

A Systematic Review of Asynchronous, Provider-to-Provider, Electronic Consultation Services to Improve Access to Specialty Care Available Worldwide

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Abstract

Background: Electronic consultation (eConsult) is an asynchronous electronic communication tool allowing primary care providers to obtain a specialist consultant's expert opinion in a timely manner, thereby offering a potential solution to excessive wait times for specialist care, which remain a serious concern in many countries.

Introduction: Our 2014 review of eConsult services demonstrated feasibility and high acceptability among patients and providers. However, gaps remain in knowledge regarding eConsult's impact on system costs and patient outcomes.

Materials and Methods: Following the PRISMA guidelines, we conducted a systematic review in May 2017 of English and French literature on OVID Medline, EMBASE, ERIC, and CINAHL databases, examining all studies on eConsult services published since our previous review. The Quadruple Aim Framework was used to synthesize outcomes. Articles reporting on the impact of eConsult on access, patient safety and satisfaction, utilization rates, clinical workflow, and continuing medical education were analyzed using a narrative synthesis approach.

Results: The initial search yielded 1,021 results, 50 of which were included on abstract and received a quality assessment and full text review. Of these, 43 were included in our final analysis. Results demonstrated the worldwide presence of eConsult services in North America and countries beyond, including Brazil, Australia, Spain, and The Netherlands. The breadth of specialty 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.

Conclusions: The availability of eConsult services has spread both geographically and in terms of specialty services offered. By allowing for a greater population 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.

Keywords: eConsult, telehealth, e-health, telemedicine, technology

Introduction

Electronic consultation (eConsult) is an emerging health innovation designed to address excess wait times for specialist care by enabling primary care providers (PCPs) to obtain a specialist consultant's expert opinion in a timely manner. According to a 2016 Commonwealth Fund report, wait times for specialist care in Canada were the highest out of 11 countries surveyed.¹ In Canada, 56% of patients waited at least 4 weeks to see a specialist, a trend that has remained consistent since 2010 and is significantly higher than the Commonwealth Fund average of 36%. Furthermore, results of the report show that one in five Canadians report that their PCP is not informed about their specialist visit, indicating a need for improved communication between PCPs and specialists similar to the international average.¹

Other countries face similar challenges in accessing specialist advice. A recent wait time report in England showed that in the first 7 months of 2017, 89.4% of patients waited up to 18 weeks to see a specialist. This result failed to meet their standard of 92% of patients waiting no more than 18 weeks for their consult.² In Northern Ireland, statistics from the first 6 months of 2017 revealed that 71.6% of patients waited longer than 9 weeks to see a specialist and 24.2% waited more than 52 weeks. These results have increased from 64.8% and 13.4%, respectively, in the same timeframe of 2016.³ In Brazil,

specialists described the referral process as unorganized, lacking patient triaging, and consisting of inadequate communication between providers.⁴

Previous reviews evaluating Consult's use and impact demonstrated its overall feasibility in application and its ability to improve timely access to specialty care.^{5,6} However, both studies revealed a lack of literature analyzing the cost effectiveness of eConsult and its impact on patient outcomes and safety. It was additionally shown that many eConsult services were primarily limited to single specialty services, particularly dermatology, thus generalizability of impact across other specialty areas was not established.

Therefore, we conducted a systematic review to expand on past reviews of the literature and examine eConsult's impact on delivery of care by applying the Quadruple Aim Framework.⁷ This framework proposes that the optimization of the performance of the health system should involve simultaneously pursuing four interdependent objectives: population health, experience of receiving care (patients), experience of providing care (providers), and per capita costs. This review will provide value in informing recently published perspectives, developments, and implications of eConsult services worldwide.

Methods

STUDY DESIGN

This is a systematic review analyzing the impact of eConsult on the delivery of care. The protocol was registered on PROSPERO.2017, CRD42017069139.

DATA SOURCES

On May 11, 2017 we conducted a search through OVID of Medline (from 1946), EMBASE (from 1947), and ERIC (1965 to April 2017) and through EBSCO of CINAHL. Titles published from August 2014 to May 2017 in English or French were included. We expanded on our previous review by including ERIC and CINAHL in our search databases. The search strategy consisted of two search clusters of keywords: (1) keywords for electronic consultation (e.g., eConsult*, teleconsult*) and (2) keywords for provider care (e.g., general practitioner [GP], specialist care). Our previous review only focused on terms regarding eConsult and primary care. We broadened the second search cluster to include search terms regarding both primary and specialty care.

INCLUSION CRITERIA

Records were screened for publication type and relevance to eConsult. Conference proceedings/articles/abstracts, editorials, letters, notes, reviews and opinion pieces, policy papers, guidelines, pilot, and case studies were excluded. Distiller SR

was used to screen titles and abstracts based on predetermined relevancy criteria. eConsult was defined as an asynchronous, directed communication between providers over a secure electronic medium that involved sharing of patient-specific information and sought clarification or guidance regarding clinical care. This excluded interventions, such as web-based discussion forums, e-mail communication (unless explicitly described as secure), videoconferencing, one-way communications, and services connecting patients and providers. Examples of PCPs included family doctors and nurse practitioners. Articles that defined dentists and pharmacists as PCPs were excluded.

Two reviewers (A.M. and N.N.) screened the abstracts for relevancy, with a third reviewer (I.M.) verifying 15 of the screened articles for rigor. C.L. and I.M. performed a second abstract screen to further eliminate (or include) any articles for full screening. Full articles were then screened for relevancy by N.N. and A.M.

A modified version of the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies by Thomas et al.⁸ was used to assess the quality of articles.⁵ The review team consisted of 4 members (C.L., E.K., I.M., and A.M.), each assessing 11–12 articles.

THE QUADRUPLE AIM FRAMEWORK

In 2008, Berwick et al. first described the Triple Aim Framework as simultaneously improving population health, improving the patient experience of care, and reducing per capita cost.⁹ The Quadruple Aim Framework, proposed in 2014 by Bodenheimer and Sinkov, builds on Berwick et al.'s work by introducing a fourth dimension, provider experience of care, which researchers have described as an essential component to adoption and sustainability.⁷ Therefore, the updated framework, which we have used in the present review (*Table 1*), includes the provider experience dimension and the corresponding outcome measures.

