Early experiences with cardiology electronic consults: A systematic review

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Background Many health systems have begun implementing electronic consultation programs. The clinical and financial impact of these programs in cardiology and the potential for more widespread adoption remains unknown.

Objectives To systematically review the current literature related to electronic consultation in cardiology.

Methods Following the PRISMA guidelines, we conducted a systematic review in August 2018 of English literature. We searched PubMed, the Cochrane Library, and Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases for studies related to electronic consultation in cardiology.

Results A total of 21 studies were included. Two of the studies were randomized controlled trials, 16 were quantitative studies with defined endpoints, and 3 were qualitative descriptions. Most studies were conducted in the United States and Canada. The available literature suggests cardiology e-consult programs can be implemented in different practice settings, have good patient and provider satisfaction, deliver greater and timelier access to outpatient cardiac care, and do so in a cost saving fashion. While studies suggest cardiology e-consultation is safe, there are no studies evaluating hard clinical outcomes.

Conclusions Cardiology e-consults appear to be a promising tool for increasing access to outpatient cardiac care. Further investigation is required to evaluate the effects of cardiology electronic consultation on the quality of care.

Condensed abstract Here we present the first systematic review of electronic consultation in cardiology. The available literature suggests cardiology e-consult programs can be implemented in different practice settings, have good patient and provider satisfaction, deliver greater and timelier access to outpatient cardiac care, and do so in a cost saving fashion. While studies suggest cardiology e-consultation is safe, there are no studies evaluating hard clinical outcomes. Overall, cardiology e-consults appear to be a promising tool for increasing access to outpatient cardiac care. Further investigation is required to evaluate the effects of cardiology electronic consultation on the quality of care. (Am Heart J 2019;215:139-46.)

Health care costs in the United States continue to rise, currently accounting for nearly 18% of gross domestic product, or $3.3 trillion.[1] Cardiovascular care makes up over $300 billion of that figure annually, with some forecasting an increase to $1 trillion by 2030.[2,3] One contributor to rising healthcare costs is increasing demand for outpatient specialty care and consultation.[4] From 1999 to 2009, the absolute number of specialty referrals in the US more than doubled, further constraining limited ambulatory care capacity and increasing costs.[5] A predicted shortage of specialist and subspecialist physicians in the coming decades will exacerbate this supply-demand mismatch.[6] Furthermore, some studies classify up to 65% of specialty referrals as inappropriate and providers complain of disjointed communication resulting in lower quality care, extra testing, and increased costs.[7-9]

In addition, government, commercial insurers, and employer payers are all increasingly focused on delivering value-oriented care for beneficiaries, putting pressure on specialists to deliver more cost-effective outpatient care. Many policy initiatives including the establishment of ACOs, bundled payments, meaningful use requirements, and quality reporting are all designed to shift towards value-based care.[10,11] Several health systems have responded to these pressures by using electronic medical record platforms to facilitate access to specialty care and advice for primary care physicians (PCPs).[12] Many of these early pilot programs were created to avoid unnecessary office visits to specialists and to provide more timely consultative

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input. In that context, electronic consultations ("e-consults") have developed rapidly.

Several specialties have explored the utility of e-consults in clinical practice. The clinical and financial impact of these programs, specifically in cardiology, and the potential for more widespread adoption remains unclear. Here, we perform a systematic review in an effort to explore the early experiences with cardiology e-consults. Our objective in this review is to answer four key questions:

1. What do we know about the current design of e-consults within cardiology?
2. What experiences have providers and patients had with cardiology e-consults?
3. How do e-consults differ from traditional face-to-face with respect to the delivery of cardiac care?
4. What are the financial implications of cardiology e-consults?

Methods

This work was supported by grants from the National Institutes of Health and Harvard Catalyst (KL2 TR001100) as well as the American Heart Association (18CDA34110215), both awarded to Dr. Wasfy. The authors are solely responsible for the design and conduct of this study, all study analyses, the drafting and editing of the manuscript, and its final contents.

