies (processes and/or process elements) that aim to improve the efficiency and/or effectiveness of the referral pathway from PCPs to specialists (and back) were eligible for inclusion. For the purposes of this evidence summary we adapted a previously published taxonomy on referral interventions to classify identified strategies to improve the referral pathway (**Panel 2**).[5]

Panel 2: Taxonomy of interventions affecting the referral pathway		
Intervention category	**Definition**	**Intervention sub-type**
GP education	Any intervention with a primary focus on GP education or training	Peer review and training/feedback GP training: professional development Guidelines (no training/feedback) Guidelines with training/feedback/specialist support
Process change	Small-scale changes to some aspect of the individual referral process that did not involve the movement of staff or relocation of clinics, the methods in which referrals were triaged at hospital, or financial arrangements for referral	Designated appointment slots/fast-track clinic Direct access to screening/diagnostic testing Specialist consultation before referral Electronic referral Decision support tool Waiting list review
System change	Large changes impacting on all referrals made that involved the movement of staff or relocation clinics, the methods in which all referrals were triaged at hospital, or financial arrangements for referrals	Additional primary care staff Community provision of 'specialist' services by GPs Outreach: community provision by specialists Return of inappropriate referrals Gatekeeping Payment system Referral management center
Patient education	Patient-focused intervention that aim to improve referral pathway	Patient education Patient concerns and satisfaction

Comparator:

Usual care of the referral from primary care to secondary care; however, studies with an alternate or no concurrent comparator were also eligible.

Outcomes:

All outcomes relating to referral were considered, including referral rate, referral quality, and appropriateness of referral. Other outcomes such as the impact on existing service provision, costs, mortality and morbidity outcomes, safety, effectiveness, user (provider or patient) experience and satisfaction were also included.

Design:

Due to the rapid nature of the review, we excluded qualitative studies. We included all original articles and systematic reviews, environmental scans, and quality improvement studies.

Study selection

Three reviewers (ML, MAO, PR) collectively screened the titles and abstracts of identified records using DistillerSR (Evidence Partners, Ottawa, Canada). Subsequently, two reviewers (ML, MAO) collectively screened full-text articles and discrepancies were resolved through discussion with a third reviewer (PR). Reference lists of included reviews

were screened and individual studies were removed as a duplicate if they had been included in the identified reviews.

Data abstraction

Data were collected for pre-defined items in Excel (Microsoft, Washington, United States). Data items included study characteristics (e.g., author, publication year, study design and country), intervention characteristics (e.g., population studied and intervention category as defined in Panel 2), description of the referral intervention (e.g., provider education and team changes) and intervention outcome results (e.g., impact on wait time). The form was pilot-tested on two articles with discrepant items. Two reviewers (ML, MAO) then collectively abstracted data from each article with the discussion and involvement of a third team member (PR).

Quality assessment of included studies

We performed an assessment of the methodological quality of included reviews using the validated tool, Assessment of Multiple Systematic Reviews (AMSTAR 2).[37] A score of Critically low, Low, Moderate, or High was assigned as per the tool's guidance document (https://amstar.ca/Amstar-2.php). Two reviewers (ML, MAO) collectively appraised the methodological quality of included reviews. Risk of bias assessment was not conducted on individual studies as this is typically excluded from rapid review methodology.[35,36]

Reporting

We summarized details and key findings on the included reviews and original studies in tables. Additionally, we summarized the breakdown of outcomes assessed by intervention type to explore gaps in the literature.

Ethics

Approval by a research ethics board was not required for this review as it only included published and publicly accessible data.

What we found

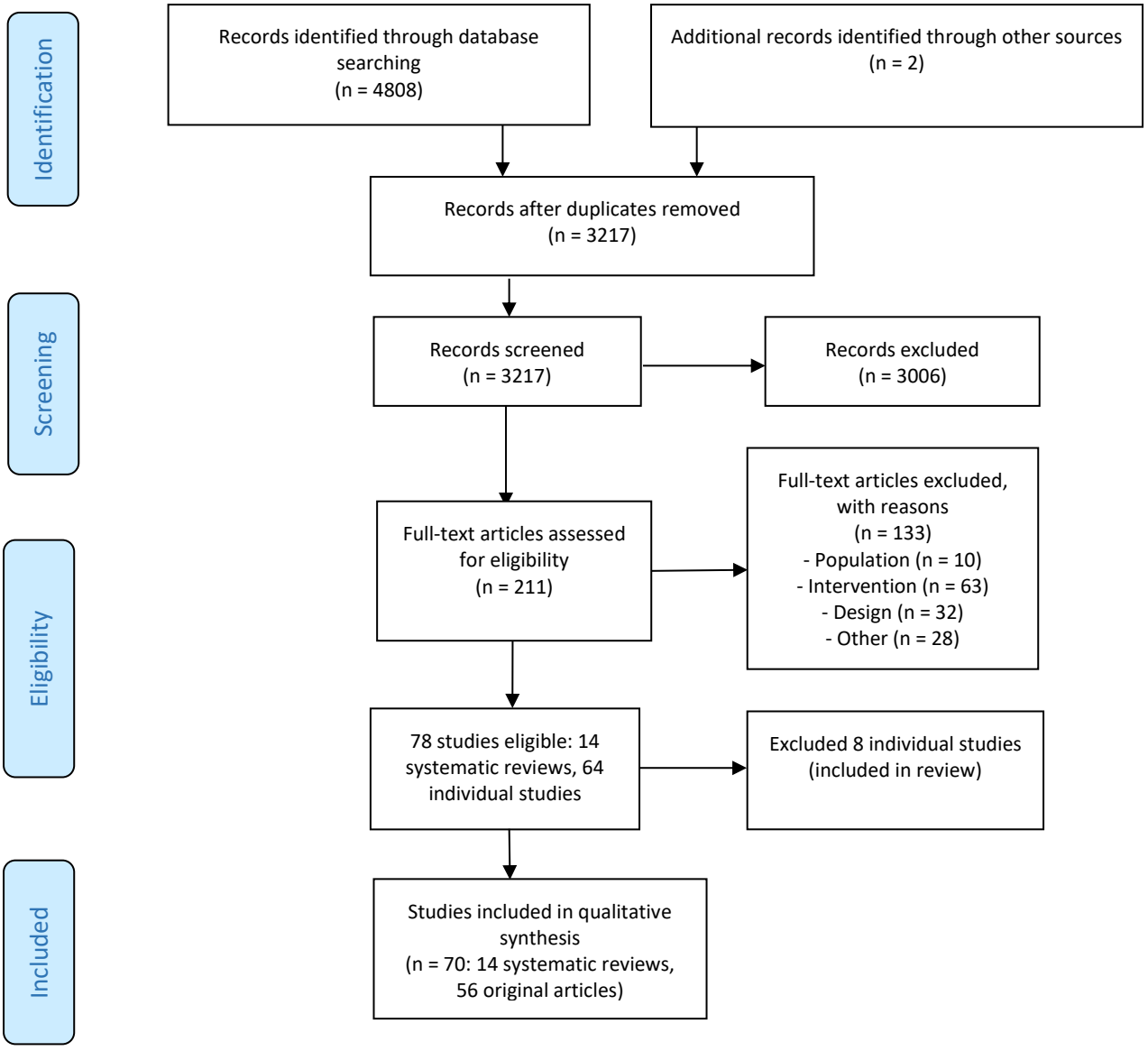
Descriptions of included reviews and studies

In total, we identified 4808 citations through database searching (**Figure 1**). We added two additional articles from other sources. After the removal of duplicates, we screened the title/abstract of 3217 citations and of these, we excluded 3006. We reviewed 211 articles for eligibility and excluded 133: 10 for population, 63 for intervention, 32 for design, and

28 for other reasons. Of the 78 eligible records, 14 were reviews and 64 were individual original studies. Eight of the 64 studies had already been included in a review, and thus we excluded these articles. In total, we included 70 records in this rapid review: 14 reviews[5,38-50] and 56 original articles[51-106]

Of the 14 reviews, 12 (86%) were systematic reviews, 1 (7%) was a scoping review, and 1 (7%) was an environmental scan. Of the 56 original articles, 39 (70%) were observational studies, 11 (20%) were Quality Improvement or Evaluation reports, 4 (7%) were randomized controlled trials, 1 (2%) was a quasi-experimental study, and 1 (2%) was a simulation study.

Figure 1. Screening process of identifying eligible articles.



A summary of the purpose, number of studies, countries, population studied, intervention, the authors' main conclusions, and a Quality score is summarized below in **Table 1**. The intervention was classified using a previously published framework by Blank et al[5]., where general practitioner **(GP) education** was defined as any intervention with a primary focus on GP education or training; **Process changes** were small-scale changes to some aspect of the individual referral process that did not involve the movement of staff or relocation of clinics, the methods in which referrals were triaged at hospital, or financial arrangements for referral; **System changes** were large changes impacting all referrals made that involved the movement of staff or relocation of clinics, the methods in which all referrals were triaged at hospital, or financial arrangements for referrals; or **Patient interventions**, which focused on patient education or patient concerns and satisfaction. Similarly, a summary of the objective(s), sample size, country, population, intervention category (using the same framework from Blank et al.), and the authors' main conclusions of each original study is also reported in Table 1. As the aim of this rapid review was only to report what is available in the literature and to identify gaps in research, we did not formally synthesize or meta-analyze the data. However, we summarize details of the interventions that were commonly used, how they were studied, which outcomes were measured (relevant to this rapid review), and results of these outcomes (**Table 2**). The findings of our review are detailed below.

Findings of review articles

In total, we included 14 reviews (Table 1). The reviews took place across multiple countries and included many interventions to facilitate referral. In most reviews, due to the heterogeneity of interventions and outcomes included in these reviews, few authors were able to meta-analyze their data and provide certainty with respect to the benefits or harms of these interventions. As stated by Blank et al. "It is clear that there is no 'magic bullet' to managing demand for secondary care services: the perfect solution does not exist and issues such as the context of a particular specialty or the location of a service impacts on the generalizability of interventions."[5]

Of the reviews with a slightly focused topic, findings suggested potential benefits; however, were still mixed. One focused exclusively on teledermatology[50] and concluded that "bearing in mind concerns regarding the applicability of study participants and of lesion image

acquisition in specialist settings, teledermatology can correctly identify the majority of malignant lesions", thereby potentially reducing the need for PCPs to refer patients through the normal referral pathway[50]. Another review focused on mental health[46] and found "evidence that consultation liaison improves mental health for up to three months and satisfaction and adherence for up to 12 months in people with mental disorders, particularly those who are depressed". Another review investigating specialist outreach programs[44] found that "specialist outreach can improve access, outcomes and service use, especially when delivered as part of a multifaceted intervention".

A review on direct access to screening/testing[41] reported that "direct access testing performs as well as, and on some measures better than, consultant triaged testing on measures of disease detection, appropriateness of referrals, interval from referral to testing, and patient and GP satisfaction". Lastly, a review on electronic consultations (eConsults)[43] reported the "overall impact on access measures, acceptability, cost, and provider satisfaction remain positive", but "there is limited research on population health outcomes of morbidity and mortality". The aims of the reviews included, interventions studied, and outcomes assessed varied greatly across the 14 reviews. Furthermore, only six of the 14 reviews were of high quality. While these reviews provide high-level guidance on what interventions are currently being explored, as well as gaps in research, future studies with a narrower scope may better identify benefits and harms of specific interventions.

Findings of original studies

What interventions have been studied?

Across the 56 original studies, the most commonly studied intervention was eConsults (n=32), followed by guidelines (n=7), direct access to testing (n=4), referral management centres (n=5), specialist outreach (n=3), community provision of 'specialist' services by PCPs (n=2), peer-to-peer training programs (n=2), decision support/algorithm-based interventions (n=2), financial interventions (n=1), and virtual consultations (n=1).

What are the effects of these interventions?

The majority (88%; n=49/56) of studies measured impact of referral, most often those evaluating eConsults (**Panel 3**). Process measures, such as the proportion of patients: with a target HbA1c; that received foot care review; that achieved targets for blood pressure, among others, were evaluated in 15 (26%) studies. Provider satisfaction and cost outcomes were both measured in 10 (18%) studies, health outcomes in 6 (11%) studies, patient-reported outcome measures (PROMS) or patient-reported experience measures (PREMS) in 5 (9%) studies, and emergency department (ED) or hospital admissions in 3 (5%) studies. Many studies evaluating eConsults noted a reduction in referrals (and thus, shorter wait times for patients that needed to be referred) and high rates of user (often the PCP) satisfaction. Studies of GP education (mainly guidelines) reported an increase of PCP knowledge and positive change in practice and process measures. The effect of interventions on health outcomes, PROMS/PREMS, or downstream healthcare utilization is unknown due to a paucity of evidence and variation in intervention type.

Panel 3. Summary of outcomes by intervention category of the 56 included individual studies.

		Outcomes Reported								
Intervention Category	**Total Number of Studies[1]**	**Referrals**	**Health Outcomes**	**Process Measures**	**PROMS/ PREMS**	**Cost**	**ED / Admissions**	**Provider Satisfaction**	**Harms**	**Other**
GP Education	9	8	1	3	2	2	0	2	0	3
Process Change	44	34	4	10	2	8	3	8	5	20
System Change	7	7	1	2	1	0	0	0	1	2
Patient Interventions	0	0	0	0	0	0	0	0	0	0

[1]The total number of studies exceeds 56 as many studies crossed over multiple outcome categories

What are the costs of these interventions?

Ten studies estimated intervention costs, which occurred in different countries under varying settings. Results were mixed and even among studies that showed a reduction in costs, the level of savings varied. One Canadian study[69] estimated an overall net savings (total societal savings less the total societal costs) of CAD 11 per eConsult. Two studies evaluated the cost savings of teledermatology. One, in the UK,[75] reported a reduction in cost of GBP 12 460 over a 3-year period. The other study, in Australia,[95] conversely found an increase in cost (teledermoscopy referral had a mean cost of AUD 318.39 per case and took a mean of 9 days before clinical resolution, compared to usual care which cost AUD 263.75

with 35 days before clinical resolution). One study in Spain[88] investigating teleophthalmology reported that 86.4% of patients avoided visiting the ophthalmology practice, resulting in a cost saving of EUR 152,550.45 over the five-year program. A study in the Netherlands[99] reported costs of telenephrology as EUR 453.86 compared to EUR 433.74 in usual practice. A study investigating guidelines with training and feedback[101] reported a 25% saving compared to baseline.

Are there any risks?

Only six studies[75,79,82,84,90,98] reported on potential harms of interventions. eConsults were a commonly studied intervention, whereby PCPs consult with a specialist about a case prior to referral. Often, the specialist is able to provide advice to the PCP, avoiding the referral to secondary care. While many studies showed a reduction in the number of referrals through this process, few studies followed patients that bypassed specialist referral to ensure no unintended consequence resulted. Future work in this area is needed to ensure these liaison systems are safe.

Studies in the Canadian context

Seventeen studies occurred in Canada. Of these, 12 (71%) evaluated the Champlain Building Access to Specialist Advice (BASE) platform, developed in Ottawa, Canada. As outlined by Witherspoon et al,[103] the "Champlain BASE system is a secure, web-based service that interfaces between a PCP (general practitioner or nurse practitioner) and a specialist. The PCP is able to submit questions using a standardized, patient-specific form. Other information (laboratory results, medical imaging, etc.) can be attached as is pertinent to the question being asked. The receiving specialist can then provide advice concerning further required investigations, potential treatment options, or provide a recommendation for a face-to-face consultation. Before each encounter between a PCP and specialist can be closed in the system, the PCP completes a mandatory survey. This survey allows the PCPs to rank their experience with this service and provide feedback on how useful they found the referral to be. This close-out survey further assesses the impact on a PCP electing to refer on to see a specialist in person. The end of service survey contains five sections:

1. Allows the PCP to choose from four options concerning how the eConsult affected the outcome for the patient;
2. Allows PCP to choose from six options concerning how the interaction affected his/her decision to refer or not;
3. Ranks eConsult's value for the patient on a five-point Likert scale;
4. Ranks eConsult's value for the physician on a five-point Likert scale; and
5. Free text space for additional comments."

Of the 12 studies in our review that evaluated this platform, positive findings included increased access to specialists,[54,70] particularly in remote areas,[71] a reduction in the number of face-to-face specialist consultations,[65] and cost savings[69]. However, authors agree that the overall value of eConsult content and PCP satisfaction with specialists' responses warrants further study[65]. Additionally, monitoring process measures and patient outcomes is required to better understand the impact of this service[93]. One study evaluating two e-consult platforms (one private and one government-funded) suggested that "e-consult needs to be integrated into reliable care pathways with adequate referrer and consultant preparation" in order to optimize its utility and uptake[59].

Other interventions tested in the Canadian setting included direct access to computed tomography (CT) scan[67], which found that PCPs can improve the effectiveness of their referrals for chronic rhinosinusitis (CRS) by utilizing an upfront CT referral strategy; however, at an additional cost of approximately CAD 1500 per patient referred. A study in Calgary, Alberta evaluated a monthly rheumatology clinic that was embedded in the primary health care service[52] and found "this model of care facilitated access for diagnosis and return to care of inflammatory arthritis conditions, and was acceptable to participants". Lastly, the RACE (Rapid Access to Consultative Expertise) program in Vancouver, British Columbia[102] was evaluated and found to help "reduce system costs by reducing unnecessary emergency department visits and face-to-face specialist consultations".