DATA EXTRACTION

We followed the data extraction template used in our previous review with a few modifications to capture the dimensions of the Quadruple Aim Framework.⁷ The potential impacts and outcome measures are shown in *Table 1*. Items extracted included title, author, location, research question/objective, study design, service type, sample size, main outcomes, and findings.

ANALYSIS

Using the Quadruple Aim Framework as a guide, we conducted a narrative synthesis of included studies. While the articles included in the study use a variety of terms to describe

Table 1. Overview of Quadruple Aim Framework Impact and Outcome Measures

DIMENSION	IMPACT	OUTCOME MEASURES
Population Health	Population-level outcomes with a defined denominator (e.g., chronic pain patients, patients in rural regions, etc.)	Traditional population health outcomes: mortality, health and functional status, healthy life expectancy Disease burden (e.g., incidence and/or prevalence rates of major chronic conditions) Behavioral and physiological factors (e.g., a composite health risk assessment score)
Experience of care (patient)	Patient-reported outcome and experience measures	Standard questions from patient surveys (e.g., health status, quality of life) Set of measures based on key dimensions (e.g., Institute of Medicine's six aims for improvement: safe, effective, timely, efficient, equitable, and patient centered)
Per capita cost	Downstream healthcare utilization costs, impact of delayed medical referral	Hospital and ED utilization rates and costs Other contacts with healthcare services (e.g., tests, specialist consultations) and associated costs
Experience of providing care (provider)	Provider-reported outcome and experience measures	Satisfaction with experience of delivering care Retention Workflow/operational efficiencies Continuing medical education and professional development

ED, emergency department.

their electronic consultation services (e.g., e-consultation, teleconsultation), for the purposes of this study we will use the term eConsult exclusively.

Results

A search of target databases on May 11, 2017 revealed 1,021 citations. A total of 43 studies were used for data extraction after limiting publication dates to 2014–present, excluding articles not published in English or French, and removing duplicates and ineligible articles (*Fig. 1*).

Table 2 shows that the majority of studies were conducted in the United States (44%) and Canada (28%), with some in Brazil (9%), Europe (Spain, Italy, Austria, The Netherlands; 7%), and Australia (2%). In addition, two services extend globally across countries: Médecins Sans Frontières (MSF) and Naval Medical Center Portsmouth (NMCP) for military services around the world.

The breadth of specialty services offered has greatly expanded beyond dermatology, with most studies focused on multispecialty service (84%), ranging from 8 to 86 specialties. Only 7 (16%) studies described a single specialty service, which included services in the following specialty groups: dermatology, cardiology, and pulmonology. *Figure 2* shows the distribution of top specialties accessed through eConsult, with endocrinology being the most frequently accessed at 19%, followed by dermatology (16%), hematology (9%), cardiology (9%), gastroenterology (8%), and neurology (7%). The

number of eConsults reported ranged from 65 to 217,014, and number of participating providers ranged from 17 to 4,260 PCPs and 4 to 479 specialists. Most articles described eConsult for PCP–specialist communication, with only one reporting on specialist-to-specialist communication.¹⁰

Study designs varied with most studies (40%) classified as retrospective and cross-sectional (16%), and smaller proportion of mixed method designs (7%) and randomized controlled trials (RCTs; 7%). Due to the fact that most studies were descriptive in nature, the majority (88%) of articles were categorized as “weak” based on the quality assessment tool. We did not exclude any articles based on the quality assessment.

There were multiple articles describing six eConsult services, which accounted for 67% ($n=29$) of the articles: 30% ($n=13$) from the Champlain BASE™ eConsult service, 9% ($n=4$) from the TNMG (Telehealth Network of Minas Gerais) in Brazil, 7% ($n=3$) from the Mayo Clinic, 7% ($n=3$) from San Francisco General Hospital, 5% ($n=2$) from the University of California San Francisco (UCSF), 5% ($n=2$) from MSF, and 5% ($n=2$) were from the Veterans Health Administration (VHA) (*Table 3*).

eConsult services were implemented on a variety of technological platforms (*Table 4*). Several services, including those at the VHA,^{11,12} Veteran's Affairs (VA),^{13–15} UCSF,^{16,17} and the Mayo Clinic,^{10,18,19} use private networks, where the eConsult service is embedded into an electronic health record shared by referring providers and specialists, enabling the