Data sources

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement. We performed systematic searches in PubMed, the Cochrane Library, and Cumulative Index to Nursing and Allied Health Literature (CINAHL) for titles published in any year. Our initial search strategy focused on keywords for electronic consultation (ie, e-consult, virtual consult, store-and-forward) and keywords for cardiac care. Reference lists of all included titles were reviewed to supplement articles identified from the electronic search. We did not include unpublished conference abstracts in this review.

Inclusion criteria

For the purposes of this systematic review, we defined electronic consultation using 4 basic features: 1) a communication occurs between (at least) two health care providers, 2) the communication is asynchronous, 3) the question and response occurs over a secure electronic medium and is documented as part of the official record, 4) the question and response involves a specific clinical issue. Importantly, this definition excludes other forms of electronic interaction including inpatient e-consults, electronic referrals, and the less formal "curbside" or e-mail messaging.

We originally planned to include only studies dedicated to electronic consultations in cardiology, however our initial search identified relatively few publications. This prompted us to expand our review to include those studies investigating multi-specialty electronic consult systems that clearly include cardiology. We included randomized control trials, empirical studies with defined metrics as well as more descriptive and qualitative studies. We excluded editorials, prior systematic reviews, and non-English articles.

Article selection and data synthesis

A physician (AO) reviewed the titles and abstracts of each article identified by our search terms. Those articles that met eligibility criteria on this first screen were then reviewed in full by a physician (AO) and selected for inclusion. For articles on multi-specialty electronic consults, data extraction and review focused on the portion of the study related to cardiology electronic consultations where possible. We collected information on patient population, setting, and reported outcomes. We did not aim to report specific quantitative outcome measures, but rather to synthesize and summarize qualitative experiences and effects of cardiology electronic consultation on the quality and cost of care.

Results

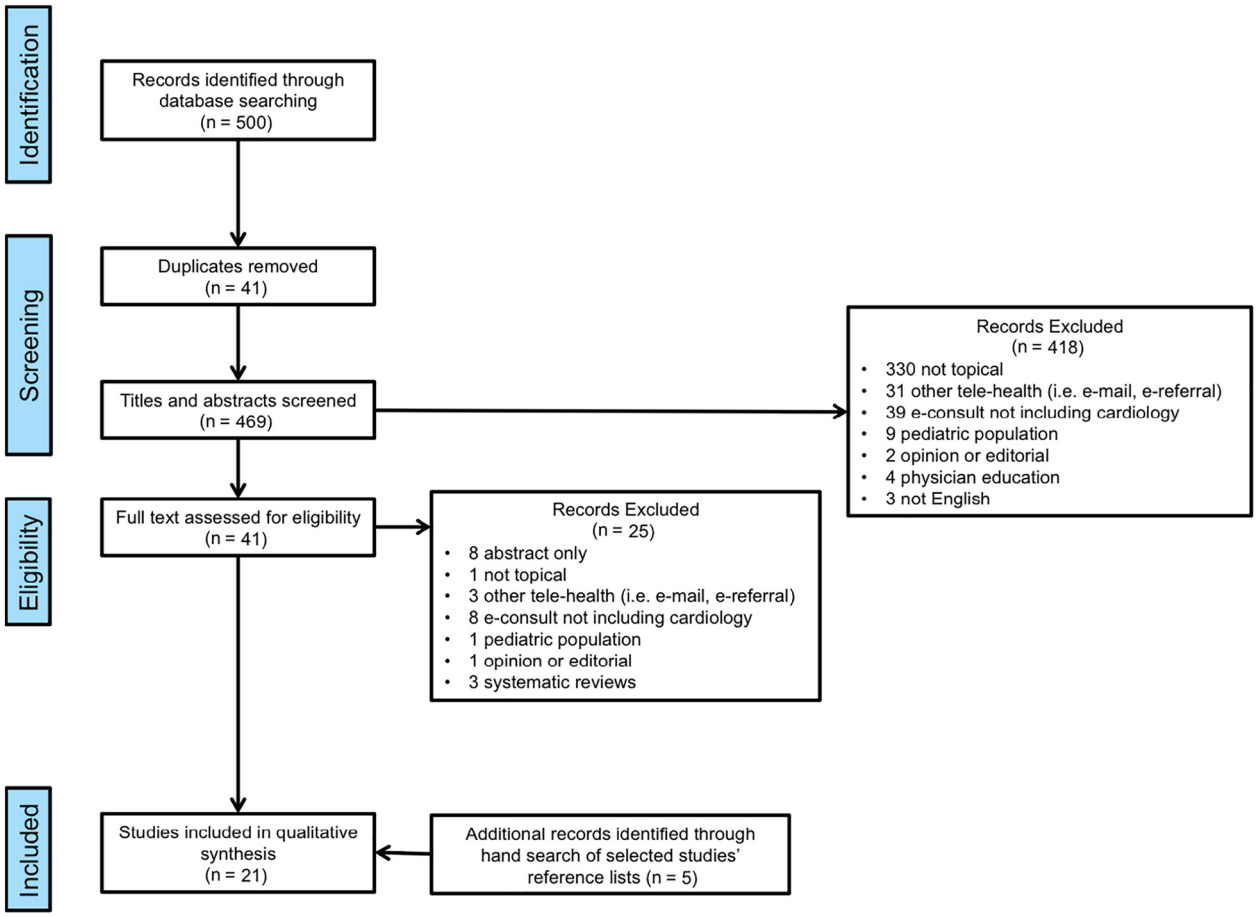
The initial database search identified 41 titles and abstracts meeting inclusion criteria. Upon review of the full-text, 16 articles were selected with an additional 5 articles identified after hand review of these studies' reference lists. The selection process is detailed in the flow diagram (Figure 1).