Conclusions

Overall, there are a number of studies exploring interventions aimed to improve the efficiency or effectiveness of referral; however, given the diverse intervention types, populations, and outcomes measured, the impact of these interventions remains inconclusive. While there are a number of studies exploring the use of eConsults, they often report demographic information and details on the characteristics of the visits, and little on impact or harms. Evidence on other interventions (integrated care, direct access, guidelines, specialist outreach, for example) is lacking, particularly in the Canadian context. Lastly, data on the costs, or cost-effectiveness, of these interventions is limited.

Table 1. Characteristics, conclusions, and quality of the included reviews and studies.

Author (Year)	Design	Objective(s) of review/study	Number of studies/ Sample Size	Country/ Countries	Population Studied (unit of analysis)	Intervention Category[1]	Authors' conclusions	Quality [2]
Reviews (n=14)								
Akbari et al. (2011)	Systematic (Cochrane) Review	Identify which interventions have been evaluated to change primary care outpatient referral rates or improve referral appropriateness. Further, to estimate the effectiveness of interventions to change primary care outpatient referral rates or improve outpatient referral appropriateness.	17	Multiple (Finland, Netherlands, Palestine, United Kingdom, United States)	Study specific (included PCPs, specialist physicians working in hospitals or community outpatient settings)	GP education Process change System change	There are a limited number of rigorous evaluations to base policy on. Active local educational interventions involving secondary care specialists and structured referral sheets are the only interventions shown to impact on referral rates based on current evidence. The effects of 'in-house' second opinion and other intermediate primary care based alternatives to outpatient referral appear promising.	High
Blank et al. (2014)	Systematic Review	Review international evidence on interventions to manage referral from primary to specialist care.	140	Multiple (high income only)	Study specific (included PCPs, hospital specialists, and their patients)	GP education Process change System change Patient interventions	It is clear that there is no 'magic bullet' to managing demand for secondary care services: the perfect solution does not exist and issues such as the context of a particular specialty or the location of a service impacts on the generalizability of interventions. To tackle demand management of primary care services, the focus cannot be on primary care alone; a whole-systems approach is needed because the introduction of interventions in primary care is often just the starting point of the referral process. In addition, more research is needed to develop and evaluate interventions that acknowledge the role of the patient in the referral decision.	Moderate

Author (Year)	Design	Objective(s) of review/study	Number of studies/ Sample Size	Country/ Countries	Population Studied (unit of analysis)	Intervention Category[1]	Authors' conclusions	Quality [2]
Chuchu et al. (2018)	Systematic (Cochrane) Review	Determine the diagnostic accuracy of teledermatology for the detection of any skin cancer in adults, and to compare its accuracy with that of in-person diagnosis.	22	Multiple (Europe, North America, South America, or Oceania)	Teleconsultations	Process change	Studies were generally small and heterogeneous and methodological quality was difficult to judge due to poor reporting. Bearing in mind concerns regarding the applicability of study participants and of lesion image acquisition in specialist settings, these results suggest that teledermatology can correctly identify the majority of malignant lesions. Using a more widely defined threshold to identify 'possibly' malignant cases or lesions that should be considered for excision is likely to appropriately triage those lesions requiring face-to-face assessment by a specialist. Despite the increasing use of teledermatology on an international level, the evidence base to support its ability to accurately diagnose lesions and to triage lesions from primary to secondary care is lacking and further prospective and pragmatic evaluation is needed.	High
Deldar et al. (2016)	Systematic Review	Review teleconsultation services to describe: type of technologies that have been used, specialty level of physicians, time and geographical distribution, medical field, and teleconsultation outcomes and structure.	174	Multiple (mix of high and low income countries	Study specific (included PCPs, specialist physicians)	Process change	Our findings have shown that although there are positive impacts of teleconsultation as an educational influence, improving patient, still have gaps that need to be repaired.	Low

Author (Year)	Design	Objective(s) of review/study	Number of studies/ Sample Size	Country/ Countries	Population Studied (unit of analysis)	Intervention Category[1]	Authors' conclusions	Quality [2]
Fauklner et al. (2003)	Systematic Review	Review the available evidence on initiatives affecting primary care referral to specialist secondary care.	44	Multiple (Canada, Denmark, England, Finland, Germany, Scotland, Sweden, Wales)	Study specific (included PCPs and practices, specialist physicians, patients, referrals)	GP education System change Patient Education	The studies identified were extremely diverse in methodology, clinical subject, organizational form, and quality of evidence. The number of good quality evaluations of innovative schemes to enhance the existing capacity of primary care was small, but increasing. Well-evaluated service initiatives in this area should be supported. Organizational innovations in the structure of service provision need not increase total costs to the National Health Service (NHS), even though costs associated with referral may increase.	High
Gillies et al. (2016)	Systematic (Cochrane) Review	Identify whether consultation liaison can have beneficial effects for people with a mental disorder by improving the ability of PCPs to provide mental health care.	12	Multiple (Australia, Canada, Germany, Italy, Netherlands, United Kingdom, United States)	Study specific (included PCPs and patients)	Process change	There is evidence that consultation liaison improves mental health for up to three months and satisfaction and adherence for up to 12 months in people with mental disorders, particularly those who are depressed. PCPs were also more likely to provide adequate treatment and prescribe pharmacological therapy for up to 12 months. There was also some evidence that consultation liaison may not be as effective as collaborative care in terms of mental disorder symptoms, disability, general health status, and provision of treatment. However, the overall quality of trials was low particularly in regards to performance and attrition bias and may have resulted in an overestimation of effectiveness. More evidence is needed to determine the effectiveness of consultation liaison for people with mental disorders particularly for those	High

Author (Year)	Design	Objective(s) of review/study	Number of studies/ Sample Size	Country/ Countries	Population Studied (unit of analysis)	Intervention Category[1]	Authors' conclusions	Quality [2]
							with mental disorders other than depression.	
Goyder et al. (2015)	Systematic (Cochrane) Review	Assess the effects of email for clinical communication between healthcare professionals on: healthcare professional outcomes, patient outcomes, health service performance, and service efficiency and acceptability, when compared to other forms of communicating clinical information.	1	United States	Study specific (included PCPs and patients)	Process change	Only one study was identified for inclusion, providing insufficient evidence for guiding clinical practice in regard to the use of email for clinical communication between healthcare professionals. Future research should aim to utilize high-quality study designs that use the most recent developments in information technology, with consideration of the complexity of email as an intervention.	High
Gruen et al. (2010)	Systematic (Cochrane) Review	Review studies of specialist outreach clinics to assess their effectiveness on access, quality, health outcomes, patient satisfaction, use of services, and costs.	9	Multiple (high income only)	Study specific (included PCPs, specialists, and patients)	System change	This review supports the hypothesis that specialist outreach can improve access, outcomes and service use, especially when delivered as part of a multifaceted intervention. The benefits of simple outreach models in urban non-disadvantaged settings seem small. There is a need for good comparative studies of outreach in rural and disadvantaged settings where outreach may confer most benefit to access and health outcomes.	High
Liddy et al. (2018)	Systematic Review	Examine the impact of eConsults on delivery of care, considering the Quadruple Aim Framework: population health, experience of care, per capita cost, provider experience.	43	Multiple (Australia, Austria, Brazil, Canada, Italy, Netherlands, United States) and globally (NGOs)	Study specific (included eConsults/ eReferrals, PCPs, cases, and specialists)	Process change	The breadth of specialty eConsult services offered has greatly expanded beyond dermatology and includes cardiology, nephrology, and hematology among others. Overall impact on access measures, acceptability, cost, and provider satisfaction remain positive. There is limited research on population health outcomes of morbidity and mortality. The availability of eConsult services has spread both geographically and in terms of specialty services offered. By allowing for a greater population	Moderate

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							to be served, access to care is being improved; however, long-term impact should continue to be assessed with a focus on patient safety, morbidity, mortality, and cost effectiveness metrics.	
Mitchell et al. (2015)	Systematic Review	Identify outcomes of different models that integrate specialist and PCPs, and characteristics of models that delivered favourable clinical outcomes.	10	Multiple (Australia, Belgium, Ireland, New Zealand, United Kingdom, United States)	Study specific (included PCPs, specialists, and patients)	GP Education Process change System change	Despite few improvements in clinical outcomes, significant improvements were reported in process outcomes regarding disease control and service delivery. No study reported negative effects compared with usual care. Economic outcomes showed modest increases in costs of integrated primary–secondary care. Compared with usual care, integrated primary–secondary care can improve elements of disease control and service delivery at a modestly increased cost, although the impact on clinical outcomes is limited. Future trials of integrated care should incorporate design elements likely to maximize effectiveness.	Moderate
Smith et al. (2018)	Systematic Review	Establish the proportion of patients diagnosed with cancer and other diseases through direct access testing, time to diagnosis, and suitability of direct access investigations.	60	Multiple (Australia, Denmark, Estonia, Finland, Hong Kong, India, Ireland, Israel, Italy, Netherlands, Saudi Arabia, Spain, Switzerland, United Kingdom, United States)	Diagnoses	Process change	GP direct access testing performs as well as, and on some measures better than, consultant triaged testing on measures of disease detection, appropriateness of referrals, interval from referral to testing, and patient and GP satisfaction.	Moderate

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Vimalananda et al. (2015)	Systematic Review	Review the literature to better understand: how e-consults are being implemented; what benefits do e-consults offer; what gaps are there in existing research.	27	Multiple (high income only)	Study specific (included healthcare providers and patients)	Process change	E-consults are feasible in a variety of settings, flexible in their application, and facilitate timely specialty advice. More extensive and rigorous studies are needed to inform the e-consult process and describe its effect on access to specialty visits, cost and clinical outcomes.	Moderate
Winpenny et al. (2016)	Scoping Review	Identify and review what is currently known about strategies involving primary care that are designed to improve the effectiveness and efficiency of outpatient services. Further, to comment on the impact of such schemes on the organization of primary care, the primary care workforce, access, clinical outcomes for patients, patient experience and cost.	183	Multiple (high income only)	Study specific (included PCPs and practices, specialist physicians, patients, referrals)	GP education System change Patient interventions	There are a number of promising interventions which may improve the effectiveness and efficiency of outpatient services, including making it easier for PCPs and specialists to discuss patients by email or phone. There remain substantial gaps in the evidence, particularly on cost-effectiveness, and new interventions should continue to be evaluated as they are implemented more widely. A move for specialists to work in the community is unlikely to be cost-effective without enhancing PCPs' skills through education or joint consultations with complex patients.	Moderate
Liddy et al. (2015)	Environmental Scan	Identify other eConsultation and eReferral systems in Canada.	3 programs	Canada	Programs	Process change	Despite the current lack of eConsultation and eReferral systems in operation in Canada, several provinces are in various stages of implementing their own eReferral systems. The lessons learned from these projects should be disseminated in order to decrease the duplication of efforts and mistakes. Improving interoperability of EMR systems is becoming a bigger priority. As drawing data from EMRs into eReferral systems becomes easier, designing eReferral systems will become more practical and physician buy-in will likely increase. Improvement is needed in the specialty referral	Low

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							process, and eConsultation and eReferral systems offer the potential to meet these needs.	
Individual studies (n=56)								
Anderson et al. (2017)	Quasi-Experimental	Explore the effect of Project ECHO (Extension for Community Healthcare Outcomes) Pain on a range of provider and patient outcomes.	48 project ECHO sessions (covering 107 unique patients) 10 PCPs assigned to intervention, 10 assigned to control	United States	ECHO sessions	GP Education Process change	Attendance at weekly Project ECHO Pain sessions not only improved PCP knowledge and self-efficacy, but also altered prescribing and referral patterns, suggesting that knowledge acquired during ECHO sessions translated into practice changes.	Not evaluated
Barnabe et al. (2017)	Observational	Evaluate a model of care to improve arthritis detection and treatment in an urban Aboriginal population.	38 patients	Canada	Patients	System change	This integrated model of care facilitated access for diagnosis and return to care of inflammatory arthritis conditions and was acceptable to participants. This model of care removes the complexities of access to non–family physician specialty care while providing health care in a setting valued by Aboriginal patients.	Not evaluated
Berg et al. (2016)	Observational	Examine for which patients with knee injury an MRI is ordered and whether direct access to MRI in primary care influences the PCP referral to an orthopaedic surgeon.	588 patients	Netherlands	Patients	Process change	In patients with knee injury, direct access to MRI of the knee in a primary care setting significantly reduced referrals to an orthopaedic surgeon.	Not evaluated
Bradi et al. (2017)	Observational	Describe the questions being asked through the Champlain BASE eConsults service and quantify the resulting reduction in referrals. Further, to identify topics to address at future continuing medical education events.	387 eConsults	Canada	eConsults	Process change	We found that an eConsult service provides timely access to neurologists and can divert half of intended face-to-face consultations. The most common questions posed by PCPs regarded diagnosis and drug therapy of headaches, seizures, altered sensation and CVD. eConsults services could provide guidance for continuing medical education planning in neurology.	Not evaluated

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Chan et al. (2018)	Observational	Investigate determinants of primary care physician cardiology referrals by analyzing questions asked by PCPs in cardiology electronic consultation services (eConsults).	114 cardiology eConsults	Canada	PCP eConsult questions	Process change	Multimorbidity leads to cardiology eConsults as PCPs try to apply treatment guidelines in medically complex patients. Mild test abnormalities unrelated to clinical problems commonly lead to cardiology eConsult requests.	Not evaluated
Chen et al. (2016)	Observational	Evaluate whether the algorithm approach to testing improved diagnostic efficiency of rheumatologic conditions within the Harris Health System.	54 patients	United States	Patients	GP education Process change	Successful implementation of this algorithm approach to testing can improve the diagnostic efficiency of rheumatologic conditions in a busy safety net health care system.	Not evaluated
Ching et al. (2016)	Observational	Assess the impact of an educational initiative for non-specialist, healthcare professionals in the community on the process and quality measures of diabetes care delivered, and changes in their learning experiences and clinical management behaviour in the short and long term.	57 PCPs	United Kingdom	PCPs	GP Education	An experiential, interprofessional intervention can result in significant improvements in quality outcomes in association with a sustained impact on behaviours and practices.	Not evaluated
Cruz et al. (2015)	Observational	Analyze the impact of virtual consultations on the spectrum and volume of endocrine consults, access to endocrine care, and downstream healthcare utilization.	158 eConsults	United States	eConsults	Process change	The use of virtual consultations in a fee-for-service, academic medical center setting significantly improved access to endocrine care and the quality of referrals. Increasing recognition and reimbursement of non-traditional consultation models will be essential to scaling and disseminating these programs.	Not evaluated
Hensel et al. (2018)	Observational	Examine actual utilization of e-consults between PCPs and psychiatrists and investigate the perceptions of PCPs about this form of psychiatric advice to inform how to optimize the utility and thereby the uptake of this service.	37 eConsults	Canada	eConsults	Process change	E-consult is a viable and timely way for PCPs to get much-needed psychiatric advice. For optimizing its utility and uptake, e-consult needs to be integrated into reliable care pathways with adequate referrer and consultant preparation.	Not evaluated

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Heron et al. (2015)	QI/Evaluation	Develop a reproducible general practitioner staffed musculoskeletal (MSK) and sport and exercise medicine (SEM) clinic based within primary care that is economically sound and sustainable, providing high-patient satisfaction.	5 patients	United Kingdom	Patients	System change	This novel service model can make sound economical sense and deliver high patient satisfaction within primary care, with low waiting times.	Not evaluated
Holland et al. (2017)	QI/Evaluation	Evaluate whether a seven-year multifaceted intervention led to sustained improvement in primary care radiology referral quality and value, and discusses the transferability to other health systems.	Not reported	New Zealand	Referrals	GP Education Process change	Sustained improvement to primary care radiology referral quality and value is achievable at scale using a multifaceted intervention.	Not evaluated
Jones et al. (2014)	QI/Evaluation	Develop a local pathway algorithm, making it available in as many online formats as possible to encourage its use.	1487 PCPs	United Kingdom	PCPs	GP education	It is possible to develop and implement an allergy pathway in various formats. The Map of Medicine (MoM) format seems most used but more work is needed on dissemination, integration with continuing professional development and general practice. An alternative approach worth pursuing is to develop the pathway into a more detailed computer patient interviewing and to build this into referral management.	Not evaluated
Jones et al. (2018)	QI/Evaluation	Evaluate the impact of a straight to test pathway (STTP) on time to diagnosis for upper gastrointestinal (UGI) cancer.	340 patients (STTP pathway) 495 patients (traditional route)	United Kingdom	Time from referral	Process change	A STTP is associated with an overall reduction of 1 week from referral to treatment for UGI cancer. The approach is feasible and did not require more resources. Larger studies are required to assess whether this time saving translates into improved cancer outcomes.	Not evaluated
Katz et al. (2018)	Observational	Demonstrate patient and doctor acceptance of receiving and providing a virtual consultation (VC), general practitioner utilization of a VC service from a specialist, ability to follow-up patients via VC after an initial face-to-face (F2F) review and whether this VC program provided a safe	70 patients	Australia	Patients	Process change	The program demonstrated safe, expedited, and efficient follow up with a clinical and web based program. Support from the general practitioners and patients was encouraging, despite logistical issues. Ongoing evaluation of VC services will continue and feasibility to larger	Not evaluated