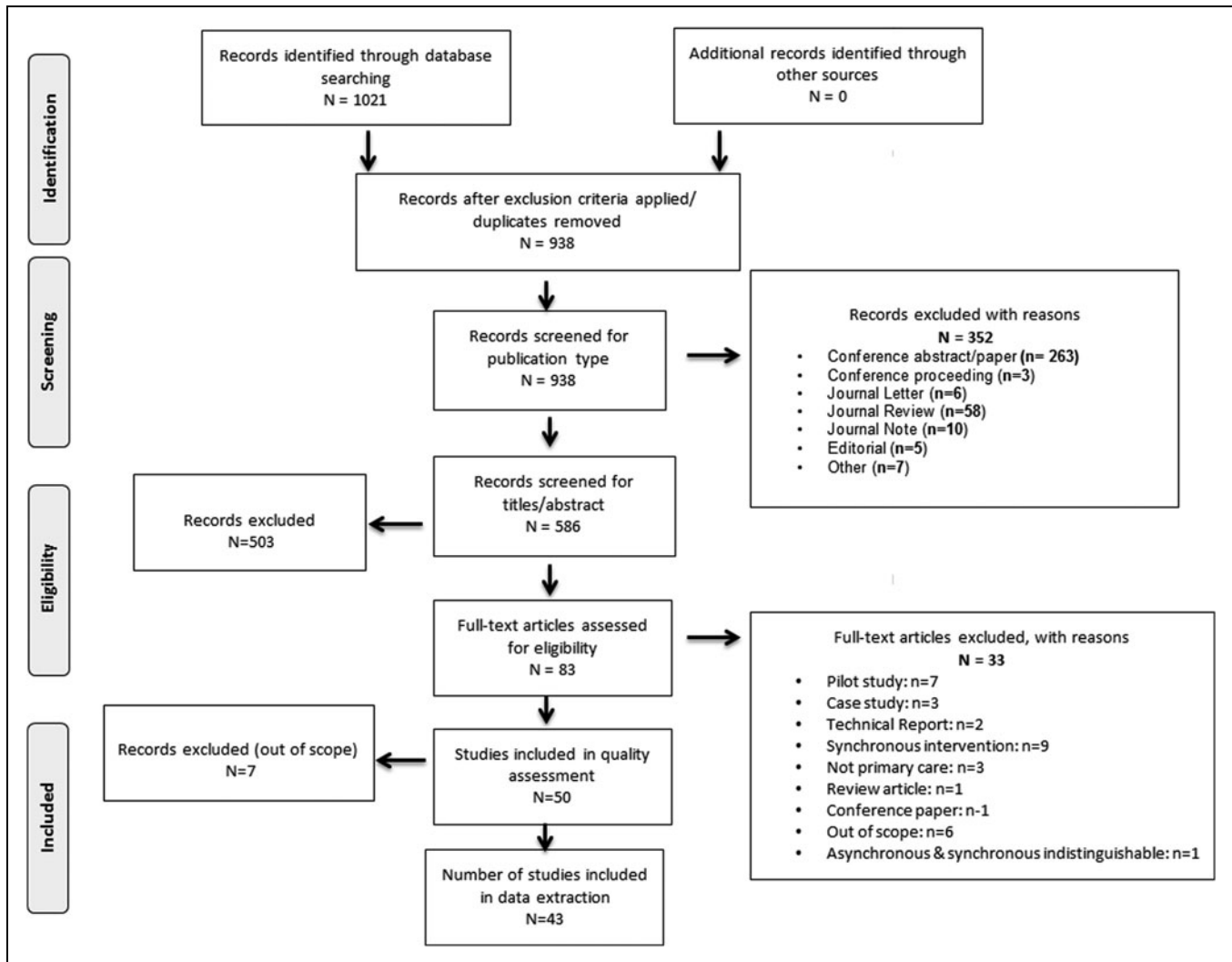


Fig. 1. Flow chart for study inclusion.

specialist to directly access patient information. Other eConsult services are independent of individual health records and use a secure web-based portals to link providers, such as the Champlain BASE in Canada,^{20–32} TNMG in Brazil,^{33–36} and KSYOS in The Netherlands,³⁷ or harness secure intranet e-mail as the means of communication, such as Army Knowledge Online (AKO).³⁸

POPULATION HEALTH OUTCOMES

There were very few reports of eConsult’s impact on traditional population health outcomes, such as risk and mortality. In a RCT of cardiology eConsults, patient outcomes, including adverse events (e.g., death, myocardial infarction, coronary artery bypass grafting, urgent or emergent cardiac catheterization and/or angioplasty) as well as hospital and emergency

department utilization for potential cardiac complaints or events, were compared between those patients who had an eConsult versus those referred through a traditional referral pathway.³⁹ The results 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.³⁹ In another study, Price et al.⁴⁰ conducted an assessment of patient harm based on a review of all electronic referrals to a gastroenterology clinic that did not result in scheduling of appointment. Within referrals considered resolved (where the referral complaints have been resolved or addressed), only nine patients (9%) received unplanned care while awaiting scheduling decisions, five of whom experienced harm that was related to referral complaints, although

Table 2. Characteristics of Included Studies

FIRST AUTHOR	YEAR	SETTING	TYPE OF SERVICE	STUDY DESIGN	STUDY POPULATION	OUTCOMES	QUALITY RATING
Alkmim ³⁵	2015	Brazil	Multispecialty	Randomized qualitative study	640 Teleconsultations	Objectivity, courtesy, ethics, quality	Weak
Alkmim ³⁴	2015	Brazil	Multispecialty	Cross-sectional	1,954 Teleconsultations	Factors associated with teleconsultation utilization rates	Weak
Barnett ⁴⁴	2017	United States	Multispecialty	Retrospective observational analysis	3,060 PCPs	Access, patterns of use, response time, sustainability	Weak
Bonnardot ⁴⁵	2014	Global (MSF)	Multispecialty	Retrospective analysis	1,039 Telemedicine cases, 163 providers	Response time, provider satisfaction, education, improved patient management	Weak
Byrom ⁴²	2016	Australia	Single specialty	Retrospective case analysis	406 Telederm cases	Response time, concordance rate, face-to-face recommendations	Weak
Cruz ¹⁷	2015	United States	Multispecialty	Program evaluation	158 eConsults	Response time changes in wait time), Downstream utilizations (ED visits, hospitalizations, and specialty clinic visits), PCP compliance with specialist recommendations	Weak
Datta ¹⁴	2015	United States	Single specialty	Randomized clinical trial	196 Patients (conventional), 195 patients (tele dermatology)	Total and per participant costs, effectiveness (trade off utility)	Weak
Delaigue ⁴¹	2014	Multicountry (Sudan, Ethiopia, Congo)	Single specialty	Retrospective analysis utilizing mixed methods	65 Tele dermatology cases	Response time, areas for improvement of system, quality of clinical details	Weak
Fogel ²⁰	2016	Canada	Multispecialty	Cross-sectional	436 Hematology eConsults submitted by 171 PCPs	Avoidance of referrals, common question types	Weak
Fort ⁵²	2017	United States	Multispecialty	Mixed methods	10 Patients, 18 safety net clinicians, 12 specialists, 3 referral coordinators, 602 eConsults	Patient satisfaction, provider satisfaction	Weak
Golberstein ⁴⁸	2017	United States	Multispecialty	Cluster-randomized evaluation	72 Control PCPs, 70 Treatment (eConsult) PCPs	Effect of eConsult on PCP perception and their ability to provide care for mental health services	Weak
Gupte ¹⁵	2016	United States	Multispecialty	Observational quality improvement study	7,097 eConsults	Provider experience, response type, most frequent specialty consulted	Weak
Johnston ²⁵	2017	Canada	Multispecialty	Cross-sectional	85 eConsults	Provider satisfaction, topics of interest and efficiency of eConsult in pediatric hematology/ oncology	Weak