The 21 articles examined a variety of topics ranging from patient and provider satisfaction with e-consult systems to the impact of e-consults on the cost of care (Table I). The bulk of the literature came from a health network in Ontario, Canada (n = 13).[13-25] In the United States, published experiences with cardiology e-consults came from various single-centers including Community Health Center, Inc. (CHCI) in Connecticut,[26,27] Massachusetts General Hospital in Boston,[28-30] San Francisco General Hospital (SFGH),[31-33] and the Department of Veterans Affairs.[34] Two of the studies were randomized control trials,[26,27] 16 were quantitative studies with defined endpoints, and three were qualitative descriptions of e-consult programs. Six of the articles were focused solely on cardiology,[25-30] while the remainder examined multi-specialty e-consult programs that included cardiology. Eight of the studies took place at a single-center, while the remaining 13 investigated multi-site models. All articles were published between 2009 and 2018.

Current design and variation in approach

Electronic consultation programs exist within diverse health systems, serving different patient populations, and utilize varied workflows and processes. Substantial

Figure 1



PRISMA Flow Diagram. Our systematic literature search followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement. We performed systematic searches in PubMed, the Cochrane Library, and Cumulative Index to Nursing and Allied Health Literature (CINAHL) for titles published in any year. One author (AO) reviewed titles and abstracts to ensure they met the pre-specified inclusion criteria. A total of 21 articles were included in the final review.

literature comes from the electronic consultation experience in the Champlain Local Health Integration Network – a regional health district in Eastern Ontario, Canada serving over 1 million patients.[17] In the United States, 2 programs have published literature specifically related to their experience with cardiology e-consult programs. The first, Massachusetts General Hospital (MGH), is a large, urban, academic medical center serving a diverse patient population.[29] The second, CHCI is a statewide, multisite federally qualified health center in Connecticut serving predominantly Medicaid patients.[26] Other well-developed e-consult programs in the United States include San Francisco Health Network, which is an academic, urban safety-net hospital and the VA, an integrated public system.