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		and effective alternative to traditional models of care.					networks and more chronic diseases remains the long-term goal.	
Keely et al. (2018)	Observational	Describe the types of nephrology questions asked through an eConsult service based in eastern Ontario and assess the service's impact on the need for face-to-face consultations.	155 eConsults	Canada	eConsults	Process change	The Champlain BASE eConsult service was able to provide guidance to PCPs in the community and reduce the number of face-to-face nephrology consultations. This service identified common nephrology questions asked by PCPs and can be used to generate continuing medical education content. The value of eConsult content in directing specialist knowledge transfer to PCPs and their satisfaction with specialists' responses warrants further study.	Not evaluated
Keely et al. (2019)	Observational	Gain a broader understanding of specialists' perspectives providing eConsult services, we surveyed all specialists actively participating in either platform.	114 specialists	Canada	Specialists	Process change	As eConsult services expand across regions and provinces, the provider perspectives and experiences should be used to evaluate the benefits of eConsult and impact on provider satisfaction.	Not evaluated
Kilty et al. (2016)	Simulation	Evaluate whether an upfront CT scan ordered by a PCP in Canada for a suspected diagnosis of chronic rhinosinusitis (CRS) would be more cost-effective when compared to symptom-based specialist referral practice.	15 000 scenarios (Monte Carlo simulation)	Canada	Patients	Process change	The results of this study suggest that PCPs can improve the effectiveness of their referrals for CRS by utilizing an upfront CT referral strategy. However, it would create an additional cost of approximately CAD 1500 per patient referred. Given these findings, the potential clinical benefits of using an upfront CT scan in the Canadian primary care setting should be further studied to determine the value of the additional money spent to improve the effectiveness of CRS referral.	Not evaluated

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Kim et al. (2018)	Observational	Better understand how PCPs use e-consults to access specialty expertise and to describe specialists' responses to these e-consults. Specifically, cardiology eConsult use by PCPs was examined.	750 patients	United States	PCPs	Process change	PCPs are the most frequent requesters of cardiology e-consults, using them primarily to obtain input on clinical questions. Cardiologists did not provide answers for one in ten, owing principally to insufficient available clinical information. Educating PCPs and standardizing the template for requesting e-consultation may help to reduce the number of unanswered e-consults.	Not evaluated
Liddy et al. (2014)	Observational	Examine the impact of new primary care models (Enhanced Fee-for-service; Capitation- Non-Interdisciplinary [CAP-NI]; Capitation – Interdisciplinary [CAP-I]) on specialist referrals.	6370 primary care clinics	Canada	PCPs	System change	The primary care model is significantly associated with referral rate. On a study population level, these differences equate to 111,059 and 37,391 fewer referrals by fee-for-service versus CAP-NI and CAP-I, respectively – a difference of CAD 22.3 million in initial referral appointment costs. Whether a lower rate of referral is more appropriate or not is not known and requires further investigation. Physician remuneration and team structure likely account for the differences; however, further investigation is also required to better understand whether other organizational factors associated with primary care model also impact referral.	Not evaluated
Liddy et al. (2016)	Observational	Estimate the costs and potential savings associated with all eConsult cases completed between 1 April 2014 and 31 March 2015.	3487 eConsults	Canada	eConsults	Process change	The findings demonstrate potential cost savings from the societal perspective, as patients avoided the travel costs and lost wages/productivity associated with face-to-face specialist visits. Greater savings are expected once other costs such as avoided tests and visits and potential improved health outcomes associated with	Not evaluated

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							shorter wait times are considered.	
Liddy et al. (2017)	Observational	Identify the proportion of eConsults that led to the PCP initiating a face-to-face specialist referral when one was not previously contemplated, and to evaluate the content of these eConsults that prompted referrals.	5601 eConsults	Canada	eConsults	Process change	By providing PCPs with increased access to specialists, the Champlain BASE eConsult service serves an important role in identifying and preventing the potential detrimental consequences of delayed medical referrals across specialty groups.	Not evaluated
Liddy et al. (2017)	Observational	Describe the use of eConsult services in Nunavut, and conduct a costing evaluation.	165 eConsult cases	Canada	eConsults	Process change	The eConsult service provided patients in Nunavut's remote communities with prompt access to specialist advice. The service's main advantage in Canada's northern communities is its ability to offer electronic access to a breadth of specialties far greater than could be supported locally. The findings from this study suggest that a territory-wide adoption of eConsult would generate enormous savings.	Not evaluated
Liddy et al. (2018)	Observational	Evaluate the potential effect of eConsult on specialist referral rates in Ontario among family physicians providing comprehensive care.	113,197 referrals	Canada	Referrals	Process change	Findings demonstrate that using eConsult service is associated with fewer referrals from primary to specialist care, with considerable potential for cost savings to our single-payer system.	Not evaluated
Liddy et al. (2018)	Observational	Report the impact of a multiple specialty eConsult service during the first 5 years of use after implementation, with a focus on growth and sustainability.	14,105 eConsults	Canada	eConsults	Process change	Results show the positive impact of an eConsult service and can inform other regions interested in implementing similar systems.	Not evaluated
Livingstone et al. (2015)	Observational	Determine whether teledermatology in a single general practice is cost-effective; whether the correct types of cases are being referred; and if patients are satisfied with the service.	248 teledermatology consults	United Kingdom	Teledermatology consults	Process change	Over a 3-year period in a single general practice, teledermatology was found to be cost-effective. The correct types of cases were referred. It also offered a high level of patient satisfaction. Overall, both the patients and the practice have benefitted from this service and. Further, the eConsults appear to have resulted in cost savings for the NHS.	Not evaluated

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Lowenstein et al. (2017)	Observational	Describe the implementation of eConsults for psychiatry in a large academic health system.	50 eConsults	United States	eConsults	Process change	For the majority of patients, psychiatrists provided strategies for ongoing management in primary care without an in-person evaluation, and PCPs implemented most psychiatrist recommendations. eConsults show promise as one means of supporting PCPs to deliver mental health care to patients with common psychiatric disorders.	Not evaluated
Mahalingam et al. (2014)	QI/Evaluation	Improvement service through introduction of referral guidelines and liaising with local general practitioners.	225 Referrals	United Kingdom	Inappropriate referrals	GP education	ENT conditions are common in primary care, however, many GPs have often had very little exposure throughout their training. This may be a causative factor in the large proportion of inappropriate referrals. Introducing a structured referral pathway as well as providing a knowledge base can help reduce inappropriate referrals. Strengthening links between local GPs and hospitals will enable both groups to work together to devise appropriate referral management schemes and reduce the financial burden associated with this common problem	Not evaluated
Mahmood et al. (2017)	Observational	Assess if telephone triage helped in prioritizing early assessment and referral of patients who were diagnosed with a cancer.	39 patients	United States	Patients	Process change	Telephone triage reduced the time from the first primary care contact to face-to-face assessments in primary and secondary care. Telephone triage should not only be seen as a way of managing demands and appointments but also as a system to improve patient outcomes.	Not evaluated

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Mann et al. (2018)	Observational	Describe the development of an eConsultation service as part of the triaging and grading process of referrals and to report on the efficacy and safety of such a service.	1013 eConsults	New Zealand	eConsults	Process change	eConsultation was effective at reducing the number of first outpatient face-to-face contacts without notable compromise of the quality of care or patient safety. E-consultation allows specialists to provide expert clinical guidance, management, and support to the referring provider when appropriate. Topics for further study include patient benefits and satisfaction, and further assessment of the social, economic, and financial impacts on all parties involved.	Not evaluated
Miniard et al. (2018)	Observational	Examine whether having nurse practitioners (NPs) facilitate patient triage in an outpatient neurosurgical practice to expedite patients' access to care and ultimately improve patient satisfaction, outcomes, and healthcare expenditure.	200 NP reviews	United States	Triages	Process change	Utilization of NPs to facilitate triage and treatment of the outpatient neurosurgical spine patient is a sustainable patient-centered care delivery model that leads to improvements in access and ensures exceptional quality outcomes.	Not evaluated
O'Toole et al. (2017)	Observational	Describe the use and impact of the Champlain BASE (Building Access to Specialists though eConsultation) eConsult service in the field of dermatology, highlighting its impact on the need for face-to face consultations, provider satisfaction, and feasibility. Furthermore, to characterize each dermatology eConsult to determine the most common clinical topics and types of questions asked by PCPs, in attempt to better understand clinical problems faced by PCPs with the potential to inform need-driven continued medical education events.	965 dermatology eConsults 217 PCPs (174 physicians, 43 nurse practitioners) 2 dermatologists	Canada	eConsults	Process change	eConsults was feasible and well received by PCPs, which improves access to dermatology care with a potential to reduce wait times for traditional consultation.	Not evaluated

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Olayiwola et al. (2016)	Randomized Controlled Trial (Cluster)	Conduct a randomized controlled trial of eConsultations to test their efficacy and effectiveness in reducing wait times and improving access to specialty care.	36 PCPs	United States	PCPs	Process change	eConsultation referrals improved access to and timeliness of care for an underserved population, reduced overall specialty utilization, and streamlined specialty referrals without any increase in adverse cardiovascular outcomes. e-consultations are a potential solution for improving access to specialty care.	Not evaluated
Olayiwola et al. (2018)	Observational	Explore the connection between eConsults and the Quadruple Aim using a unique national dataset of PCC-reported eConsult outcomes.	3872 eConsults	United States	PCPs	Process change	Electronic consultation systems are being implemented, adopted, or optimised in nearly all 50 states in the United States and have demonstrated remarkable impact on population health, system efficiency, and referral utilization. While there remain barriers in terms of time necessary to submit eConsults and what we call specialist eConsultants being available and skilled, there is great promise in eConsults to serve as more than educational for PCCs. Through the lens of the PCC, eConsults may indeed offer more than has already been established.	Not evaluated
Price et al. (2016)	Observational	Assess communication in an electronic referral system by review of referrals to a public urban health care system's gastroenterology clinic that were not scheduled for appointments.	266 not-scheduled e-referrals	United States	eReferrals	Process change	Few adverse outcomes in electronic referrals not scheduled for in-person gastroenterology visits were found, and none were clearly due to communication lapses in the referral process. Contributors to the potential for harm in referrals that were unintentionally left unscheduled included discontinuity of care and lack of patient or provider follow-up.	Not evaluated

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Quanjel et al. (2018)	Observational	Evaluate the effects of an in-house internist at a PCP practice on the number of referrals to specialist care in the hospital setting. Additionally, the involved PCPs and internist were asked to share their experiences with the intervention.	Not reported	Netherlands	Referrals	System change	This small explorative study did not find any evidence to support that an in-house internist at a primary care setting results in a decrease of referrals to internal medicine in the hospital setting.	Not evaluated
Rathod et al. (2014)	QI/Evaluation	Identify a practical and cost effective solution to reducing avoidable referrals by assisting GPs with chest pain discrimination. (Study 1: Preliminary study to assess the quality of RACPC referrals; Study 2: A pilot study testing the effectiveness of chest pain symptom scoring in improving GP discrimination of chest pain; Study 3: Review of RACPC referrals post implementation of new referral form)	Study 1: 167 patients Study 2 and 3: 79 referrals	United Kingdom	Referrals	GP education	Many GPs may be cautiously "over-diagnosing" angina in primary care, potentially resulting in avoidable or unnecessary referrals to RACPC for specialist assessment. GPs who use chest pain symptom scoring (incorporated into the RACPC referral form) are more than twice as likely to correctly discriminate non-cardiac chest pain.	Not evaluated
Riis et al. (2016)	Randomized Controlled Trial (Cluster)	Evaluate whether a 12-week multifaceted implementation strategy (MuIS) reduced secondary care referral, compared to a passive implementation strategy (PaIS).	60 primary care practices	Denmark	Practices, patients	GP education	Compared to a passive implementation strategy, a multifaceted implementation strategy changed general practice referral behaviour and was cost effective, but patients were less satisfied.	Not evaluated
Rodriguez Villa et al. (2016)	Observational	Identify the prevalence and risk factors of diabetic retinopathy (DR) among rural inhabitants included in a teleophthalmology program. Further, to analyze diagnostic accuracy among primary care physicians, concordance with ophthalmologists, and financial savings.	394 patients	Spain	Patients	Process change	Teleophthalmology programs are a useful tool in DR screening. PCPs are able to distinguish patients who need specialist care, avoiding unnecessary referrals to ophthalmologists, and saving costs.	Not evaluated
Ronda et al. (2018)	Randomized Controlled Trial (Cluster)	Investigate the effectiveness of an alert in patients' electronic medical record (EMR) provided to physicians aimed to allocate patients to the preferred treatment setting (hospital outpatient clinic or primary care practice). Further, the study explored reasons of physicians not adhering to advice.	47 practices 2778 patients	Netherlands	PCPs, patients	Process change	This study found no evidence that using the EMR to send consultation-linked advice to physicians resulted in a shift in patients' allocation to the preferred treatment setting. Physicians did not appear to follow the advice, at least partly due to patients' preferences.	Not evaluated

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Rutten et al. (2017)	Observational	Study the quality of care given by general practitioner co-operatives (GPCs) to self-referrals at emergency-care-access-points (ECAPs).	783 records	Netherlands	Medical records	System change	Self-referred patients at an ECAP are mostly trauma related, low-urgent and male patients. The majority could be treated by the GPC without subsequent referral to the ED. Care given at the GPC is reasonably efficient and safe. Triage and treatment of self-referrals by the GPC at ECAPs might offer opportunities for other countries facing problems with inappropriate emergency department visits.	Not evaluated
Rutten et al. (2018)	Observational	Investigate patient and care characteristics, indication for diagnostics, and outcomes at general practitioner co-operatives (GPCs) with and without access to radiology.	657 patients	Netherlands	Patients	Process change	GPC access to radiology is beneficial for patients and professionals. The diagnostics were adequately used. With access to radiology, unnecessary referrals and specialist care are prevented. This may lead to a decrease in emergency department attendance and overcrowding.	Not evaluated
Schettini et al. (2017)	Observational	To evaluate single center experience of eConsults and test whether they improve closure of the specialty referral loop, reduce nephrology care wait times, and increase referral completion rates.	853 referrals	United States	Referrals	Process change	The eConsult pilot program reduced nephrology wait times and significantly increased referral completion rates. In large integrated health systems, eConsults have considerable potential to improve access to specialty care, reduce unnecessary appointments, and optimize the patient population being seen by specialists.	Not evaluated
Skeith et al. (2017)	Observational	Evaluate the use and impact of the Canadian Champlain BASE (Building Access to Specialists through eConsultation) eConsult service in the specialty of thrombosis medicine.	162 eConsults	Canada	eConsults	Process change	An eConsult service in thrombosis medicine improved timely access to specialist advice and potentially reduces the number of face-to-face consultations needed. Further research is needed to understand how a thrombosis eConsult service affects thrombosis clinic performance data and patient outcomes.	Not evaluated

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Smyth et al. (2013)	QI/Evaluation	Quantify the numbers of patients attending the rapid access clinic, source of referral, patterns of conditions and overall appropriateness of referrals.	1985 clinic attendances	United Kingdom	Patients	System change	The rapid access clinic has enabled time and resources to be more effectively directed towards a smaller number of patients, whose needs are more urgent.	Not evaluated
Snoswell et al. (2018)	Observational	Assess the cost-effectiveness of teledermoscopy as a referral mechanism for skin cancer diagnosis and management in Australia.	Not reported	Australia	Referrals	Process change	Teledermoscopy for skin cancer referral and triage in Australia will increase the cost per case but reduce time to clinical resolution, when compared with usual care. Implementation recommendations depend on the preferences of the Australian health system decision makers for either lower cost or expedited clinical resolution.	Not evaluated
Tran et al. (2016)	Observational	Examine whether there is an association between avoiding face-to-face referrals using an e-consult service and specific content within each e-consult.	1055 eConsults	Canada	eConsults	Process change	Referral outcomes are associated with the type of question being asked, the formulation of each question, and the specialty being addressed. Discrepancies among PCPs and specialists regarding which patients require face-to-face referrals may help identify knowledge gaps and guide professional development.	Not evaluated
Tuot et al. (2015)	Observational	Examine how different specialties leverage eReferral to engage in pre-consultative exchange and virtual co-management; assess the quality defined by helpfulness and educational value of specialist consultative communication from the PCP perspective using a novel peer evaluation system; identify determinants of high-quality specialist communication; and determine whether individualized feedback to specialists could enhance the quality of consultative exchange.	Not reported	United States	Referrals	Process change	This study demonstrates that an electronic referral and consultation system such as eReferral expand the specialist role in a way that PCPs find helpful and educational. Highly rated specialist communication comes from specialist reviewers who individually manage a modest volume of referrals, and thus can spend the time necessary to properly educate their colleagues through high-quality pre-visit consultative exchange or virtual co management. In turn, this allows for a high never-scheduled referral disposition strategy, furthering the tenets of patient-centered care.	Not evaluated