continued →

Table 2. Characteristics of Included Studies *continued*

FIRST AUTHOR	YEAR	SETTING	TYPE OF SERVICE	STUDY DESIGN	STUDY POPULATION	OUTCOMES	QUALITY RATING
Keely ³⁰	2015	Canada	Multispecialty	Survey	34 Specialists	Provider experience/ satisfaction	Weak
Kirsh ¹²	2015	United States	Multispecialty	Observational cohort	217,014 eConsults	Growth of eConsults by VHA regional networks, medical centers and specialty, location of patients PCP, potential patient mileage needed to travel for F2F consult with specialist instead of eConsult and specialty care use following eConsult	Moderate
Liddy ²¹	2015	Canada	Multispecialty	Mixed-methods	2,052 eConsults	Satisfaction, education, impact on patient care, response time	Weak
Liddy ²²	2015	Canada	Multispecialty	Economic analysis based on survey	235 PCPs, 27 specialists	Cost savings	Weak
Liddy ²³	2016	Canada	Multispecialty	Costing evaluation	3,487 eConsults	Costs and potential savings of eConsult based on referral avoidance	Weak
Liddy ³¹	2016	Canada	Multispecialty	Mixed methods study (cross-sectional analysis and survey)	4,260 eConsults	eConsult patterns and provider satisfaction	Weak
Liddy ²⁴	2016	Canada	Multispecialty	Cross-sectional	1,796 eConsults	Response time, impact of eConsult on course of action, Provider/patient satisfaction	Weak
Liddy ²⁹	2016	Canada	Multispecialty	Cross-sectional	93 PCPs	Response time, provider satisfaction	Weak
Lin ⁴⁶	2016	Global (NMCP)	Multispecialty	Teleconsultation review	585 Teleconsultations	Referral/medevac avoidance, response time, cost savings	Weak
Maddry ³⁸	2014	United States (note: data obtained from Iraq, Kuwait, and Afghanistan also)	Multispecialty	Retrospective observational analysis	99 Teleconsultations	Response time, type, and frequency of teleconsultation	Weak
Marcolino ³³	2016	Brazil	Multispecialty	Ecological study	73,698 Teleconsultations	Provider satisfaction, avoidance of referrals, cost savings	Weak
Marcolino ³⁶	2015	Brazil	Multispecialty	Observational retrospective study	63,975 Teleconsultations	Referral avoidance, response time, provider satisfaction	Weak
McGeady ⁴³	2014	United States	Multispecialty	Retrospective chart review	1,705 eReferrals, 487 patients	Avoidance of referrals, diagnostic testing efficiency	Weak

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Table 2. Characteristics of Included Studies *continued*

FIRST AUTHOR	YEAR	SETTING	TYPE OF SERVICE	STUDY DESIGN	STUDY POPULATION	OUTCOMES	QUALITY RATING
Murthy ²⁷	2017	Canada	Multispecialty	Retrospective analysis utilizing mixed methods	224 Infectious diseases eConsults	eConsult response time, impact on course of action, provider satisfaction, impact on patient care	Weak
Nami ⁵⁰	2015	Italy and Austria	Single specialty	Clinical trial	391 Patients	Concordance between store and forward and face-to-face consultation management	Weak
Nelson ⁴⁹	2016	United States	Single specialty	Prospective study	196 Teledermatology consults	Impact on diagnosis and management (response time, anticipated level of dermatology input without teledermatology, and number of consults managed solely with teledermatology)	Weak
North ¹⁰	2015	United States	Multispecialty	Retrospective review	3,008 eConsults, 2,885 patients, 353 specialists	Conversion of eConsults to face-to-face assessments	Weak
Olayiwola ³⁹	2016	United States	Single specialty	Cluster-randomized controlled trial	19 PCPs (control), 17 PCPs (intervention)	Specialist response time, patient outcomes (ED utilization), physician satisfaction, workload	Moderate
Pecina ¹⁸	2016	United States	Multispecialty	Retrospective study	1,041 eConsults	Follow-up of recommendation from the e-consultations by the PCP	Weak
Pecina ¹⁹	2016	United States	Multispecialty	Retrospective analysis	5,115 eConsults	Reason for face-to-face referrals following eConsult	Weak
Price ⁴⁰	2016	United States	Multispecialty	Chart review	266 eReferrals	Reasons for not scheduling referrals, harm, and potential for harm caused by preconsultation	Weak
Rodriguez ¹³	2015	United States	Multispecialty	Quality improvement project evaluation: semistructured telephone interviews	15 Veteran patients, 15 PCPs, 4 specialists	Provider satisfaction, patient satisfaction	Strong
Scheibe ⁵¹	2015	United States	Multispecialty	Retrospective chart review	2,105 eReferrals	Volume/appropriateness of pre-eConsultation exchange and impact on face-to-face referral	Moderate
Segura ⁴⁷	2016	Spain	Multispecialty	Observational retrospective study	938 Virtual consults, 44 PCPs	Avoidance of referrals, provider satisfaction	Weak
Shehata ²⁸	2016	Canada	Multispecialty	Retrospective electronic chart review	394 eConsults 151 PCP	Avoidance of traditional referrals	Weak

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Table 2. Characteristics of Included Studies *continued*