While all the programs in this review met the 4 basic features defining electronic consultation, there was variation in approach and process. The Champlain Building Access to Specialists through eConsultation (BASE) program was launched in 2009 in order to improve access to specialty care, including cardiology. The service is an independent e-consultation system built on an existing web-based platform. It allows community PCPs to voluntarily complete an electronic form when deemed clinically appropriate that is then forwarded to the appropriate, non-affiliated specialist. The system allows for iterative communication following the initial consult question. In this program, the PCP is responsible for initiating the consultation, relaying any recommendations and, finally, closing the case.[15]

SFGH has implemented an active referral management (ARM) system.[33] Under this system, primary care providers, located either in the hospital or the community, utilize a web-based portal integrated into the hospital's electronic health record (EHR) to place a consult request.

Table I. Characteristics of included studies

First author (year)	Setting	Type of service	Study design	Study size	Outcomes
Anderson (2018)	USA	Cardiology	RCT	590 patients 36 PCPs 3 Cardiologists	Total cost
Chittle (2015)	USA	Cardiology	Chart review	54 patients	Patient and provider satisfaction
Keely (2015)	Canada	Multi-specialty	Survey	34 specialty clinicians	Provider satisfaction
Kim (2009)	USA	Multi-specialty	Survey	368 PCPs	Provider satisfaction
Kim-Hwang (2010)	USA	Multi-specialty		505 specialty clinicians	Referral appropriateness; need for and avoidability of follow-up visit
Liddy (2016)	Canada	Multi-specialty	Mixed methods	3686 PCPs 574 NPs	E-consultation referral patterns, experience, and satisfaction based on provider type (ie NP vs PCP)
Liddy (2017)	Canada	Multi-specialty	Cross-sectional	594 e-consults	E-consult response time Provider satisfaction Overall program cost
Liddy (2015)	Canada	Multi-specialty	Survey	2052 e-consults	Provider satisfaction
Liddy (2016)	Canada	Multi-specialty	Cross-sectional	1796 patients over 65yo	E-consult response time Provider satisfaction Need for follow-up face-to-face visit
Liddy (2017)	Canada	Multi-specialty	Cross-sectional	5601 e-consults	Percentage of prompted e-consults (ie would not have otherwise been made) Clinical question and process measures associated with prompted consults
Liddy (2018)	Canada	Multi-specialty	Cross-sectional	14,105 e-consults	E-consult system utilization data over time
Liddy (2018)	Canada	Multi-specialty	Mixed methods	28,838 e-consults	Patient and provider satisfaction Cost (total system, per capita) Provider adoption and utilization Patient safety
Liddy (2016)	Canada	Multi-specialty	Economic	3487 e-consults	Net societal cost savings
Liddy (2015)	Canada	Multi-specialty	Economic	2606 e-consults	Total cost
Liddy (2016)	Canada	Multi-specialty	Economic simulation	3670 e-consults	Total and per e-consult cost based on physician remuneration structure
Liddy (2017)	Canada	Multi-specialty	Cross-sectional	165 patients 19 PCPs 55 specialty clinicians	Utilization statistics Costing evaluation
McAdams (2014)	USA	Multi-specialty	Descriptive/qualitative	Not specified	Understand implementation of e-consult system at a VA health center
Olayiwola (2016)	USA	Cardiology	RCT	590 patients 36 PCPs	Time to consultation with cardiologist Completion rate of e-consult Number of face-to-face visits Adverse events
Skieth (2017)	Canada	Cardiology	Cross-sectional	162 e-consults	Patient and provider demographic data Consultative-specific data Impact on provider referral patterns
Wasfy (2014)	USA	Cardiology	Descriptive	78 e-consults 62 PCPs	Utilization statistics E-consult question type Provider satisfaction
Wasfy (2017)	USA	Cardiology	Chart review	165 e-consults	Trends in E-consult utilization and volume Safety and adverse events Clinical and demographic differences in e-consults and traditional consults