Author (Year)	Design	Objective(s) of review/study	Number of studies/ Sample Size	Country/ Countries	Population Studied (unit of analysis)	Intervention Category[1]	Authors' conclusions	Quality [2]
Ulloa et al. (2017)	Observational	Evaluate the impact of an eConsult system on surgical yield for a safety-net general surgery service; to examine whether the completeness of electronic consultation requests was associated with the decision to schedule or not schedule an ambulatory general surgery clinic visit; and to assess the potential safety implications related to the triage function of a general surgery eConsult program, which could serve as a balancing measure to surgical yield.	150 eConsults	United States	eConsults	Process change	The eConsult system reduced referrals to surgery by 25%. Of the 36 patients that avoided referral, 4 (11%) patients required urgent care/emergency room evaluation. Overall, eConsult systems can be used to safely optimize the surgical yield of a safety net general surgery service.	Not evaluated
van Gelder et al. (2017)	Randomized Controlled Trial (Cluster)	Investigate whether a web-based consultation platform (telenephrology) led to a lower referral rate of indicated patients. Furthermore, to assess consultation rate, quality of care, costs and general practitioner experiences with telenephrology.	47 general practices (128 GPs), 3004 CKD patients	Netherlands	Patients	Process change	There was no difference in referral rates between the intervention and the control group. There were also no significant differences in consultation rate, quality of care, and costs. The majority of GPs had a positive opinion on telenephrology. The referral rates of only 2.3% (n = 29) in the intervention group and 3.0% (n = 52) in the control group were much lower than the expected referral rates of 11.1% and 19.4%, which resulted in a lower power of the study. The data from this study did not allow for conclusions on the effect of telenephrology on the rate of patient referrals and provider-to-provider consultations, compared to conventional methods. It was positively evaluated by GPs and was non-inferior in terms of quality of care and costs.	Not evaluated

Author (Year)	Design	Objective(s) of review/study	Number of studies/ Sample Size	Country/ Countries	Population Studied (unit of analysis)	Intervention Category[1]	Authors' conclusions	Quality [2]
Walsh et al. (2015)	QI/Evaluation	Evaluate whether the intervention was successful in improving the cost-effectiveness of the diabetes service; improving the quality of referrals to the secondary care diabetes clinics; reducing waiting lists for out patient diabetes clinics; and improving diabetes management in the community. Further, to evaluate the community care model to contribute to the evidence base behind community diabetes management.	108 referrals	United Kingdom	Referrals	Process and System Change	The community diabetes initiative intervention significantly improved the appropriateness of Type 2 Diabetes referrals from GP practices engaged with the initiative.	Not evaluated
Williams et al. (2016)	QI/Evaluation	Identify those patients who despite symptoms were at low risk of pathology, and gear the focus of their management towards symptom control using specialist dietetic input to avoid expensive and unnecessary secondary care referral and investigations in a time of limited resources.	277 patients	United Kingdom	Referrals	GP education	The combination of GP education, providing diagnosis and management pathways, appropriate screening, and providing an effective treatment for patients with likely irritable bowel syndrome (IBS) appeared successful in this pilot. This proved cost-effective, reduced secondary care involvement and improved patient care	Not evaluated
Wilson et al. (2016)	QI/Evaluation	Evaluate the The RACE (Rapid Access to Consultative Expertise) program, following the Triple Aim framework (the care experience, the per capita cost of care, and population health).	102/800 family physicians completed survey 5000 calls reviewed	Canada	Family physicians, calls	Process change	RACE can more effectively remain the locus of patient care, calling on other specialist expertise when appropriate and providing better coordination of care for their patients. Evaluations to date suggest RACE helps reduce system costs by reducing unnecessary emergency department visits and face-to-face specialist consultations.	Not evaluated
Witherspoon et al. (2017)	Observational	Describe the use and impact of the eConsult service in urology and to characterize the type and content of clinical questions being asked.	190 eConsults	Canada	eConsults	Process change	Although certain clinical presentations still require a formal in-person urological consultation, eConsultations can potentially reduce unnecessary clinic visits while identifying patients who may benefit from early urological consultation. Through both these mechanisms, timely access to urologists may be improved.	Not evaluated

Author (Year)	Design	Objective(s) of review/study	Number of studies/ Sample Size	Country/ Countries	Population Studied (unit of analysis)	Intervention Category[1]	Authors' conclusions	Quality [2]
Wrenn et al. (2016)	Observational	Describe the types of clinical questions PCPs ask through eConsults, what management recommendations specialists provide, and the extent to which PCPs implement specialist recommendations. Additionally, to investigate the downstream healthcare utilization, including specialist office visits, emergency department (ED) visits, and hospital admissions following eConsults.	200 eConsults	United States	eConsults	Process change	eConsults provide guidance to PCPs across the spectrum of patient care. PCPs implement specialists' recommendations in the large majority of cases, and few patients subsequently require in-person specialty care related to the reason for the eConsult.	Not evaluated
Wright et al. (2015)	Observational	Investigate whether a new computerised referral management and booking system met its goals and to eliminate technical problems.	46 practices (13 intervention, 33 control)	United Kingdom	Practices	Process change	Findings provided favourable evidence for the effectiveness of the new referral management system. They were, however, preliminary. If referrals into secondary care continued to be reduced on a long-term basis, the system would be cost effective despite the time and effort required for clinical triage.	Not evaluated
Zekria et al. (2017)	QI/Evaluation	Examine whether the program was successful in decreasing the average wait time from referral to first face-to-face assessment, and concomitantly increasing the proportion of patients being assessed within the 28-day target period.	Not reported	United Kingdom	Referrals	Process change	The measures implemented have been effective in reducing the average waiting time from referral to initial face-to-face assessment. Likewise, the percentage of patients offered appointments within the 28-day target time frame has increased.	Not evaluated

PCP = primary care provider

[1] Categorized using the framework published by Blank *et al.* (Referral interventions from primary to specialist care: a systematic review of international evidence. British Journal of General Practice, December 2014). Interventions were classified as either: **GP education** (as any intervention with a primary focus on GP education or training); **Process changes** (small-scale changes to some aspect of the individual referral process that did not involve the movement of staff or relocation of clinics, the methods in which referrals were triaged at hospital, or financial arrangements for referral); **System changes** (large changes impacting on all referrals made that involved the movement of staff or relocation clinics, the methods in which all referrals were triaged at hospital, or financial arrangements for referrals); or **Patient interventions** (Patient education, patient concerns and satisfaction).

[2] The AMSTAR 2 tool was used to assess the quality of systematic reviews (Shea *et al.* AMSTAR 2: a critical appraisal tool for systematic reviews that include randomized or non-randomized studies of healthcare interventions, or both. BMJ. 2017; 358. j4008). The quality of individual studies was not assessed.

Table 2. Intervention details, outcomes, and results of included reviews and studies.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Systematic Reviews (n=14)				
Akbari et al. (2011)	GP education	Professional educational (referral guidelines, secondary care provider-led educational strategies)	Objectively measured provider performance in a health care setting (for example, referral rates or appropriateness of referral) or health outcomes	The referral process will most likely improve when guidelines for referral are distributed with standard referral forms and when the health care professionals who are the consultants are involved in teaching about referring. But simply distributing guidelines and providing health care professionals with feedback about how they are referring may not improve the process. There is little evidence about organizational changes. But providing a second opinion before referring, or enhancing the services provided before a referral (e.g., providing access to a physiotherapist) may improve the referral process. There is not enough evidence to draw firm conclusions about financial changes. Financial changes can change the number of referrals but it is not known whether they improve the quality or appropriateness of referrals.
	Process change	Organizational interventions (multiple)		
	System change	Financial interventions (multiple)		
Blank et al. (2014)	GP education	Peer review and training/feedback, Professional development, Guidelines with or without training/feedback.	All outcomes relating to referral were considered including: referral rate, referral quality, appropriateness of referral, impact on existing service provision, costs, mortality and morbidity outcomes, length of stay in hospital, safety, effectiveness, patient satisfaction, patient experience, and process measures (such as referral variation and conversion rates).	Interventions that aim to moderate referral processes by educating GPs is mixed. Interventions that aim to moderate referral outcomes by changing an element of the referral process is mixed. Stronger evidence exists for electronic referral interventions (positive effects on referral, appropriate referral, GP satisfaction, reduction in non-attendance, waiting times, and transfer of information) and interventions including specialist including specialist consultation prior to referral (positive effects on number of referrals [referrals avoided], time to treatment, accuracy of diagnosis, and patient evaluation of services). The overall picture for interventions that aim to implement large system changes to impact on referral is mixed. Two of the types of interventions for which stronger evidence was identified involved the provision of specialist services in the community (positive effects on referral rate, appropriate referrals, patient satisfaction, and service accessibility). Stronger evidence also existed to suggest that the provision of additional staff in primary care (for example, nurses or counsellors) had a negative effect on referral outcomes. Some system change interventions conducted internationally where enormous change to the NHS system would be required to implement in the NHS. The education interventions were graded as inconsistent and the patient concern intervention was graded as no evidence.
	Process change	Designated appointment slots/fast-track clinic, Direct access to screening/diagnostic testing, specialist consultation before referral, electronic referral, decision support tool, and wait list review.		
	System change	Additional primary care staff, Community provision of 'specialist' services by GPs, Outreach-community provision by specialists, Return of inappropriate referrals, Gatekeeping, Payment system, Referral management centre.		
	Patient interventions	Patient education, Patient concerns and satisfaction.		

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Chuchu et al. (2018)	Process change	Specialist consultation before referral	Target condition: detection of any skin cancer; invasive melanoma or atypical intraepidermal melanocytic variants; invasive cutaneous melanoma; cutaneous squamous cell carcinoma Referral accuracy	Seven studies provided data for the primary target condition of any skin cancer (1588 lesions and 638 malignancies). For the correct diagnosis of lesions as malignant using photographic images, summary sensitivity was 94.9% (95% confidence interval (CI) 90.1% to 97.4%) and summary specificity was 84.3% (95% CI 48.5% to 96.8%) (from four studies). Individual study estimates using dermoscopic images or a combination of photographic and dermoscopic images generally suggested similarly high sensitivities with highly variable specificities. Limited comparative data suggested similar diagnostic accuracy between teledermatology assessment and in-person diagnosis by a dermatologist; however, data were too scarce to draw firm conclusions. For the detection of invasive melanoma or atypical intraepidermal melanocytic variants both sensitivities and specificities were more variable. Sensitivities ranged from 59% (95% CI 42% to 74%) to 100% (95% CI 48% to 100%) and specificities from 30% (95% CI 22% to 40%) to 100% (95% CI 93% to 100%), with reported diagnostic thresholds including the correct diagnosis of melanoma, classification of lesions as 'atypical' or 'typical, and the decision to refer or to excise a lesion. Referral accuracy data comparing teledermatology against a face-to-face reference standard suggested good agreement for lesions considered to require some positive action by face-to-face assessment (sensitivities of over 90%). For lesions considered of less concern when assessed face-to-face (e.g. for lesions not recommended for excision or referral), agreement was more variable with teledermatology specificities ranging from 57% (95% CI 39% to 73%) to 100% (95% CI 86% to 100%), suggesting that remote assessment is more likely recommend excision, referral or follow-up compared to in-person decisions.
Deldar et al. (2016)	Process change	Specialist consultation before referral (i.e., teleconsultation)	Process measures (teleconsultation effect on the decision of requesting physician, specialty level of requesting physicians, teleconsultation structure)	The teleconsultation were reported to result in change in treatment plan, referral (28%) or evacuation rate, change in diagnosis, and educational effects. Teleconsultation between two levels of centers/experts (general physician or hospital with a specialist center/physician) was more effective for referrals (mostly reducing referrals) and treatment decisions. Use of structured template for teleconsultation had been noticed only in five articles. Of them, two were in the teledermatology areas that used a semi-structured form and an online structured pre-consultation questionnaire (mostly to educate medical trainees). In another case, a web-based structured format to upload patient-related information was established to determine the effect of teleconsultation in cases of strabismus. In two other cases, a structured interview was performed in acute stroke care by telephone consultation and a standardized query form (including all relevant clinical information) was designed for teledermatology consultation.
Faulkner et al. (2003)	GP education	Guidelines, information	Descriptions of interventions identified and impact on referral rates	There were 16 studies assessing professional interventions. Results demonstrate that education and/or guidelines generally result in some change in clinical behaviour. This may or may not be reflected in referral rates. There were 22 studies assessing organizational interventions. The impact of these

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
	System change	In-house PCPs, in-house specialists, GP fundholding, open-access schemes, financial and regulatory interventions		interventions on referral rates varied across studies. . There were 6 studies assessing financial/regulatory .Although none of these, except the last study, aimed primarily to change the number or proportion of referrals from primary to specialist state-provided secondary care, the direction of change was as expected in all cases and usually a decrease. There were 4 studies assessing patient/public interventions . Two studies of campaigns about malignant melanoma both showed large increases in secondary care referral. A study of antidepressant drug prescription compliance was underpowered, and educational material on general health for mothers of infants showed a small but non-significant effect on referral and other service use. There were 11 interventions specifically targeted toward mental health. Studies included those assessing professional interventions, organizational interventions (such as specialist outreach). Professional interventions showed an effect on referral rates, but the clinical appropriateness is difficult to judge and generalizability is questionable Of the organizational intervention studies, all demonstrated an apparent effect on referral rates to secondary care in the expected direction, with widely varying degrees of precision and sizes of effect.
	Patient interventions	Access to information		
Gillies et al. (2016)	Process change	Consultation liaison interventions: Could involve three levels of interaction: i) between the mental health specialist and consumer; ii) between the mental health specialist and primary care provider; and iii) between the primary care provider and consumer.	Health outcomes Patient satisfaction Treatment adherence	Consultation liaison may improve mental health outcomes up to 3 months, but may lead to little or no improvement in mental health outcomes between 3 and 12 months. Consultation liaison may lead to little or no difference in symptoms of mental disorder between 3 and 12 months. Consultation liaison may improve patient satisfaction up to 3 months and may also improve, to a lesser extent, consumer satisfaction between 3 and 12 months. Consultation liaison may lead to little or no improvement in adherence to treatment up to 3 months and may improve adherence to treatment recommendations between 3 and 12 months.
Goyder et al. (2015)	Process change	Email for clinical communication between healthcare professionals	Healthcare professional outcomes, patient outcomes, health service performance, and service efficiency and acceptability	One randomized controlled trial involving 327 patients and 159 healthcare providers at baseline was included. It compared an email to physicians containing patient-specific osteoporosis risk information and guidelines for evaluation and treatment versus usual care (no email). This study was at high risk of bias for the allocation concealment and blinding domains. The email reminder changed health professional actions significantly, with professionals more likely to provide guideline-recommended osteoporosis treatment (bone density measurement or osteoporosis medication, or both) when compared with usual care. The evidence for its impact on patient behaviours or actions was inconclusive. One measure found that the electronic medical reminder message impacted patient behaviour positively (patients had a higher calcium intake), and two found no difference between the two groups. The study did not assess health service outcomes or harms.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Gruen et al. (2010)	System change	Visiting specialist outreach clinics in primary care or rural hospital settings	Access to care, quality, health outcomes, satisfaction, service use, and cost	No measures of perceived access used standardised scales. O'Brien found outreach led to 7.5% of patients reporting "cost being a problem" compared to 23.2% of controls, and 15.3% "having difficulty parking" compared with 73.1% of controls. One study reported an objective measure of access, and found that outreach reduced the cost for the consumer by 19%, reduced the distance to the clinic by 29% and the time taken getting to the clinic by 41%, although the absolute differences were small (22 pence, 1.67 miles and 16 minutes, respectively). Patients also spent on average 14 minutes (33%) less at the outreach clinic. The improved access measures in this study were associated with an increased in the attendance at booked appointments from 81% to only 83%. Two studies evaluated rural populations, where access changes may be more significant. One found outreach led to 9% more breast cancer patients receiving an oncology consult, and the other found a large increase in numbers of specialist consultations involving remote community patients (390%). Guideline-consistent care and referrals: One study reported 7% more breast cancer patients received guideline-consistent care. Another study reported that almost twice as many patients in the intervention group than in the control group received the appropriate type, dose and duration of medication. One study reported 8% more patients were appropriately referred to the specialist, although only 2.2% more were offered treatment by the specialist. Self-reported adherence to treatment was greater for outreach in three studies, and was sustained at one and three months. When pooled, these three studies showed outreach had a combined relative risk (RR) for not adhering to treatment of RR 0.62 (95%CI 0.49-0.78, p<0.0001) and were statistically homogenous (p=0.67). One study reported no improvement in objective clinical assessment or subjective measures of symptoms, except on the variable "disorder free at one year," which was a self-reported assessment of psychological and physical health, reported favourably by 35% of intervention patients and 23% of controls. Two studies, conversely, all reported substantial improvements in objective measures of symptom improvement and disease resolution. Pooling of the 3 studies led to a combined relative risk (RR) of persistent symptoms for the outreach group of RR 0.63 (95%CI=0.52-0.77, p<0.00001), although they were statistically heterogeneous (p=0.01). No measures of satisfaction used standardised scales. Three studies reported greater patient satisfaction with quality of care, the effect of medication, and over-all treatment, with a combined relative risk (RR) of being unsatisfied of RR 0.43 (95% CI 0.29-0.62, p<0.0001), which was statistically homogenous (p=0.28). No studies reported measures of provider satisfaction. Both studies that examined numbers of PCP visits in 1 year found that outreach led to a non-statistically significant increase (combined standardised mean difference in number of visits of 0.14 (95% CI -0.05-0.32, p=0.15). There was a reduction in use of other non-hospital services reported: 3% fewer consulted a mental health worker (in one study), and 23% fewer were referred to physiotherapy (in one study). Hospital outpatient clinics: Use of relevant hospital outpatient clinics was examined in two studies, one which found that outreach reduced hospital attendances from 10% to 3%, and another that demonstrated a significant trend reversal (positive to negative) in annual hospital outpatient consultations for members of rural disadvantaged communities. One study