FIRST AUTHOR	YEAR	SETTING	TYPE OF SERVICE	STUDY DESIGN	STUDY POPULATION	OUTCOMES	QUALITY RATING
Shpherd ¹¹	2016	United States	Multispecialty	Feasibility program evaluation	303 eConsults, 230 patients	Time spent responding to econsults, question types	Weak
Tran ²⁶	2016	Canada	Multispecialty	Cross-sectional	1,055 eConsults	Impact of question type on avoidance of referrals and discrepancies between PCPs and specialists	Weak
Tran ³²	2016	Canada	Multispecialty	Cross-sectional	180 PCPs, 464 eConsults	Provider satisfaction, response time, frequency of additional recommendations by specialist	Moderate
Thijssing ³⁷	2014	The Netherlands	Single specialty	Descriptive study	227 Telespirometry tests, 4,488 telepulmonology consultations	Referral avoidance, impact on patient care, and education for provider	Weak
Wrenn ¹⁶	2017	United States	Multispecialty	Retrospective descriptive analysis	200 eConsults, 86 PCPs, 195 patients	Referrals following eConsult, frequency of question type/answers, frequency of PCP following recommendation	Weak

MSF, Médecins Sans Frontières; NMCP, Naval Medical Center Portsmouth; PCPs, primary care providers; VHA, Veterans Health Administration.

authors noted that scheduling of appointments may not have avoided this harm. Within unresolved referrals (no evidence that the referral complaints resolved spontaneously or were addressed in some other way), 55 (73%) were identified as having potential for major harm (including prolonged hospitalizations, permanent disability, delayed diagnosis of malignancy, and/or death).⁴⁰ The authors 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. A retrospective analysis of dermatology cases referred by MSF field doctors revealed that only 10 of 65 cases (15%) had patient follow-up data with two cases of patient death.⁴¹ The lack of information about patient follow-up was a critical issue raised by the participating specialists and referrers.⁴¹ Similar lack of follow-up was noted by Byrom et al., who reported that patient outcome was largely unknown in 83% of 406 cases.⁴²

PATIENT EXPERIENCE OF CARE

Thirty (out of 43) studies reported on percentage of avoided face-to-face visits. The lowest was 7.4%⁴³ and the highest

78%,³⁶ with most studies reporting between 22% and 68% reductions in face-to-face specialist visits. Barnett et al. noted a threefold variation in the rate of eConsult requests resolved without a visit across specialist consultants.⁴⁴

Only one study described interviewing patients (in addition to providers), who had an eConsult, about their experience, including satisfaction with the eConsult program and perceived facilitators of and barriers to eConsult utilization. Overall, the patients were satisfied with the eConsult program (median ratings of 5 on a 5-point Likert scale) in terms of met expectations and confidence in eConsult.¹³ They also rated the service high (median ratings of 4) for quality of care, timeliness, improved access, and safety. Furthermore, patients identified communication (effective communication with PCPs or providers) as the domain that was most important regarding their overall satisfaction with the eConsult process and unanimously indicated that they intended to use eConsults in the future based on the quality of care and the timeliness of care.¹³ Other studies surveyed users (PCP referrers and specialists) to examine the services' benefits for patients. Bonnardot et al. showed that 79% of referrers reported that the advice received improved their management of the patient.⁴⁵ Similarly, Thijssing et al. reported that in 72% of the cases, the

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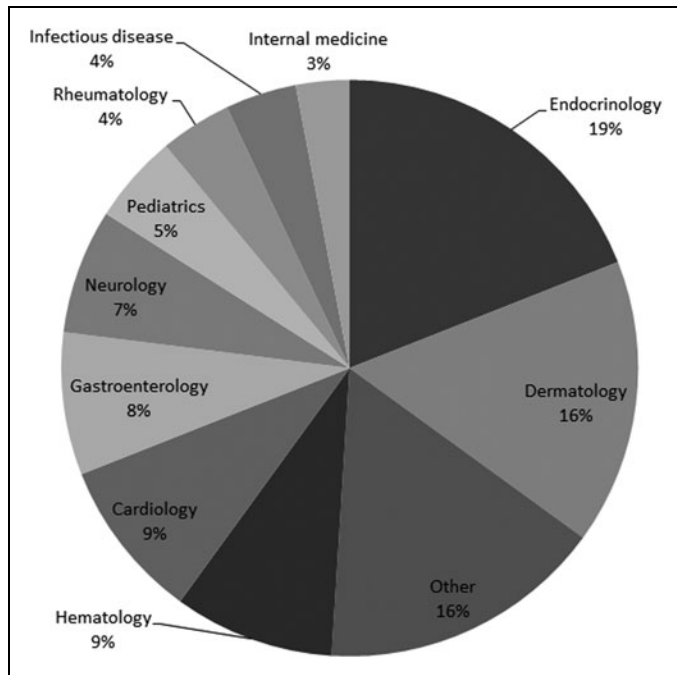


Fig. 2. Proportions of specialties accessed via eConsult service (based on the top three specialties assessed most frequently in each article). Note: “other” refers to small proportions (1% each) for the following specialties: Chronic Back Pain, Gastroenterology and Hepatology, Medical Toxicology, Obstetrics and Gynecology, Orthopedics, Psychiatry, Pulmonology and Spirometry, Radiology, Sleep medicine, Spine Center, Transgender Care General, and Urology.

referrers indicated that they and the patients were helped by the consultant’s response.³⁷ In three separate studies from the Champlain BASE service, primary healthcare providers (i.e., nurse practitioners and/or physicians) were asked to rate the value of eConsult to their patients using 5-point Likert scale (from 1: little/no value to 5: very high value).^{24,29,31} The findings were consistently positive, with most providers (89%) rating eConsult’s value to patients as high or very high (i.e., 4 or 5 out of 5).