In contrast to the Champlain BASE program, all requests for specialty consultation must go through this process. Next, a clinician reviewer sorts referrals into various categories: those to be managed by the referring provider with electronic guidance and recommendations from the specialist, those requiring a face-to-face visit with the specialist, and those requiring further testing or work-up prior to either an in-person or electronic visit. The VA, which began implementing e-consults in 2011, utilizes a similar process for referrals to 50 medical specialties in over 150 medical centers and 800 community-based clinics nationwide.[34]

At Massachusetts General Hospital, the cardiology e-consult program was started in 2014. In that system, referring providers and patients together choose between a traditional face-to-face consult and an e-consult. If an e-consult is placed, the consulting cardiologist reviews available clinical data, including primary imaging data,

and provides detailed management recommendations in the EHR, which are ultimately conveyed to the patient by the PCP.[28]

These variations in design and submission workflow may have significant impact on uptake and utilization by participating providers. For example, the e-consultation program at SFGH, which is mandatory for all requests for specialty care, has experienced universal adoption by PCPs, compared to only 75% uptake in the voluntary Champlain BASE experience.[35]

Satisfaction

E-consults have generally been associated with high levels of satisfaction among both patients and providers. Survey data from the MGH cardiology e-consult program found that 100% of patients were 'very' or 'somewhat' satisfied, while similar data from the vascular Medicine e-consult program revealed a patient satisfaction score of over 90%.[29,30] Primary care providers similarly tend to have very high levels of satisfaction. In the Champlain BASE experience, PCPs reported high value for their patients and themselves in over 90% of e-consults.[16] These high levels of satisfaction are driven by both perceived improvements in workflow (i.e. shorter wait times, convenience) and clinical care (i.e. better access to specialty input, improved communication, educational value). Specialists have also largely been satisfied with e-consultation programs. Survey data suggests improved access to specialty care, better communication between providers, and educational value for PCPs as three reasons for specialist satisfaction. In this same study, 88% of specialists felt that the e-consultation program should be expanded.[24]

Clinical care

Important clinical differences seem to exist between traditional consults and e-consults. It appears different types of providers may have different thresholds for placing e-consults, with attending physicians being more likely than residents who are in turn more likely than physician assistants and nurse practitioners.[31] Another study comparing referral patterns of primary care physicians and nurse practitioners in a multi-specialty e-consult system found that PCPs directed a larger percentage of their consults to cardiology compared to NPs.[14] Practice environment may similarly influence likelihood for placement of an electronic consult, with physicians practicing in hospital-based clinics outnumbering community clinics in at least one study.[31] There may also be differences in the types of patients referred for electronic consultation. One study of a cardiology e-consult program found that patients who received e-consults were on average 5.1 years younger than those who received traditional consults, however, there did not appear to be gender differences.[29] Finally, the type of clinical question asked varies, with e-consults lending themselves to questions about abnormal test results or laboratory data that rely less heavily on physical examination or procedures. In two separate cardiology studies, the most common reason for an e-consult was abnormal electrocardiogram or echocardiogram findings.[27,28]

Other studies have examined the effect of cardiology electronic consultation on certain process measures. One randomized controlled trial evaluating the effects of cardiology e-consultation on wait time and access to specialty care found that the median wait time to consultation was just 5 days in the e-consult arm, compared to 24 days in the control arm. Furthermore, just 14% of patients had not seen a cardiologist within 31 days of the e-consult being placed, compared to 38 days for traditional consult requests.[27] Another study found that electronic consultation successfully improved access to specialty care for the elderly.[17] Finally, there is reason to believe that cardiology e-consultation might improve access for medically underserved patients in rural locations. While this has been seen with certain telehealth programs and may apply to electronic consultation, evidence found in these papers is currently lacking.[36]