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
				found a small increases in the use of other hospital outpatient clinics, including referrals to other specialties. Two studies found outreach to be more expensive to provide per patient ($487 and $296 more per patient, respectively), whereas two other studies (one urban and one rural disadvantaged) found it less expensive per patient (71 pence and AUD$173 less respectively). One study also demonstrated that, despite being more costly to deliver, their multifaceted outreach intervention was 7.4% more cost-effective than usual care when health outcomes were considered.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Liddy et al. (2018)	Process change	eConsult	Population health outcomes Patient experience with care Cost reduction Provider experience	There were very few reports of eConsult's impact on traditional population health outcomes, such as risk and mortality. One study showed that those who had an eConsult were significantly more likely (1.5 times) to receive a consultation with a cardiologist and had lower rates of emergency department utilization than those who had traditional face-to-face consultations. The authors from one study concluded that the few adverse outcomes that were observed were not due to communication lapses in the referral process, but rather to being unintentionally left unscheduled with evidence for discontinuity of care and lack of patient or provider follow-up. 30 studies reported on percentage of avoided face-to-face visits (range: 7.4% to 78%). One study measured patient satisfaction with eConsults and reported a high level of satisfaction with the platform. Other studies surveyed PCPs and specialists and found that eConsults improved their management of the patient (one study), were helped by the consultant's response (one study), and added value to their patients (3 studies). Six articles, reported on costs of eConsults. Studies comparing costs of eConsults with in-person specialist visits reported eConsult costs ranging from $5 per eConsult compared with $56 for face-to-face; to $298 per person using eConsult (compared with $338 for face-to-face). Alternatively, another study estimated that using eConsults would save USD 467,181/year; where civilian monthly savings were estimated as $28,260 (yearly savings were $105,400). The return of investment was also estimated at 6.1 for eConsult in one study assessing cost effectiveness. From a societal perspective, another study found that costs of eConsult averaged at $460 per patient, compared with face-to-face costs of $542 per patient. Similarly, in another study, societal savings were estimated to be approximately $11 per eConsult. Lastly, another study suggested a potential for millions in transportation saving by implementing eConsult to minimize face-to-face consultations. In 3 studies, more than 90% of providers rated eConsult as having a high to very high value for themselves. In 2 studies, when asked about satisfaction with eConsult, 75–100% of providers reported being satisfied. In 1 study, most providers reported that they would use eConsult again in the future. One study found that 90% of providers reported having learned from eConsult. Another study reported that 74% of providers felt their questions were answered. In another study, 89% of providers thought eConsult results were conclusive. One study found that 75% of providers reported no impact or decreased workload as a result of eConsult; however, another identified an increase in workload for specialists, along with the potential for issues in communication. In a cardiology trial, the median number of days to receive a response was 5 days for eConsults versus 24 days for traditional referrals. One study used open-ended input responses, and revealed that most providers appreciated the service, found it safe, timely, easy to use, beneficial to patient care, and capable of improving communication and facilitating provider education. One study reported challenges associated with eConsult: unclear directions from specialists, an occasional lack of information or pertinent questions delivered to specialist by the PCP, and lack of patient follow-up.
Mitchell et al. (2015)	GP Education	Interdisciplinary teamwork Communication and information exchange	Clinical	Eight studies reported clinical outcomes. There were many outcomes that showed no difference between groups. For the five diabetes studies, there were a few improved outcomes in studies, but the magnitude of the improvements was larger in the non-randomized studies. One RCT showed improvements in wellbeing. In programs for respiratory disease and heart failure, some of the quality of life subscale scores improved.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
	Process change	The use of shared care guidelines or pathways Training and education Access and accessibility A viable funding model.	Process	Seven studies reported process of care outcomes. Patient attendance rates improved in one study of patients with diabetes and hospital attendances fell in another. Reported non-attendance rates reduced in one study but were worse for intervention clinics in another. One study also noted increased combined hospital and outpatient clinic usage. While hospital admission rates fell in the intervention for complex medical patients, there was no change in admission rates for patients with chronic obstructive pulmonary disease (COPD) or heart failure. However, falls in hospital length of stay and readmission rates were reported. There was evidence of improved clinical performance by GPs, with better recording of important clinical information, and better capture of diabetes patients on practice diabetes registers. There was also evidence of better patient information sharing between sectors in one study. Clinicians and patients reported satisfaction with these initiatives in 4 and 3 studies, respectively, with clinicians holding the view that the interventions improved patient outcomes. Four studies reported cost data. One study showed a substantial cost reduction of clinic-based care for patients with diabetes compared with hospital outpatient-based care. Other programs showed modest extra costs (2 studies) or no difference (one study). Only one study calculated an incremental cost benefit for the intervention.
	System change		Economic	
Smith et al. (2018)	Process change	GP direct access testing	Number of cancers diagnosed by direct access or specialist testing (recorded as the absolute number and expressed as the cancer conversion rate) Non-cancer diagnoses (with corresponding CR) Indications for testing Time to diagnosis The appropriateness of referral determined by local, national, or international guidelines Measures of GP, specialist, and patient acceptability	Overall, the direct access cancer conversion rate ranged from 0% to 12% for cancer, and 4% to 99% for non-cancer diagnoses, dependent on the type of direct access test and the indications for referral. Nine studies reported the appropriateness of referral. Overall, there was no significant difference between the appropriateness of GP DA referrals (mean pooled appropriateness 66.4%, 95% CI = 41.2 to 87.4%) and specialist referrals (mean pooled appropriateness 80.9%, 95% CI = 73.9 to 87.1%) (P = 0.24). Specialist referrals resulted in a significantly longer interval between referral and testing (mean 76.6 days, SD 48.0 days) compared with GP DA referrals (mean 31.9 days, SD 20.5 days) (p = 0.03, nine studies). There was no significant difference, however, in the interval between GP DA (mean 74.0 days, SD 15.6 days) and specialist referral (mean 59.5 days, SD 21.9 days) and final diagnosis (p = 0.44, two studies). Three studies reported patient satisfaction with DA endoscopy and sigmoidoscopy of >90%. One study reported >90% patient satisfaction with the time from referral to test and the test to receiving results, and the majority of patients felt that seeing a specialist first or receiving test results from a specialist was not necessary. Two studies reported on GPs' satisfaction with DA testing. One study reported that >90% of GPs found DA sigmoidoscopy 'useful', and the other that 72% of GPs who had referred patients for DA MRI felt that it was good value for money, including 84% of those who had thought that DA MRI involved extra cost.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Vimalananda et al. (2015)	Process change	e-Consult	Process Provider perceptions Patient perceptions Clinical outcomes	Across systems, the time between placing a referral and receipt of specialist input was shorter with e-consults than with traditional referrals. Expected time to completion of an e-consult was usually specified by the organization, but was most commonly reported as less than 3 days. PCPs affirmed that e-consults often allowed management of patients in primary care, who would otherwise have been referred to specialists. Specialists reported fewer inappropriate clinic visits, fewer avoidable follow-up visits, and an increase in necessary follow-up visits with e-consult-based versus paper-based referrals. Though improvements in clinic wait times have been described, these data are limited to reports or describe provider perceptions of wait times. The most commonly described use of e-consults is by PCPs to request clinical input from specialists on outpatient issues. Hematology and endocrinology are consistently among the top five specialties receiving these e-consults across systems. For the PCP, placing an e-consult is generally easy and convenient. Receiving the specialist's response, however, generates additional work that may have fallen to the specialist in the case of a face-to-face visit. In a VA report, specialists estimated that 27% of e-consults represented new work, i.e., consultations that would not have occurred formally or informally in the absence of e-consults. The time to complete an e-consult is usually less than 15 minutes, but could be much longer. PCP satisfaction was generally good across systems, with 70-95% of providers reporting high satisfaction with e-consults. Common reasons for PCP satisfaction included convenience, educational value, rapid turnaround, improved access to specialty input, better provider-provider communication, avoidance of unnecessary patient travel, and the perception of shorter waiting times for patients ultimately referred to face-to face visits. Specialist satisfaction with e-consults was less uniformly high. In a VA study in which 93% of PCPs were satisfied, just 53% of specialists were satisfied and 26% were dissatisfied. In surveys, high levels of patient satisfaction have been reported, both overall and with the convenience of e-consults. Two studies examined objective measures of clinical care. E-consults reduced the days to completion of a hematuria workup by over 50% compared to paper-based referrals in a UCLA-Olive View study. A specialist-initiated eConsult led to increased rates of bisphosphonate treatment and calcium/vitamin D supplementation in a VA study.
Winpenny et al. (2016)	GP education	Professional behaviour change (to reduce referral rates)	Number of referrals Appropriateness of referrals Costs	Transfer of services from secondary to primary care and strategies aimed at changing referral behaviour of primary care clinicians can be effective in reducing outpatient referrals and in increasing the appropriateness of referrals. Availability of specialist advice to primary care practitioners by email or phone and use of store-and-forward telemedicine also show potential for reducing outpatient referrals and hence reducing costs. There was little evidence of a beneficial effect of relocation of specialists to primary care, or joint primary/secondary care management of patients on outpatient referrals. Across all intervention categories there was little evidence available on cost-effectiveness.
	System change	Transferring services from secondary to primary care; Relocation of specialist services to primary care settings; Joint management of patients by primary and secondary care clinicians		
	Patient interventions	Patient behaviour change		

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Liddy et al. (2015)	Process change	eConsult	Descriptions of identified programs Process	Bridging General and Specialist Care (BGSC) eReferral system in Manitoba: Year: 2008; Type: Web-based; N of PCP: 177; N of Specialists: 55 specialists; N of Referrals/ Consults Processed: 1906 referral requests. Ambulatory Referral Management (ARM) system in Toronto: Year: 2006; Type: Fax-based; N of PCP:5000; N of Specialists: 54 specialists; N of Referrals/ Consults Processed: 67000 referrals. Champlain BASE (Building Access to Specialist through eConsultation) system in Eastern Ontario: Year: 2010; Type: Web-based; N of PCP: 200+; N of Specialists: 26 55 speciality services; N of Referrals/ Consults Processed: 843 eConsults.
Individual Studies (n=56)				
Anderson et al. (2017)	GP Education, process change	Peer review/training eConsult	PCP attendance	PCPs attended an average of 78.1% of the sessions offered (mean = 37.5 sessions, min = 13, max = 48)
			PCP Pain Knowledge	Project ECHO resulted in a statistically significant increase in pain care knowledge (measured by the KP50 knowledge survey) in intervention providers (N=10), from baseline (mean=160.20) to post-intervention (mean=172.84; p<0.001). The intervention group increased by 12.64 points (7.9%) on the KP50 pre- vs. post, compared with a 4.60-point increase (2.9%, p=0.119) in the control group. Note: Pre-intervention assessment of knowledge revealed a nearly statistically higher mean baseline score among intervention group providers than control providers (p=0.060).
			PCP Attitudes and Beliefs Regarding Pain	Following the intervention, PCPs in the intervention group were more likely to affirm that they used opioid agreements (5.43 vs. 5.13, with scale 6=strongly agree to 1=strongly disagree; p=0.050) and expressed less concern about their patients becoming addicted to opioids (average response of 2.87 [post] vs. 3.52 [pre] on a six-point Likert scale of agreement with the statement "Patients I treat become addicted to opioids," with a scale of 6=strongly agree to 1=strongly disagree; p=0.006).
			Impact on Pain Treatment	PCPs in the intervention group had a statistically significantly greater reduction in the percentage of patients with chronic pain treated with an opioid medication compared with providers in the control group (from 56.2% to 50.5% compared with 50.1% to 50.3%; P=0.002). Further, the average number of opioid prescriptions written per patient with pain increased significantly less for providers in the intervention compared with their colleagues in the control group (from 4.89 to 5.00 compared with 3.05 to 3.97; P=0.001). There was a significant reduction in referrals to orthopedic and neurosurgery sub-specialists in the intervention group and increased in the control group. There was no statistically significant difference in referrals to addiction medicine specialists.
Barnabe et al. (2017)	System change	Outreach: community provision by specialists	Accessibility	87% (33 of 38) of patients reported that it was easy or very easy to access arthritis specialist services with the arthritis model of care.
			Acceptability	89% (34 of 38) reported they were satisfied (11%) or very satisfied (79%) with the arthritis model of care.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			Effectiveness	Patients with inflammatory arthritis had significant reductions in tender joint count (68 joints, p = 0.0045) and swollen joint count (66 joints, p = 0.0016) during the year after diagnosis. However, improvements in the HAQ score, patient global evaluation score, and pain levels were not significant.
			Cultural safety	Nearly all participants (95%) disagreed (21%) or strongly disagreed (74%) that they felt discriminated against because of race or ethnicity. They also did not perceive that assumptions were made about their level of education or income, or that less attention was paid to them based on race or ethnicity (24% disagreed and 68% strongly disagreed).
Berg et al. (2016)	Process change	Direct access (DA) to screening/diagnostic testing	Referral avoidance (comparison of the intended referral to secondary care with the final referral after the MRI)	On the application form for the MRI scan, the GPs had indicated that they would refer 487 of the 588 patients (82.8%) to an orthopaedic surgeon in secondary care. After receiving the results of the MRI (i.e., the DA intervention), GPs changed their decision whether or not to refer, from 'no need to refer' to 'refer' or vice versa, in 39.1% of all cases [230 of 588 patients, 95% confidence interval (CI): 35.2–43.1]. After DA, the percentage of patients that GPs considered to require referral to an orthopaedic surgeon was significantly reduced by 22.8% (487 cases before and 353 after, 95% CI: 19.4–26.2, P < 0.0001). This reduction in referral percentage was even larger in the group of patients younger than 50 years (28.1% reduction).
			Increased referral	Of the 101 patients whom the GP did not intend to refer prior to MRI, 48 were referred to an orthopaedic surgeon based on the MRI findings.
Bradi et al. (2017)	Process change	eConsult	eConsult characteristics Impact on referral	Question topic: The top 5 topics were headache (17%), incidental imaging findings (11%), numbness/tingling (11%), seizure (9%), and cerebrovascular disease (CVD) (9%). Question type: 51% were related to diagnosis (choice of test, imaging interpretation and symptom interpretation), 23% to drug treatment (choice, adverse effects, prescribing instructions), and 17% to management (general, need for referral). eConsult time: 88% of questions took under 10 minutes of specialist time to answer, and 80% were answered within one day.
			Impact on referral	eConsults decreased face-to-face referrals by 50%. In 54% of cases, the PCP received information for a new course of action.
Chan et al. (2018)	Process change	eConsult	eConsult question themes	Exceptions to clinical guidelines (n=13), non-cardiac treatment in a cardiac patient (n=13), specific investigation/management (n=18), interpretation of diagnostic testing (n=46), clinical concerns despite normal testing (n=4) and screening for positive family history (n=6). Subthemes include multiple comorbidities and mild abnormalities on cardiac tests.
Chen et al. (2016)	Process change	Algorithmic approach to testing for systemic lupus erythematosus (SLE) was implemented initially through	Availability of diagnostic laboratory studies at the first rheumatology clinic visit	Diagnostic laboratory studies: prior to algorithm implementation, only 10% of patients referred to the specialist clinic had all laboratory studies available at the first specialist clinic visit required for the rheumatologist to make a diagnosis at this initial visit.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
		the HHS referral center. The algorithm was further offered as a "one-click" order for physicians, with automated reflex testing, interpretation, and case triaging by clinical pathology.	Outcomes after initial implementation of the SLE algorithm (diagnosis only)	Outcomes after initial implementation: Of the 54 randomly selected patients that underwent testing by the algorithm, 23 (42.6%) were approved for referral to rheumatology after completion of the SLE algorithm testing, 29 (53.7%) were determined not to require a rheumatology consult and referred back to the PCP, and two (3.7%) were lost to follow-up before all laboratory testing was completed. Of the 23 patients referred to rheumatology, most had SLE or another related rheumatologic condition. The records of patients who were not referred to rheumatology were also reviewed, and there are no apparent missed cases of a rheumatologic condition. Of the 29 patients who were not referred to rheumatology, three (10.3%) had abnormal thyroid function tests and two (6.9%) had an abnormal hepatitis panel, necessitating a different diagnostic workup with potential referral to a specialist other than rheumatology. The waiting time to see a rheumatologist was 4 to 6 months prior to implementation of the SLE algorithm through the referral center. After implementation of this algorithm, we successfully decreased the wait time for a rheumatology consultation to 2 to 3 months.
			Outcomes after implementation of the SLE algorithm (with reflex testing and pathology consultation)	Outcomes after full implementation: the number of phlebotomy visits to complete the laboratory workup for the initial rheumatology visit was significantly reduced from a mean of 2.7 to 2.2 and then eventually to 1 visit per patient after pathologist intervention. Unnecessary rheumatology visits were also eliminated simultaneously in approximate 80% of patients in their initial rheumatology assessment
Ching et al. (2016)	GP Education	Interprofessional education program (systematically change practice behaviour in the locality and reduce the need for specialist input in the secondary care setting)	Process measures	The proportion of patients with a HbA1c of <57.4 mmol/mol (7.4%) and >85 mmol/mol (10%) was significantly higher (44% vs. 53% p=0.0001) and lower (12.5% vs. 10%; p=0.002) respectively. There was an increase in the proportion (95% CI) of patients receiving foot care reviews (+26.0% (24.0% to 28.1%)), microalbuminuria screening (+29.8% (27.7% to 31.9%)) and who achieved targets for blood pressure (+9.6% (7.5% to 11.6%)) and total cholesterol (+14.4% (12.3% to 16.5%); p<0.001).
			Referrals	241 fewer patients were referred to secondary care.
			Provider confidence and clinical behaviour	Increases in the healthcare professional's confidence and collaborative clinical behaviour were evident 3 years after completing the program.
Cruz et al. (2015)	Process change	eConsult	Proportion of endocrinologist recommendations that were implemented	Implementation rate of endocrinologist recommendations: Overall, 76.0% of endocrinologist recommendations were fully implemented. For those recommendations that were carried out, implementation occurred within 30 days of the recommended time frame for 84.1% of eConsults.
			Impact on referrals	Impact on referrals: There was no induced demand in total volume of referrals to endocrinology. Comparison of total endocrine referrals in the first year of the program to total referrals in the year preceding the eConsult launch showed no evidence of induced demand, with no significant change in total referral volume across this observation period (p = 0.68).
			Access to endocrinology care	Access to care: Introduction of eConsults significantly improved access to endocrine care. 49.3% of patients had timely endocrine access with eConsults, as compared to 21.2% of patients referred during the previous year with no eConsults (odds ratio [OR], 3.6; 95% CI, 2.7 to 4.9).