REDUCING PER CAPITA COST OF CARE

Six articles, including two by our study group, reported on costs of eConsults (Table 5). Different techniques were used that included cost analysis, cost-minimization analysis (comparing the costs of eConsult with traditional referral methods), and cost effectiveness (determination of a savings ratio, such as a return on investment or ROI). Studies comparing costs (i.e., those conducting a cost-minimization analysis) of eConsults with in-person specialist visits report eConsult costs (viewed through impact on health services) ranging from \$5 per eConsult (compared with \$56 for face-to-

face)³³; to \$298 per person using eConsult (compared with \$338 for face-to-face).¹⁴ Alternatively, another study estimated monthly savings for the military (using a cost minimization analysis) by using eConsult to be \$140,907 (yearly savings were \$467,181); where civilian monthly savings were estimated as \$28,260 (yearly savings were \$105,400).⁴⁶ The return of investment was also estimated at 6.1 for eConsult in one study assessing cost effectiveness.³³ From a societal perspective, another study found (through a cost minimization analysis) that costs of eConsult averaged at \$460 per patient, compared with face-to-face costs of \$542 per patient.¹⁴ Similarly, in another study, societal savings (including cost to the healthcare payer, and costs to the patient) were estimated to be approximately \$11 per eConsult.²³ Finally, another study suggested a potential for millions in transportation saving by implementing eConsult to minimize face-to-face consultations.¹²

PROVIDER EXPERIENCE OF CARE

Many studies assessed provider experiences of eConsult, including perceived value, satisfaction, educational value, quality of response, and impact on workload. There are several reports from Champlain BASE assessing perceived value using a 5-point Likert scale. Overall, more than 90% of providers rated eConsult as having a high to very high value for themselves (i.e., at a value of at least 4 out of 5).^{24,29,31} In other studies, when asked about satisfaction with eConsult, 75–100% of providers reported being satisfied,^{33,47} and most providers reported that they would use eConsult again in the future.¹³

eConsult’s educational value was noted in several studies, with 90% of providers reported having learned from eConsult,³⁷ whereas in others 74% reported their questions were answered,³⁵ and 89% thought eConsult results were conclusive.⁴⁷ Providers also reported that psychiatric eConsults increased access to specialty consultations for mental health and improved support for diagnosis and treatment.⁴⁸ In another study, 75% of providers reported no impact or decreased workload as a result of eConsult.³⁹ In general, the time it took for the specialists to prepare an answer to the question from an eConsult ranged from under 20 min,²⁴ to under 30 min,¹⁵ to 78 min.¹¹

Many studies also evaluated timeliness of eConsult. The average/median time for the PCPs to receive a response from the specialists to the eConsult requests ranged from <1^{18,49,50} to <6 days.^{11,51} In a cardiology RCT, which compared time to response between eConsult and traditional referrals, the median number of days to receive a response was 5 days for eConsults versus 24 days for traditional referrals.³⁹ Only one

Table 3. Service/Article Breakdown

SERVICE	ARTICLES
Champlain BASE™ eConsult Service	Fogel et al. (2016) ²⁰
	Johnston et al. (2017) ²⁵
	Keely et al. (2015) ³⁰
	Liddy et al. (2015) ²¹
	Liddy et al. (2015) ²²
	Liddy et al. (2016) ²⁹
	Liddy et al. (2016) ²³
	Liddy et al. (2016) ²⁴
	Liddy et al. (2016) ³¹
	Murthy et al. (2017) ²⁷
	Shehata et al. (2016) ²⁸
	Tran et al. (2016) ³²
	Tran et al. (2016) ²⁶
TNMG	Alkmim et al. (2015) ³⁴
	Alkmim et al. (2015) ³⁵
	Marcolino et al. (2016) ³³
	Marcolino et al. (2015) ³⁶
Mayo Clinic eConsult	North et al. (2015) ¹⁰
	Pecina and North (2016) ¹⁹
	Pecina et al. (2016) ¹⁸
SFGH eConsult	McGeady et al. (2014) ⁴³
	Price et al. (2016) ⁴⁰
	Scheibe et al. (2015) ⁵¹
UCSF eConsult	Cruz et al. (2015) ¹⁷
	Wrenn et al. (2016) ¹⁶
MSF Telemedicine Network	Bonnardot et al. (2014) ⁴⁵
	Delaigue et al. (2014) ⁴¹
VHA (nationwide)	Kirsh et al. (2015) ¹²
	Shipherd et al. (2016) ¹¹
Los Angeles Safety Net Program DHS (Los Angeles County Department of Health Services) eConsult	Barnett et al. (2017) ⁴⁴
KP Safety Net Specialty Care Program (Denver) eConsult (collaboration with KPCCO)	Fort et al. (2017) ⁵²
Allina Health Twin Cities eConsult	Golberstein et al. (2017) ⁴⁸
U.S. Army Medical Department (AMEDD) AKO electronic mail system for dermatology; Electronic mail telemedicine system	Maddry et al. (2014) ³⁸

continued →

Table 3. continued

SERVICE	ARTICLES
HELP Teleconsultations; Pediatric and Adult (military and civilian families)	Lin et al. (2016) ⁴⁶
Department Dermatology Siena University/ Medical University STF/Store-and-Forward Mobile Tele dermatology using MugDerma	Nami et al. (2015) ⁵⁰
University of Pennsylvania Store-and-Forward Tele dermatology: AccessDerm mobile SAF platform	Nelson et al. (2016) ⁴⁹
Tele-Derm National: Australian College of Rural and Remote Medicine (ACRRM)	Byrom et al. (2016) ⁴²
Netherlands Telepulmonology and Telespirometry KSYOS Telemedical Center	Thijssing et al. (2014) ³⁷
CHCI eConsult	Olayiwola et al. (2016) ³⁹
Autonomous Community of the Canary Islands Virtual Consultations in Rheumatology (DRAGO)	Segura and Bustabad (2016) ⁴⁷
Veterans Affairs Boston Healthcare System (VABHS)	Gupte et al. (2016) ¹⁵
VA Minneapolis	Datta et al. (2015) ¹⁴
Veterans Affairs Pittsburg Health Care System (VAPHS)	Rodriguez et al. (2015) ¹³

AKO, Army Knowledge Online; CHCI, Community Health Center, Inc.; DHS, Department of Health Services; HELP, Health Experts onLine at Portsmouth; KP, Kaiser Permanente; KPCCO, Kaiser Permanente Colorado; SFGH, San Francisco General Hospital; TNMG, Telehealth Network of Minas Gerais; UCSF, University of California San Francisco; VA, Veterans Affairs.

study determined the median time for patient notification after eConsult and found it to be 3 days.¹⁸

Open-ended input responses revealed that most providers appreciated the service, finding it safe, timely, easy to use, beneficial to patient care, and capable of improving communication and facilitating provider education.²⁵ Some challenges associated with eConsult were those relating to unclear directions from specialists, an occasional lack of information or pertinent questions delivered to specialist by the PCP, and lack of patient follow-up.⁴¹ Moreover, although the few studies which assessed specialist experiences found them to be positive (i.e., in terms of perceived impact on patient, ease of use, improving access, usefulness), one identified challenge was the potential for an increase in workload for specialists, along with the potential for issues in communication.³⁰ Issues in communication refer to unclear specialist responses or expectations, which may be the result of unclear questions and expectations posed,¹⁵ or from an unclear

Table 4. Description of Technological Platforms

PLATFORM TYPE	LOCATION	DESCRIPTION
Shared health records		
VHA ^{13,15}	United States	eConsults are entered into the EHR, which specialists have access to
Veteran's Affairs ¹⁴	United States	Clinicians request the eConsult within the EHR
UCSF ^{16,17}	United States	Integrated into EMR
Mayo Clinic ^{10,18,19}	United States	Integrated into EMR, which is available to both PCP and specialist
SFGH ^{40,49}	United States	Referring provider completes a query within the SFGH eReferral system, an integrated electronic referral and consultation system within the EHR
Allina Health ⁴⁸	United States	PCPs have the option within the EHR of ordering an eConsult on behalf of their patients; all communications for the eConsult are routed through Allina health's EHR system
CHCI ³⁹	United States	eConsultation module embedded within EHR
Secure web-based portals		
Champlain BASE eConsult ²⁰⁻³²	Canada	PCP logs on the secure web portal and submits the patient information, consultation question, and any attachments
HELP ⁴⁶	United States (global services)	Store-and-forward telemedicine platform, where providers submit relevant clinical information for the review of the NMCP specialist.
AccessDerm ⁵⁰	United States	Mobile SAF platform available through an application for Google Android cellular telephones, iPhones, iPads, and a World-Wide web-based interface
TNMG ³³⁻³⁶	Brazil	TNMG teleconsultation system in its web site
KSYOS Telemedical Center ³⁷	The Netherlands	Uploaded by PCP to secure web-based teleconsultation system (KSYOS)
KPCO ⁵²	United States	eConsults are submitted through a clinical messaging portal enabled by a third party
MSF ^{41,45}	Global	Referrer logs in at https://telemed.msfg.org using any web browser and submits a clinical case
Tele-Derm National ⁴²	Australia	Provider submits the patient case online in Tele-Derm for consultation by dermatologist
MugDerma ⁵¹	Italy and Austria	Provider obtains pictures according to specific guidelines and uploaded in the MugDerma program for teledermatologist analysis
DRAGO ⁴⁷	Spain	Computerized program with access by PCP and specialists, consolidated for clinical use and has a centralized medical record for each patient
KP Safety Net Specialty Care Program ⁵²	United States	Web-based software used to submit consult requests by PCPs. Requests reviewed by specialists within the DHS system.
Secure e-mail-based		
AKO ³⁸	United States and worldwide	Electronic mail system for dermatology teleconsultations. Provider sends an e-mail with the consult to the toxicology e-mail address, which is received by one of the toxicologists

EHR, electronic health record; EMR, electronic medical record.

understanding on how to use the program.⁴¹ Fort et al. reported that many of the specialists participating in the Safety Net Specialty Care eConsult Program in Denver Metropolitan Area believed there was room to expand the program beyond the current volume of eConsults, although this perception varied by department, with high-volume or lower-staff-ratio departments expressing interest in maintaining the program at its current size.⁵²

Discussion

In our updated systematic review of eConsult services worldwide, we viewed eConsult through the lens of the Quadruple Aim Framework, and attempted to assess the impact of this innovative technology on population health, patient experience of care (including quality and satisfaction), provider experience of providing care, and healthcare costs. Similarly to our past review, we found that, while the majority

Table 5. Reducing per Capita Cost of Care

FIRST AUTHOR	YEAR	SPECIALTY	CHARACTERISTICS (a) COMPARISON GROUP (b) TYPE (c) PERSPECTIVE	COST PARAMETERS	RESULTS
Liddy ²²	2015	Champlain BASE eConsult Service	(a) Traditional (b) CA and CMA (c) Health Service	Assessing the direct (i.e., start-up/development costs) and variable costs (associated with supporting eConsult service; includes delivery and consultation costs) of eConsultation. Measured across 3 years.	Total costs per eConsult for year 1: \$131.05; year 2: \$10.34; year 3: \$6.45. Average cost across 3 years per eConsult: \$16.71. Compared with average of \$150 per face-to-face visit. eConsultation will break even when 7,818 eConsults are reached.
Lin ⁴⁶	2016	HELP teleconsultations; Pediatric and Adult (military and civilian families)	(a) Traditional (b) CA and CMA (c) Health Service	Estimating cost savings by examining the number of avoided medevacs (for military) and specialist referrals (for civilians).	From June 2014 to May 2015, estimated cost savings for military (assessed from avoided medevacs) was \$467,181; cost savings for civilians (assessed from avoided specialist referrals) was \$105,400. Estimated monthly savings of \$140,907 (from medevac prevention) and \$28,260 (civilian referral prevention).
Liddy ²³	2016	Champlain BASE eConsult Service	(a) Traditional (b) CA and CMA (c) Societal	Potential societal costs and savings assessed. Potential Societal costs: include direct (costs to payer i.e., delivery, consultation specific, and referral costs) and indirect (costs to patient). Potential Savings: include direct (i.e., costs of avoided referrals) and indirect costs (i.e., avoided travel and productivity losses).	From April 2014 to March 2015, eConsult societal costs (from 3,487 eConsultations) estimated as \$207,787; estimated potential savings of \$246,516. Societal savings of \$38,729 or \$11 per eConsult.
Datta ¹⁴	2015	STFDerm/store-and-forward tele dermatology	(a) Clinical Trial Traditional (b) CA and CMA (c) Department of VA and Societal	Costs of tele dermatological and conventional referrals compared in randomized trial from VA and societal perspectives. Costs included VA (i.e., dermatology clinic visit, intervention, medication, and reimbursed travel costs) and other costs (i.e., productivity loss, travel, dermatology care costs).	VA perspective: Costs for conventional and tele dermatology referrals are comparable. Total cost for conventional referrals was \$66,145 (\$338 per participant). Total cost for tele dermatology was \$59,917 (\$298 per participant). Societal perspective: Costs for tele dermatology referrals are less than conventional referrals. Total cost for conventional referrals was \$106,194 (\$542 per person). Total cost for tele dermatology referrals was \$89,523 (\$460 per participant).
Kirsh ¹²	2015	eConsultation for the VHA	(a) Traditional (b) CA (c) Health Service (VHA)	Cost of travel for F2F consultation (VHA reimburses 41.5 cents per mile) analyzed for those receiving primary care from community-based outpatient clinics (n=95,425).	Patients would have to drive on average 72.1 miles for F2F, resulting in an average cost of \$2,853,387, suggesting savings in this regard for using eConsultation.
Marcolino ³³	2016	Teleconsultation; TNMG	(a) Traditional (b) CA, CMA, and CE (c) Health Service	Assessed number of referrals and 2 main costs: Fixed (i.e., salaries and benefits; not affected by referrals) and variable costs (ex. Transportation) for 2,538,697 telehealth activities. From this they calculated ROI.	Cost for telehealth was \$5.00 USD, cost of F2F was \$56.00. Since 80% of F2F referrals avoided, estimated savings were \$63 million. Since 10.3 million invested, ROI is 6.1 until Dec 2015.