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			Downstream healthcare utilization rate	Healthcare utilization rate: Rates of downstream healthcare utilization within 6 months of a completed eConsult were low. Of the 113 eConsults completed without suggested conversion or conversion to a clinic visit, 5.3% (n = 6) of patients were subsequently referred for an office-based endocrine clinic visit on the eConsult topic of interest within 6 months. A total of 18.2% of patients referred to endocrinology were either hospitalized or had an ER visit for any indication within 6 months of the endocrine referral in the year prior to the eConsult launch, as compared to 17.6% of patients referred during the first year of the eConsult program (p =0.75).
Hensel et al. (2018)	Process change	eConsult	eConsult question type and time	Question type: Among the e-consults reviewed, different psychiatric diagnoses were represented: 70% of requests (26/37) queried about medication safety or side effects, whereas 59% (22/37) asked about psychiatric symptom management. eConsult time: 81% (30/37) of e-consults were answered within 24 hours, and 65% (24/37) were addressed in a single exchange.
			PCP views	In general, new PCPs and PCPs practicing in rural areas were more receptive to psychiatry e-consult. PCPs viewed e-consult as an opportunity to collaborate and desired that it be integrated with other available services. Recommendations include the need for appropriate specialist staffing to address a wide range of requests, adequate education to referrers regarding the use of psychiatry e-consult, and the need to integrate psychiatry e-consult with other geographically relevant services, given the complexity of psychiatric issues.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Heron et al. (2015)	System change	Community provision of 'specialist' services by GPs	Referral rates	Between August 2014 to October 2014 there was 732 referrals overall from the GP practice, with fifty-three specific orthopaedic referrals. Over this period there was 257 MSK presentations within the practice. The number of physiotherapy referrals between August to October 2014 was eighty-six from the practice and the number of radiology referrals for x-rays between August to October2014 was 229. Ten patients were referred to rheumatology from the practice over this period. All the patients referred to the GP-based MSK clinic were seen within four weeks. The cost of one hour of GP-patient contact, including direct care staff costs with qualification costs, for 2013-14 was £183. Three patients were at least seen per hour and therefore the cost per patient reviewed at the GP-based MSK and SEM clinic was conservatively costed at £61 per patient. These referral rates were compared to the same time period for the practice in 2013 when there was 881 referrals overall from the GP practice, with fifty-five specific orthopaedic referrals. Over this period there was 317 musculoskeletal presentations within the practice. The number of physiotherapy referrals between August to October 2013 was 133 and the number of radiology referrals for x-rays was 319. Thirteen patients were referred to rheumatology from the practice during this period. A review of the 2013 orthopaedic ICAT waiting times showed that 5,833 patients (49.5%) were seen between 0-6 weeks of referral, 2,304 patients (19.6%) between 6 –9 weeks, 1,872 patients (15.9%) waiting between 9 – 12 weeks,1,389 patients (11.8%) waiting between 12 – 15 weeks, 236patients (2%) 15 – 18 weeks and 144 patients (1.2%) waiting more than 18 weeks to be seen (from a total of 11,778 patients). The cost of a routine hospital orthopaedic outpatient review in 2014 was £213 and the average orthopaedic ICAT cost per attendance was£82. Therefore if all the clinic's patients were reviewed within a hospital orthopaedic outpatient clinic the cost to the Northern Ireland health service would have been £7,455 or within the orthopaedic ICAT system the cost would have been £2,870. This is compared to the £2,135 which it cost to run the GP-based MSK and SEM clinic, a potential saving of between £735 and £5,320 per thirty-five patients reviewed.
Holland et al. (2017)	Multiple	Clinical access criteria to prioritise requests; Clinical pathways to promote testing guidance, access criteria and patient information; Electronic referral to improve referral accuracy and administration; A shared health record to increase visibility of prior results; Referral process improvements to streamline referral flow; Referral quality improvement strategies to ensure appropriate testing; Radiology reporting	Referral quality	Referral quality: The median acceptance rate for individual referrers increased from 78% in 2011 to 88% in 2015 (program was initiated in 2010). The proportion of referrals requested urgently (within one week) reduced from 59% in the 12-month period before the change to 22% in the subsequent 12 months. This simplified the booking process and reduced pressure on administrative staff, eliminating delays for acute cases.
			Referral value	Since the program's implementation, there has been a sustained reduction in plain fi lm volumes of 40%. Volumes of CT and ultrasound have continued to grow. Resources conserved by a reduction in low-value imaging have been reallocated to enable new clinical pathways to support community-based investigation and management.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
		guidelines to improve utility of results; Clinical pathway audits to ensure patient safety.	Clinician experience	In the first year of operation, the service received a number of complaints from clinicians and patients. Most complaints related to the reduction in access to lower value imaging. Informal discussion with local clinicians suggests that by 2016 there was a high level of satisfaction with the service. Many find it useful to share access criteria with their patients during a consultation when they are pressured to order imaging they do not consider clinically necessary.
Jones et al. (2014)	GP education	Guidelines with training/feedback	Pathway use	In the first year, the pathway ranked in the top 10/160 local care maps accessed via Map of Medicine and was viewed 900 times. Only 96 GPs registered to use the clinic website.
			PCP views	Only 110 (7%) GPs responded to the feedback request, of which 13/110 (12%) had used the pathway; nearly all thought it useful.
Jones et al. (2018)	Process change	Direct access to screening/diagnostic	Time from referral to treatment and to diagnosis	There was a significant reduction in referral to treatment time between patients on the STTP and traditional pathway. STTP saved a mean of 7 days from referral to treatment (with a 95% CI of 3 to 11 days, p<0.008) and a mean of 16 days from referral to diagnosis, when compared with a traditional referral pathway. There is a spike in the STTP line early on in the days from referral to diagnosis (groups of 10 days) axis with 55% of patients referred via STTP being diagnosed within 10–20 days. The traditional pathway line is more evenly distributed with the peak being 29% being diagnosed within 20–30 days. The STTP was associated with a longer time between diagnosis and treatment, negating some of the impact of the faster initial diagnosis. The number of diagnostic tests performed using STTP or traditional referral pathways was similar.
Katz et al. (2018)	Process change	Virtual consultation	Clinical outcomes	Of the patients followed virtually, most had stable renal function, although three patients died and one patient died before 12 months follow up. At 12 months, there was no difference in eGFR or albuminuria between F2F and virtual clinic HR patients.
Keely et al. (2018)	Process change	eConsult	eConsult characteristics	Question topic: Twenty-five percent of cases were related to proteinuria, 18% to chronic kidney disease (CKD), 17% to imaging, and 12% to drug use in CKD. Question type: Common question types included general management (37%), interpretation of laboratory test (17%), interpretation of an image report (13%), and need for nephrology referral (11%). eConsult time: Thirty-two percent of eConsults took specialists less than 10 minutes to complete, 55% took 10 to 15 minutes, 11% took 15 to 20 minutes, and only 2% took more than 20 minutes.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			Impact on referrals	A traditional consult visit was avoided in 45% of cases based on the specialist's advice; 21% cases required referral.
Keely et al. (2019)	Process change	eConsult	Experience with the service	The most frequent motivations for participating in eConsult were: innovative patient care (58% and 69%), opportunity to reduce wait times (45% and 54%), and opportunity to communicate directly with primary care providers (41% and 51%). Most specialists agreed that eConsult is feasible and results in improved communication between providers, and can be integrated into their clinical workflow without difficulty. 52% of OTNs specialists and 49% of BASE specialists agreed that they were appropriately compensated for answering eConsults.
Kilty et al. (2016)	Process change	Direct access (DA) to screening/diagnostic testing	Cost per successful referral to the appropriate specialist.	Cost: The CT-based strategy cost more than the symptom-based strategy ($788.76 versus $514.67, respectively) and, the ICER for the CT-based strategy was $1522.72 per patient arriving at the correct specialist.
			Proportion of appropriate referrals	The CT-based strategy resulted in the patient arriving at the most appropriate specialist 95% of the time while the symptom-based referral strategy resulted in the patient arriving at the correct specialist 77% of the time.
			Sensitivity analysis	There is a greater than 60% certainty in the economic conclusion that the CT-based referral strategy was the most cost-effective decision for any willingness to pay (WTP) threshold greater than CAD 10 000. However, the WTP threshold for correct patient referral is poorly defined and the additional cost of the CT-referral strategy need to be put into context of the downstream clinical benefits to the patient before a decision to adopt one strategy can be performed.
Kim et al. (2018)	Process change	eConsult	eConsult characteristics	Purpose: Among the 424 e-consults requested from PCPs, 92.7% were used to request answers to clinical questions, while 7.3% were used for administrative purposes. Questions type: Among the 393 e-consults with clinical questions, 60 e-consults were regarding pre-operative management.
			Response	Cardiologists provided answers for the majority (89.6%) of clinical questions. Among the e-consults in which cardiologists did not provide answers or clinical guidance (n=41), the reasons included missing or insufficient clinical information (n=18), medical complexity (n=6), and deferment to the patient's non-VA primary cardiologist (n=7).
			eConsult outcome	Cardiologists recommended that the patients be seen as face-to-face consults for 7.9% of e-consults.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Liddy et al. (2014)	System change	Payment system	Referral characteristics	Over the two-year examination timeframe, there were a total of 16,286,998 referrals across all medical specialties. The majority of specialist referrals were for diagnostic radiology (40.0%), followed by cardiology (8.7%), internal medicine (4.1%), and general surgery (4.1%). Female and Canadian trained physicians referred more often, while female, older, sicker and urban patients were more likely to be referred.
			Referral rate (# of referrals to all medical specialties/1000 patients/year)	Fee-for-service had a significantly lower adjusted referral rate (676, 95% CI: 666-687) than the CAP-NI (719, 95% confidence interval (CI): 705-734) and CAP-I (694, 95% CI: 681-707) models and the interdisciplinary CAP-I group had a 3.5% lower referral rate than the CAP-NI group (RR = 0.965, 95% CI: 0.943-0.987, p = 0.002).
Liddy et al. (2016)	Process change	eConsult	Impact of eConsult platform on referrals	In 39.9% (n=1393) of eConsults, a referral was originally contemplated by the PCP but, as a result of the eConsult, a face-to-face referral was no longer required. In 109 (3.1%) eConsults, a face-to-face referral was not originally contemplated but as a result of eConsult, one was initiated.
			Costs (delivery costs, specialist remuneration, costs associated with traditional (face-to-face) referrals initiated as a result of eConsult)	The total direct and indirect costs of eConsult were CAD 202 735 and CAD 5052, respectively; the overall societal cost was CAD 207 787. Two hundred and thirty-six new users were registered during the year, amounting to CAD 8142 in human resource time. Additionally, support and administrative costs amounted to CAD 15 078 and CAD 6615, respectively. The cost of the 109 referrals initiated as a result of eConsult amounted to CAD 13 873. Exclusion of added referral costs: Excluding added referral costs decreases the total costs to the payer by CAD 13 873 and to the patient by CAD 5052. The resulting net cost savings is CAD 57 654, or CAD 17 per eConsult. This increases the overall societal cost savings per eConsult by 55%.
			Potential savings (costs of traditional referrals avoided, indirect patient savings through avoided travel and lost wages/productivity)	The total direct (1393 specialist referrals that were no longer needed) and indirect cost savings of eConsult were CAD 177 909 and CAD 68 607, respectively. Inclusion of patients aged 65 and older: Including patient savings for patients aged 65 and over increases the cost savings by CAD 9700–48 430.
			Net potential societal cost savings were estimated by subtracting total costs from total potential savings	The total societal savings, less the total societal costs, resulted in an overall net savings of CAD 38 729. This amounts to a saving of CAD 11 per eConsult
Liddy et al. (2017)	Process change	eConsult	% of eConsults that prompted referral	Of the 5601 eConsults processed between April 15, 2011, and January 31, 2015, 188 (3.4%) resulted in prompted referrals to 26 different specialty groups. The eConsults that prompted referrals were directed to cardiologists (10.6%), dermatologists (10.6%), infectious disease specialists (9.0%), hematologists (9.0%), urologists (8.5%), and neurologists (7.5%).
			Characteristics of eConsult questions and urgency	Among the prompted referrals, the most common types of questions were about diagnosis (34.0%), drug treatment (18.0%), and management (15.0%). For 30.0% of cases, there was more than 1 type of question. In 5.0% (n = 9) of cases, the referral was deemed urgent.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			Response time	The median initial specialist response time for prompted referrals was 0.96 days (interquartile range 0.17 to 3.80 days). The self-reported time it took specialists to complete the eConsult was less than 10 minutes in 54.3% of cases, 10 to 15 minutes in 22.9%, and 15 to 20 minutes in 16.5% of cases
Liddy et al. (2017)	Process change	eConsult	Characteristics of eConsults (patient age, usage rate of primary care physicians (PCPs), specialty breakdown)	In total, 165 patients from Nunavut received an eConsult between August 2014 and April 2016. Most patients were adults between the ages of 18 and 65 (78%), while 13% were over 65 and 10% were under 18.Nineteen PCPs registered to use the service, of whom 15 submitted at least one eConsult. PCPs submitted requests to 31 specialty groups and answered by 55 different specialists. The most commonly referred to specialties were dermatology (16%), cardiology (8%), endocrinology (7%), otolaryngology (7%), and obstetrics/gynaecology (7%).
			Specialist response rate and completion time	Specialists provided a response in a median of 0.9 days (IQR=0.3–3.0, range=0.01–15.02). The self-reported time specialists spent completing the eConsult was under 10 minutes in 38% of cases, 10–15 minutes in 23%, 15–20 minutes in 26%, and more than 20 minutes in 13%.
			Advice from specialists	Overall, PCPs reported receiving new advice for an additional course of action in 56% of cases, while in 43% of cases the PCP was able to confirm the course of action they already had in mind. In 1% of cases, PCPs reported that the response was not very useful.
			Referrals	In 35% of cases, PCPs were able to avoid referring patients for a face-to-face specialist visit that they had originally planned. In particular, of the specialties, which received more than 10 cases, endocrinology had the highest rate of avoided referrals (58%).
			User experience	PCPs rated the value of the eConsult service for themselves as 4 or 5 on a scale of 1 (minimal) to 5 (excellent) in 93% of cases, with an average score of 4.7/5. Using the same scale, they rated the value for patients as 4 or 5 in 93% of cases, with an average score of 4.6/5.
			Costs, savings	The delivery costs of eConsult in Nunavut were CAD 1,379.69, including user setup and registration, user support, and variable administration costs. The costs of remunerating specialists were CAD 8,600.00 and the total assignment costs were CAD 31.43. The physician/ specialist fees associated with added referrals amounted to CAD 539.15. Patient travel costs for these referrals were estimated at CAD 13,088.25, while patient lost wages were estimated at CAD 1,193.58. The total estimated costs of eConsult came to CAD 24,832.10. Fifty-eight specialist referrals were no longer needed as a result of eConsult, which led to a saving of CAD 7,092.05 in specialist fees. Avoided patient travel for these cases amounted to CAD 184,447.20, while avoided patient lost wages came to CAD 13,845.58. The total estimated savings resulting from eConsult were CAD 205,384.83. The estimated total societal savings resulting from eConsult in Nunavut were CAD 180,552.73, or CAD 1,100.93 per eConsult.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Liddy et al. (2018)	Process change	eConsult	Referral rates per physician and patient	Referral rates per physician were significantly lower in the eConsult group for all specialty groupings [unadjusted rate ratio (RR) = 0.87, 95% confidence interval (CI) = 0.80-0.95; adjusted RR = 0.92, 95% CI = 0.85-1.00]. Referral rates per patient were lower among eConsult physicians (unadjusted RR = 0.91, 95% CI = 0.84-0.98) but this difference was not statistically significant after adjustment (adjusted RR = 0.96, 95% CI = 0.90-1.02). No statistically significant difference was observed when referrals were expressed per 100 patient encounters.
Liddy et al. (2018)	Process change	eConsult	eConsult Service Use and Growth	Service Use: The specialty groups receiving the highest number of eConsults were dermatology (17.11%), obstetrics/gynecology (7.02%), hematology (6.99%), endocrinology (6.93%), cardiology (6.27%), and neurology (5.98%). Specialists responded in a median of 21 hours, with 75% of cases answered within 3 days. The self-reported billing time for specialists was less than 10 minutes in 48% of cases, 10–15 minutes in 32%, 15–20 minutes in 15%, and over 20 minutes in 4%. Service Growth: The service experienced exponential growth during the 5-year pilot study, increasing from 4 cases closed in April 2011 to 769 cases closed in April 2016. Primary care clinicians submitted a similar number of cases in their first year regardless of the year they joined the service, with average annual number of cases ranging from 4.24 to 6.33 per primary care clinician.
			Impact on PCP Behavior	Across specialty groups, primary care clinicians reported receiving advice for a new or additional course of action in 57% cases and confirmatory advice in 40% of cases. A face-to-face specialist visit was originally planned but avoided as a result of eConsult in 39.56% of cases, originally planned and still needed in 24.64%, neither originally contemplated nor ultimately needed in 27.98%, and not originally contemplated but instigated based on the specialist's advice in 3.53%.
Livingstone et al. (2015)	Process change	eConsult	Impact on referral	Of the 248 patients,102 (41%) were subsequently recommended by the dermatologist viewing the images to be referred for a secondary care appointment. The remaining 146 patients (59%) did not require a secondary care consultation and recommendations were given for management in general practice. The median wait for the photos to be taken was 7 days, and 1–2 weeks for results.
			Cost-effectiveness	Teledermatology (eConsult) saved £12 460 over the 3-year period.
			Safety	Patients were followed for up to 51 months and no lesions were found to be malignant.
			Patient views	97% of patients were satisfied/very satisfied and 93% found the procedure comfortable/very comfortable.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Lowenstein et al. (2017)	Process change	eConsult	Completion time by the specialist	Completion time by the specialist: All consults received responses, and the average consultant response time was 1.4 business days, with a median response time of 1 day and range of 0 to 30 days. In comparison, mean and median wait times for an in-person consult in the psychiatry practice during the final 3 months of the study period were 46 days and 38 days, respectively.
			Implementation of consultant recommendations by the PCP	Implementation of consultant recommendations: PCPs implemented psychiatrist recommendations in 76% (38/50) of consults.
Mahalingam et al. (2014)	GP education	Guidelines with training/feedback	Proportion of inappropriate referrals	Following introduction of guidelines there was a significant reduction in inappropriate referrals from 31% (69/225) to 16% (28/179), p<0.01. Despite significant improvements overall, the proportion of inappropriate referrals from GPs remained higher than those from the local A&E department in both Cycle 1 (42% vs.24%, p<0.01) and Cycle 2 (23% vs. 5%, p<0.01).
Mahmood et al. (2017)	Process change	Telephone triage	Wait time (duration of time between first contact with GP practice to the date patients were seen in the hospital)	The average time required for telephone triage patients was 19.54 days and the average time required for standard practice patients was 35.69 days (p= 0.0474).
Mann et al. (2018)	Process change	eConsult	Impact on referral	One hundred and forty-seven patients (14.5%) with an initial e-consult were re-referred within 6 months for the same condition. The reduction in face-to-face contacts was 18.2% (866/4738).
			Adverse outcomes	No death and/or acute admission for the same reason as stated in the initial referral occurred among the patients with e-consultation and none were later diagnosed with an underlying (pre)-malignancy.
Miniard et al. (2018)	Process change	Referral management centre (NP triage system and an NP-led spinal clinic)	Diagnostic concordance	Nurse practitioner and surgeon diagnoses were congruent 100% of the time. Patients triaged were correctly referred to the clinic for surgical consultation, with a sensitivity of 95.7% (95% CI, 90.8%-98.4%) and a specificity of 73.8% (95% CI, 60.9%-84.2%).
O'Toole et al. (2017)	Process change	eConsult	Time efficiency, specialist time	In 64% (n = 618) of eConsults, dermatologists took between 10 and 15 minutes to answer. Nineteen percent (n = 181) of cases required less than 10 minutes, and 17% (n = 160) required between 15 and 20 minutes for dermatologists to respond. In 0.6% (n = 6) of cases, dermatologists required more than 20 minutes to complete.
			Impact of dermatology eConsults	In 49.4% of eConsults, a referral was originally contemplated but now avoided as a result of the eConsult. In 27.5% of cases, a referral was not planned, but the eConsult provided useful feedback. In 17.3% of cases, a referral was still needed based on specialist advice, but the eConsult allowed for a more effective visit as the specialist provided recommendations for necessary workup prior to referring the patient. In 65.4% of cases, eConsults provided useful advice on a new or additional course of action necessary to PCPs, while in 31.2% of cases, the current treatment plan was validated.
			Value of dermatology eConsults rated by PCPs	The vast majority of PCPs rated the overall value of the eConsult service very highly. On a scale from one (minimal) to five (excellent), 91.8% (n = 886) of PCPs gave the service a rating of four or five on its value for care of the patients included in the study, and 93.2% (n = 899) provided a rating of four or five on its value for them as PCPs.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			Clinical topics and question type analysis	In a subset of the most recent cases, diagnosis was the most common question type asked by the PCPs, accounting for 65.2% (n = 86) of the Dermatology eConsults followed by management (29%) and drug treatment (10.6%). Questions on procedure (1.5%) and nonclinical, administrative aspect (0.8%) made up a very small portion. The five most common clinical topics referred to the Dermatology eConsult services, representing 40% of the cases, included: dermatitis (10.4%), infections (9.7%), neoplasm (7.8%), nevi (6.5%), and pruritus (6.5%).
Olayiwola et al. (2016)	Process change	eConsult	Median time to consultation	Intervention (E-consultation) = 5 days; Intervention (traditional) = 29 days; Control = 24 days
			Proportion of patients not consulting cardiologist within 31 days of referral	Intervention (E-consultation) = 14 days; Intervention (traditional) = 48 days; Control = 38 days
			Proportion of patients not consulting cardiologist within 180 days of referral	Intervention (E-consultation) = 6 days; Intervention (traditional) = 21 days; Control = 16 days
Olayiwola et al. (2018)	Process change	eConsult	Impact of eConsults	More than one in four PCCs reported that the eConsult "avoided referral altogether or to wrong specialty" (26.3%) and "avoided unnecessary diagnostics/procedures" (26.1%). In three of every four eConsults, PCCs reported that the eConsult resulted in an "improved care plan" (75.1%), and half reported that the eConsult was "educational" for them (50.7%).
			eConsult impact by specialty	The 10 specialties that received the highest volume of eConsults for which outcomes were reported were dermatology, endocrinology, hematology/oncology, cardiology, gastroenterology, neurology, orthopaedic surgery, obstetrics-gynaecology, infectious disease, and pediatrics.
Price et al. (2016)	Process change	eConsult	Reasons for not scheduling referrals	Of the 266 eReferrals, reasons for not scheduling an appointment included: specialist indicated no appointment was needed (32%; n=86); referrals had been made via the wrong route (31%; n=82); referrals were more appropriate for another specialty (6%; n=16); specialty reviewer requested additional clinical history or diagnostic studies before scheduling, and this information was not provided (30%; n=80); specialist planned to discuss the patient in an upcoming clinical conference (n=1), or because the specialist arranged for immediate hospitalization (n=1)
			Completion of diagnostic studies requested by reviewer	Of the 49 referrals for which additional diagnostic studies were requested, the evaluation was completed but the eReferral system was not updated for 19 (39%) of the referrals, and evaluation had been ordered but not completed for another 10 (20%).
			Resolution of referrals	Of the 180 referrals for which charts were reviewed, referral complaints were not further addressed in the medical record (i.e., unresolved) in 42% (n=75) of cases. The remaining 105 cases were resolved (i.e., referral complaints were further addressed, of which 69 (66%) were later scheduled for specialist visits via other routes.
			Harms	Of the 105 resolved referrals, 96 (91%) were categorized as having no patient harm from not having gastroenterology clinic. The remaining nine (9%) patients received unscheduled care for their referral complaints; four were categorized as having no harm; three, moderate harm; and two, major harm. For the referrals with no clear resolution, 55 (73%) had potential for major harm.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Quanjel et al. (2018)	System change	Outreach: community provision by specialists	Number of referrals	The mean number of referrals to internal medicine in the hospital setting was 18.3 per quarter during the pre-intervention period and 14.4 during the intervention period, this difference was not significant (p = .133).
Rathod et al. (2014)	GP education	Guidelines without training (chest pain scoring system)	Quality of referrals (comparison of pre/post)	Pre: Assuming that the specialist assessment of chest pain is the gold standard, only 45% of patients referred had typical angina or possible angina. There was substantial over-diagnosis of angina/atypical angina by GPs: 95% vs. 45%. The correlation ratio of GP assessment of non-cardiac chest pain: cardiologist assessment of non-cardiac chest pain was 11:1. The mean wait time for specialist review was 11 days. Post: The mean patient wait time was 9.4 days. The correlation ratio of GP assessment of non-cardiac chest pain: cardiologist assessment of non-cardiac chest pain was 5:1. There was an unexpected >50% percent reduction in the total number of referrals to RACPC seen (79 vs. 167 when compared with study 1) and the mean wait time was shorter, though an unknown proportion of this variation may be due to seasonal variations in referral numbers.
			Effectiveness of chest pain symptom scoring in improving GP discrimination of chest pain	All 79 unselected consecutive GP referrals to KGH RACPC were included. The mean patient wait time was 9.4 days. Approximately one third (32.5%) of patient referrals were received on the novel form. GPs who used the novel form for referrals were more than twice as likely to correctly determine non-cardiac chest pain as compared with the conventional form. Overall, there was less "over-diagnosis" of angina/possible angina by GPs who used the novel form (88% vs. 58%).
Riis et al. (2016)	Process of GP education	Implementation process to distribute guidelines; two methods were compared: passive implementation (PaIS) and multifaceted implementation (MuIS)	Referral of patients to secondary healthcare within 12 weeks with an low back pain (LBP) code	Twenty-seven patients (5.0 %) in the MuIS group were referred to secondary care vs. 59 patients (10.5 %) in the PaIS group. The adjusted odds ratio (AOR) was 0.52 [95 % CI 0.30 to 0.90; p = 0.020].
			Patient-reported measures (employment status, sick leave, satisfaction with treatment, functional disability, back pain intensity)	There were no statistically significant differences in effect on employment status, sick leave, functional status, and quality of life (EQ VAS) between the two groups, but patients in the MuIS group were less satisfied than the PaIS group after 52 weeks (adjusted odds ratio: 0.50 [95 % CI 0.31 to 0.81; p = 0.004]).
			Cost-effectiveness	The MuIS was cost-saving £−93.20 (£406.51 vs. £499.71 per patient) after 12 weeks.
Rodriguez Villa et al. (2016)	Process change	Direct access to screening/diagnostic testing	Sensitivity and specificity of tool	Using the teleophthalmology tool, the ability of primary care physicians to detect DR in the non-mydriatic retinographs (test sensitivity) was of 83.6% whereas their ability to identify the absence of DR (test specificity) was 92.7%.
			Appropriate requests by primary care physicians	Overall, 29.9% of retinographs were sent for ophthalmological assessment. According to the established referral criteria, appropriate requests by primary care physicians exhibited a significant increase (p < 0.05), going from 28.9% of appropriate requests in 2010 up to 45.5% in 2014 (60% in 2011; 57.1% in 2012; 52.4% in 2013).