CA, cost analysis; CE, cost-effectiveness; CMA, cost-minimization analysis; ROI, return on investment.

of new research examined outcomes related to patient and provider experience, reporting on population health and cost measures is still limited. In contrast to the previous review, we have found an increased international presence of eConsult and noted that the breadth of specialty services offered has greatly expanded beyond dermatology, with most studies (84%) focused on multispecialty and only a handful of studies addressing a single specialty service.

eConsult services in this review were shown to be effective in terms of providing faster access to specialists advice, with short response times of the participating specialists and resulting in substantial avoidance of face-to-face referral visits. The average/median time for specialists to respond to eConsult requests sent by PCPs ranged from 1 to 6 days.^{11,18,51} Comparing these wait times to those typically experienced with a traditional referral pathway for face-to-face visits with a specialist, which are at least 4 weeks in Canada,¹ eConsults provide a promising alternative.

While a wider breadth of specialty services are now being offered by many eConsult services worldwide, which may enable a wider population to obtain access to specialty care, there are still significant gaps in understanding the impact of the service on population health using traditional measures of mortality, morbidity, and clinical outcomes. Only three articles in this systematic review provided some outcomes in relation to risk and mortality. While an RCT demonstrated the potential of eConsult for reducing adverse cardiovascular outcomes,³⁹ 2 retrospective studies reported potential for harm due to lack of patient follow-up.^{40,41} As the number of patients receiving eConsults increases, linking to healthcare databases to determine impact may be beneficial, despite their shortcomings related to data availability and limitations in their ability to capture the details of clinical encounters across healthcare sectors.^{53,54}

A majority of studies assessed patient experience of care from a PCP perspective, which points to a need to measure patient experience directly. In our own recent study, we interviewed patients who have had an eConsult done on their behalf by their PCP and reported that all patients expressed acceptance for eConsult as a model for improving access to specialist care, had largely positive experiences with it as a model of care delivery, and supported its use in their future care.⁵⁵ It is important that future research includes the patient voice through the incorporation of patient-reported outcomes and the direct measurement of the patient experiences with services such as eConsult that have direct impact on the quality of care they receive.

Findings in this review support the view that eConsult improves the work life of healthcare providers as per the Quadruple

Aim Framework. Unlike other e-health technology solutions, eConsult services show sustained use and spread, high adoption, and little pushback from the providers who use them, as evidenced by high provider satisfaction ratings.²⁵ Furthermore, reports of provider education, quality of responses/feedback, and impact on healthcare support and workload,³⁷ suggest the provider experience is generally positive in these domains and point out that eConsult has the potential to improve overall job satisfaction, retention in remote communities, and provide educational/continuing professional development opportunities.

Although the articles analyzed in this review shed a considerable amount of light on the prevalence and impacts of eConsult, there are a number of limitations to consider. First, the paucity of RCTs reflects the early, emerging nature of this health technology. There is a need for more studies with stronger designs, including more traditional measures of population health. Similarly, the impact of eConsult services on specialists, although deemed fairly positive by a few articles, is another understudied area in need of further attention, especially since there is a potential for increases in workload, which could affect quality of care.³⁰ Finally, in agreement with our previous review, the question of cost effectiveness continues to be underexamined. Only six studies attempted to address and report on the economic impact of eConsult services. All used different methods, ranging from cost analysis, through cost-minimization analysis, to cost effectiveness. In general, these studies yield promising findings in terms of cost savings to the healthcare systems, return of investment, and societal savings. Regardless, studies like those assessed in this review, are useful in assessing and adding to our current understanding, and can be used as an exploratory base for further research.

Conclusions

We assessed the breadth of literature on eConsult through the lens of the Quadruple Aim Framework to guide our narrative synthesis and attempted to assess the impact of this innovative technology on population health, patient experience of care (including quality and satisfaction), provider experience of providing care, and healthcare costs. We characterized the various technology platforms used and confirmed that they still range from services built into existing shared electronic health systems to stand-alone web-based portals. The results to date indicate that eConsult systems have expanded significantly internationally and are largely multiservice in nature. While the majority of new research examined outcomes related to patient and provider experience, the population health and cost measures continue to be limited and require further development.

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Disclosure Statement

The authors have no conflicts of interest to declare, real or perceived.

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