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			Cost savings	Overall, 70.1% of the retinographs studied by primary care physicians were not referred for specialist assessment and those that were referred resulted in an ophthalmological visit in 45.56% of patients. Accordingly, the authors estimate that 86.4% (CI 95%: 83.3–89.5%) of patients (2.083) avoided visiting the ophthalmology practice, involving a saving of EUR 152,550.45 (visit to practice: EUR 172; telemedicine assessment: EUR 98.75).
Ronda et al. (2018)	Process change	Decision support tool	Proportion of patients that changed to the correct treatment setting after one year (correctness of the treatment setting was assessed by an algorithm based on management guideline cut-off values)	At baseline 599 (42.3%) patients in the intervention group and 598 (43.9%) patients in the control group were treated in the correct setting. After one year 175 out of 1416 (12.4%) patients in the intervention group and 144 out of 1362 (10.6%) patients in the control group (p=0.30) had shifted to the correct setting; 642 (45.3%) patients in the intervention group and 620 (45.5%) in the control group remained in the incorrect setting (p=0.67). Most patients remained in the setting they started, which was incorrect for most patients in primary care and correct for those in secondary care. No intervention effect for change in treatment setting after one year was found (adjusted odds ratio 0.99 (95% CI 0.77–1.28)).
			The number of different types of advice and the markers they were based on	Advice to change treatment setting was applicable to 817 (57.7%) persons in the intervention group with an incorrect setting at baseline. In 559 persons, the general practitioner was advised to consult an internist (292 patients with sole advice for consultation and 267 patients with both an advice for consultation and advice for referral), most frequently based on HbA1c values above target (n = 220) or signs of kidney complications (n = 195). In 451 patients, the general practitioner was advised to refer to an internist (184 patients with sole advice for referral and 267 patients in combination with a consultation advice), mainly based on a SBP above target or the presence of a high BMI. Advice for change in treatment setting could be based on one or more markers.
			Reasons for physician non-adherence to the advice	Advice for consultation of a medical specialist was intentionally followed in only 5.9% of the concerning advices, the advice to refer the patient in only 8.2% and the advice for self-monitoring in 24.4%. In about one in three (34.5%) cases the internists followed the advice to refer people back to the GP. If GPs did not follow the advice to consult an internist, most frequently they reported not to do so because they wanted to make treatment adjustments themselves. If patients were not referred by the primary care physician, this was rarely (6.7%) the result of a patient's request. In contrast, internists reported that if they did not refer a patient back, this was because of patients' request in 40% of cases.
Rutten et al. (2017)	System change	GPC at ECAPS (Community provision of 'specialist' services by GPs)	Impact on referral	Impact on referral: In 76% of cases (580/783) the GPC was able to treat the patient without referring.
			Follow-up	30% of cases had follow-up contact. After the initial contact at the GPC, the patient's own GP performed complementary diagnostics in 52 patients (7%). In 24 cases (3%) the GP altered the diagnosis and in 66 cases (8%) the treatment was changed; 34 patients (4%) were referred to a specialist by their own GP.
			Adequacy of triage	79% of contacts were judged to have a correct triage category. In 12% of contacts, the urgency was underestimated by the triage nurses and in 9% it was overestimated (over-triage).
			Guideline adherence	Of the 219 cases that had applicable guidelines, the GP adhered to those guidelines 72% of the time. The guidelines that were most often applicable were Injuries to the ankle ligament (19%), Red eye (15%), Traumatic knee problems (11%) and Acute coronary syndrome (7%).

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			Clinical management	79% of cases received the right type of diagnostics. In 85% of cases, the clinical management of the GP was considered appropriate. Predominant reasons for inappropriate clinical management (15% n = 117) were no or insufficient follow-up advice (51%), and no or incorrect type of medication prescription (38%). Of all referrals, 98% were judged correct.
			Adverse events	None of the patients from the research population died or suffered from permanent adverse events. Complications related to GPC care occurred in 3% (n=25) of patients, of which 3 (0.4%) could have possibly been prevented.
Rutten et al. (2018)	Process change	Direct access to screening/diagnostic	Indication and assessment of the professional	There were no significant differences in indications or risk assessments between the three organizational varieties (no direct access, limited direct access, unlimited direct access).
			Health outcomes	There was a significant difference in outcomes between the model without access and the models with (limited) access. The percentage of radiological abnormalities (fractures and luxations) was 51.3% in the model without access to radiology, 34.6% in the model with limited access and 34.7% in the model with unlimited access.
			Assessment, indication and diagnosis	When the risk assessment by the GP was 'high', there were more fractures/luxations (48.8%) compared to a low-risk assessment (24.4%). Of all fractures and luxations, 79.6% was requested with a high-risk assessment and 87.7% on a strict medical indication. Nine of the 28 patients where radiology was only requested on demand of the patient showed a fracture (32.1%)
			Emergency department: referrals	Of all patients, 60.5% was referred to the emergency department. Logically the referral rate for GPC without access to radiology was 100% (N = 226). This was only 38.4% (N = 118) in case of limited access. 39.8% (N = 47) in case of unlimited access.
Schettini et al. (2017)	Process change	eConsult	Impact on referral wait times and completion	Traditional nephrology referrals: 51-day median appointment wait time and a 40.9% referral completion rate. eConsults: median nephrologist response time of one day and a 100% completion rate; 67.5% of eConsults did not require a subsequent face-to-face specialty appointment. For eConsults that were converted to an in-person visit, the median wait time and completion rate were 40 days and 73.1%, respectively. Compared to traditional referrals placed during the study period, eConsults converted to in-person visits were more likely to be completed ($p<0.001$).
			PCP satisfaction	Survey responses revealed that PCPs were highly satisfied with the program and consider the quick turn around time as the greatest benefit.
Skeith et al. (2017)	Process change	eConsult	Question topic	The most common referral topics were for thrombophilia testing, management of superficial vein thrombosis, and the choice and duration of anticoagulation for venous thromboembolism.
			Impact on referral	By completing an eConsult, PCPs reported 47.5% of face-to-face consultations were avoided, and 4.3% prompted a thrombosis referral that was not originally contemplated.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			PCP perception	Primary care providers' responses to a thrombosis eConsult service were overwhelmingly positive, which included appreciation for timely access for patients, expert guidance and providing additional educational opportunities.
Smyth et al. (2013)	System change	Referral management centre (Rapid Access Clinic)	Change in the number and appropriateness of patients accessing the ENT	Before clinic: 45% of patients presenting to the clinic had no evidence of first accessing primary care assessment or treatment. Waiting times were unpredictable, averaging 75 minutes and clinic numbers above those recommended to be safe in national guidelines. 60% of attendances to the department were judged to be inappropriate. After clinic: Re-audit confirmed a 43% reduction in the number of patients accessing the ENT emergency clinic facility, allowing individual clinic numbers to fall to safe levels. Average patient waiting times fell by 70% to 22 minutes. The number of referrals judged to be inappropriate was halved.
Snoswell et al. (2018)	Process change	eConsult	Teledermoscopy referral cost and time to clinical resolution	Teledermoscopy referral (eConsult) had a mean cost of A$318.39 per case and took a mean of 9 days (range, 1-50 days) to clinical resolution, while usual care cost A$263.75 with 35 days (range, 0-138 days) to clinical resolution. Therefore, teledermoscopy referral cost A$54.64 (95% CrI, A$22.69-A$97.35) more per case than usual care alone and was associated with a mean reduced time to clinical resolution of 26 (95% CI: 13-38) days. This resulted in an incremental cost-effectiveness ratio of A$2.10 (95% CrI, A$0.87-A$5.29) per day saved to clinical resolution.
Tran et al. (2016)	Process change	eConsult	Question type	The most common type of question was request for direction (35.4%), followed by diagnosis (32.4%), management (26.8%), self-improvement (4.1%), and prognosis (1.3%). There were 426 (40%) avoided referrals among 1,055 cases analyzed.
			Questions associated with the highest avoided referral rate	Questions associated with the highest avoided referral rates included ones pertaining to diagnosis (44%), nonspecific requests for direction (44%), questions without specified interventions or outcomes (47%), and dermatology cases (49.5%).
			Specialist agreement	Specialists agreed on the need for a referral in 82% of cases, with most discrepancies due to the PCP making a referral without the specialist recommending one.
Tuot et al. (2015)	Process change	eConsult	Characteristics of eReferral across specialties	Referral volume, referral management and time spent by each specialty reviewer differed substantially across the specialties. The percentage of referrals immediately scheduled without any back and forth between specialist and requesting providers ranged from 27.2% to 82.8%. The percent of referrals never scheduled for a face-to-face specialist appointment ranged from 7.7% to 59.3%. All of the specialties with a never-scheduled prevalence of at least 30% were medical subspecialties, which tended to be the more laboratory-dependent specialties (allergy, endocrinology, hematology, hepatology, and nephrology) rather than the more exam-dependent or procedural specialties (pulmonology, gastroenterology, neurology, rheumatology). The average time spent per unique referral by specialty reviewers ranged from 2.5 to 15.5 min.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			Determinants of high-quality specialist consultative exchange	Overall, 71% of baseline specialist communications for not initially scheduled referrals were considered high quality by PCPs. Subspecialty, volume, reviewer type (physician vs. nurse), eReferral management (i.e. % electronic consultation), and time spent were significant predictors of reported quality.
			Impact of individualized feedback on quality of consultative exchange	Estimated prevalence of high-quality communication increased immediately post-intervention from 69.9% to 74.1% and decreased slightly in the 3–6 months post-intervention to 71.8%. Physician reviewers were more influenced by the intervention than NP reviewers, with higher adjusted odds of receiving high-quality ratings post-compared to pre-intervention (p=0.01).
Ulloa et al. (2017)	Process change	eConsult	Consult characteristics	Of the 150 referrals, 35% were requested by nurses and 65% were requested by physicians (family doctors).
			Referral (to surgery) avoidance	Nearly one quarter (n=36, 24%) were not scheduled for an in person clinic appointment (i.e., the eConsult avoided referral).
			Safety considerations	Among the 36 consultation requests that were not scheduled for a general surgery clinic appointment via the electronic consultation and referral system, 4 patients required urgent care/emergency room evaluation for complaints related to the content of their consult request. Of those patients, 2 required admission to the hospital.
			eConsult completeness	The frequency of consult domains included in the initial consultation request were as follows: quality/severity of problem (88%); pre-consult evaluation and/or treatment (93%); patient co-morbidities (49%); temporality (66%); and pre-consult diagnosis (99%).
van Gelder et al. (2017)	Process change	eConsult	Referral rate	Twenty-nine patients were referred in the intervention group against 52 in the control group (referral rates of 2.3% and 3.0%, respectively), resulting in an odds ratio (OR) of 0.61 (95% CI 0.31–1.23).
			Consultation rate	The difference in consultation rate was also non-significant, 6.3% (n = 81) in the intervention group against 5.0% (n = 87) in the control group
			Quality of care (adherence to the advised monitoring criteria)	There was no difference on any of the process or outcome variables measured.
			Related medical costs	The mean costs per patient during the trial in the intervention group were €453.86; 95% CI 392.98–514.74 against €433.74; 95% CI 387.64–479.84 in the control group (P = 0.60).
			Incidence of CKD during the trial	Patients newly diagnosed with CKD stage 3 or worse during the trial amounted 338/89 659 in the intervention group and 469/117 810 in the control group.
			GP experience with telenephrology	Of 23 GP clinics, 19 completed a survey (total of 38 GPs). Twenty-seven GPs felt that the content of information sent via telenephrology was good. Ease of use was deemed "good" by 15 respondents, "reasonable" by 14 and "insufficient" by 3. Twenty-six GPs mentioned that telenephrology had added to their knowledge of kidney disease. Thirty respondents were pleased with the feasibility of telenephrology and twenty-nine would recommend telenephrology to colleagues. Six GPs did not make use of telenephrology.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
Walsh et al. (2015)	Process and system changes	Diabetes Integrated Care Service (DICS) model: Outreach: community provision by specialists and specialist consultation before referral	Change in the number and quality of referrals	The total number of referrals to the secondary care diabetes clinic fell from 108 to 75 referrals. This equates to a ~30% decrease in the volume of referrals post-initiative. The proportion of referrals outside of the guidelines decreased from 28% before the initiative to 12% after its introduction, resulting in a 57% reduction ($p < 0.01$). There was a marked improvement in waiting times for a secondary care appointment after the initiative. Waiting lists for a diabetes clinic were 6 months pre-initiative, whereas post-initiative there was no waiting list and patients were seen within 2 weeks.
Williams et al. (2016)	GP education	Guidelines with training/feedback	Impact on referral	The proportion of new patient slots used reduced from 14.3% to 8.7% over 10 months while overall costs reduced by 25% for patients with no alarm symptoms and likely IBS aged 16–45 years.
			Costs	When figures from both hospitals were extrapolated over 12 months, the total costs from these patients were approximately £120 000, including their outpatient slot, endoscopy, radiology and serological investigations. This was a 25% saving over baseline compared with costs from the 2011 audit data of approximately £161 000.
			Patient views	63% of patients had satisfactory control of their IBS after specialist dietetic input with 74% reporting improved quality of life.
Wilson et al. (2016)	Process change	eConsult	Response rate and impact on referral	Of the selected calls to the Rapid Access to Consultative Expertise model (RACE) line, 78% were responded to by a specialist within 10 minutes; 90% were shorter than 15 minutes; 60% prevented patients from needing a face-to-face specialist consultation; and 32% prevented patients from visiting a hospital ED for treatment.
			Care experience	Overall, FPs who used RACE said they were satisfied with the timely access to specialist consultations RACE provided, and with the quality and efficiency of the consultations. All FPs who had used RACE would use the service again. More than 95% of FPs who responded to the survey would recommend RACE to colleagues. The service was viewed by FPs as an excellent resource—access to RACE transformed how FPs sought prompt assistance. The service is seen by both FPs and other specialists as a means to improve relationships between these 2 physician groups. Overall, 83% of FP respondents believed the service helped them manage care for their patients. More than 90% of calls to RACE were returned within 1 hour and 78% of calls were returned within 10 minutes. 90% of calls were less than 15 minutes (the goal of the program was to have 95% of calls under this time frame).
			Per capita cost of care	60% of RACE calls prevented referral to a specialist and 32% of the calls prevented an ED visit. Per capita cost of care: Of 148 calls, this resulted in a savings of CAD 15 096.
Witherspoon et al. (2017)	Process change	eConsult	eConsult characteristics	Question topic: The most common diagnoses were hematuria (13%) and renal mass (8%). Question type: The most common clinical questions related to the interpretation of imaging reports (16%) and tests to choose for investigating a condition (15%). eConsult time: Of 190 eConsultations, 70% were completed in less than 10 minutes.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			Impact on referral	In 35% of cases, referral to a urologist had originally been contemplated and was avoided. In 8% of cases, a PCP did not believe a consultation was initially needed, but a referral was ultimately initiated after the eConsultation.
Wrenn et al. (2016)	Process change	eConsult	Characteristics (PCP and eConsults)	The first 200 eConsults were submitted by 86 individual PCPs (60% women). Of these 35% were residents (n=30), 5% were fellows (n=4), 16% were assistant professors (n=14), 21% were associate professors (n=18), 17% were professors (n=15), and 6% (n=5) were nurse practitioners. The mean number of clinic sessions per week for PCPs submitting eConsults was 2.9 half-day clinics. The average response time for these eConsults was 2.5 business days, with 79% completed within three business days. PCPs asked questions related to diagnosis in 71% of cases, treatment in 46% of cases, and monitoring in 21% of cases. Among specialist responses, 76% related to diagnosis, 64% to treatment, and 40% to monitoring. The majority of eConsults (65.5%) included only one type of question posed by the PCP, whereas specialist responses often provided additional recommendations pertaining to more than one category. Among the 80 eConsults that pertained to ''diagnosis only,'' 26 specialist responses pertained to ''diagnosis plus treatment,'' and 10 responses pertained to ''diagnosis plus monitoring'' recommendations. Specialists provided additional recommendations in 43% of all eConsult responses.
			PCP implementation of specialist responses	PCP implementation of specialist responses: PCPs ordered 79% of all recommended laboratory tests, and an additional 10% ordered some of the recommended laboratory tests. PCPs ordered 86% of recommended imaging tests or procedures, 65% of recommended new medications, and 73% of recommended medication changes.
			Specialist visits following eConsults	Specialist visits following eConsults: Based on medical record review, 14% of eConsult patients (n=27) had a visit with the specialist in the same speciality as the eConsult during the six-month period following the eConsult. Among the 27 patients who had a subsequent visit with the specialist, 24 had a visit addressing the condition discussed in the eConsult (89%). In 59% of cases (n=16), the PCP referred the patient for an in-person visit based on conditional recommendations provided by the specialist in the initial eConsult response.
			ED visits and hospital admissions following eConsults	ED visits and hospital admissions following eConsults: Based on chart review, 11% of eConsult patients (n=22) had an ED visit in the six-month period following the eConsult. Only 1.5% (3/196) had an ED visit related to the condition discussed in the eConsult. Of the patients, 11% (n=22) had a hospital admission within the six months following completion of the eConsult. Of these 22 patients, 16 were also patients noted to have an ED visit. Only one patient had an admission related to the condition discussed in the eConsult (0.05% of all eConsults in this analysis).
Wright et al. (2015)	Process change	Referral management and booking service that combined referral guidelines, online referral templates and administrative and clinical triage	Change in outpatient attendance	Overall rates of first outpatient attendances declined more strongly for pilot practices than controls.
			Incomplete referrals	The number of referrals challenged for being incomplete or having insufficient clinical information decreased.
			Rate of non-compliant referrals	The rate of referrals challenged by clinical triage for not conforming to referral guidelines was well below the rate of inappropriate referrals published in the literature. Interviews with practices revealed a number of themes and a broad range of attitudes.

Author (year)	Intervention category	Intervention description	Outcomes measured	Results
			Patient satisfaction	Patients were highly satisfied with the service. Of the 41 patients that completed a survey, all reported the option to be contacted by phone regarding an appointment as useful. More than 90% rated the service as "excellent" and all considered the new service as better than the previous choose and book system.
Zekria et al. (2017)	Process change	Referral management centre (single point of entry for all mental health referrals to secondary services)	Wait time	The initial average wait time at baseline was 60.7 days, based on data from 2014. By March 2016, this had reduced to an average of 40.1 days, equivalent to a 34% reduction in average wait time.
			Impact on referrals	Over the same period, the monthly number of referrals to CHAMHRAS grew from a baseline of 176.4 to 385.3 per month.
			Percentage missing face-to-face	The percentage of patients not attending their first face-to-face appointment dropped from a baseline of 51% to 26%.

eConsult refers to any liaison service (via email, phone, web-based platform, etc.) to connect primary care providers with specialists to facilitate specialist consultation before referral. This includes synchronous and asynchronous communication (for example, teledermatology, teleradiology, and teleophthalmology).

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Appendix 1: Search Strategy

Databases	MEDLINE via Ovid Cochrane Database of Systematic Reviews EMBASE via Ovid Google Scholar via http://scholar.google.com/ <first 10 pages>
Strategy	MEDLINE 1. "Referral and Consultation"/ or "Delivery of Health Care, Integrated"/ 2. (refer* or referral* or coordination or coordinate or coordinated or "co-ordination" or "co-ordinate" or "co-ordinated").tw,kf. 3. 1 or 2 4. Primary Health Care/ or General Practice/ 5. Family Practice/ or General Practitioners/ 6. ("primary care" or "primary health care" or "primary healthcare" or "family doctor*" or "general practi*" or GP).tw,kf. 7. 4 or 5 or 6 8. Secondary Care/ 9. exp Specialization/ 10. ((specialist* or specialt* or secondary) adj5 (care or health* or referral* or clinic*)).tw,kf. 11. 8 or 9 or 10 12. 3 and 7 and 11 13. limit 12 to yr="2013 -Current" 14. limit 13 to english language
	Cochrane Database of Systematic Reviews 1. (refer or refers or referred or referral* or coordination or coordinate or coordinated or "co-ordination" or "co-ordinate" or "co-ordinated").tw. 2. ("primary care" or "primary health care" or "family doctor*" or "general practitioner*" or GP).tw. 3. ((specialist* or specialt* or secondary) adj5 (care or health* or referral).tw. 4. 1 and 2 and 3
	Embase 1. exp patient referral/ or exp integrated health care system/ 2. (refer* or referral* or coordination or coordinate or coordinated or "co-ordination" or "co-ordinate" or "co-ordinated").tw,kw. 3. 1 or 2 4. exp primary health care/ or exp general practice/ 5. exp general practitioner/ 6. ("primary care" or "primary health care" or "primary healthcare" or "family doctor*" or "general practi*" or GP).tw,kw. 7. 4 or 5 or 6 8. exp secondary health care/ 9. exp specialization/ 10. ((specialist* or specialt* or secondary) adj5 (care or health* or referral* or clinic*)).tw,kw. 11. 8 or 9 or 10 12. 3 and 7 and 11 13. limit 12 to yr="2013 -Current" 14. limit 13 to english language 15. limit 14 to conference abstracts 16. 14 not 15