At the time of this systematic review there are no studies evaluating definitive clinical outcomes such as mortality or myocardial infarction associated with cardiology e-consults. With that said, in both the MGH (n = 329) and the UCHC (n = 120) cardiology programs, a review of medical records did not show any evidence to suggest patients managed through electronic consultation had increased rates of adverse events; however in both instances detection of events was limited to records accessible within the system's EHR.[27,29]

Economics and financial impact

The literature suggests that e-consults have the potential to save costs through a number of possible mechanisms. First, they are less expensive and necessitate fewer resources than traditional office visits. While the absolute cost of an e-consult is still being defined and varies based on reimbursement structure and physician specialty, one study estimated the cost per consult to be between $45 and $60.[21] The MGH experience with cardiology e-consults estimated that replacing a traditional visit with an e-consult results in overall savings in provider charges of nearly $125 (based on a cost of $52 per e-consult).[29] Second, allowing specialists to review and triage consults based on the clinical scenario may result in a reduction in avoidable specialty visits, saving face-to-face encounters for those patients who benefit most – for example pre- or post-procedure visits. In one study, in 40% of cases the PCP had originally considered a face-to-face specialty visit that was ultimately avoided as a result of e-consultation. Specific to cardiology, the VA Boston found that approximately one-third of cardiology e-consults avoided traditional referrals with a face-to-face visits.[34] In the MGH cardiology e-consult experience, only one fourth of patients who received an e-consult return to traditional cardiology care. Similarly, patients that ultimately

have a face-to-face visit with a specialist following an e-consult, may be less likely to require follow-up appointments because they receive a more extensive pre-visit work-up under the e-consult system. Finally, electronic consultation may reduce duplicative or otherwise unnecessary tests and procedures. An RCT evaluating the economic impact of the CHCI cardiology e-consult program demonstrated a net reduction in overall outpatient procedures for patients in the e-consultation arm compared to the usual care arm.[26]

A number of recent studies have attempted to estimate the overall cost consequences of electronic consults. One study evaluating a multi-specialty e-consult system in Canada estimated that e-consults led to a net societal saving of $11 per e-consult.[20] A randomized controlled trial evaluating the cost consequences of cardiology e-consults for 590 Medicaid patients concluded that cardiology e-consults reduced total healthcare costs. Specifically, giving PCP's the option to place cardiology e-consults resulted in a $466 decrease in total costs per Medicaid beneficiary compared with traditional face-to-face visits.[26]

While e-consult utilization is expanding, policy regarding reimbursement for these services continues to evolve. Examples of existing reimbursement schemes include fee-for-service, pro-rated hourly rates, workload credits, and the use of salaried physicians.[31,33] In January 2019 Centers for Medicare & Medicaid Services (CMS) introduced new Current Procedural Terminology (CPT) codes to allow direct payment to physicians for electronic consultation through Medicare.[37] Connecticut's Medicaid program has also begun reimbursing for e-consults.[38] Many commercial health insurers have also begun reimbursing for electronic consultation.[39,40] The specific reimbursement mechanism for specialists has implications for both overall cost and ease of implementation.[21] Additionally, specialist satisfaction with reimbursement structure and amount has varied.[24]

Discussion

While cardiology e-consult programs are growing, definitive conclusions are limited by relatively short experience in a select number of diverse institutions. Early reports suggest that cardiology e-consult programs can be successfully implemented in varied practice settings with high patient and provider satisfaction. Cardiology e-consults appear to improve access to specialty care and reduce wait times. While studies suggest that e-consultation is safe, rigorously determining how e-consults affect clinical outcomes as compared to the traditional model will be essential. Other clinical outcomes besides overt adverse events, for example relief of symptoms, will be important to include in any assessment. At least initially, surveying participants and continuing to monitor for adverse events may be the most realistic way to answer this question given the high variability of clinical questions and difficulty in determining meaningful clinical endpoints in the ambulatory setting. As programs become more robust, with higher volumes, and streamlined processes, randomized-controlled trials comparing traditional and electronic-consultation with respect to clinical end points such as myocardial infarction will be important.

Understanding the financial implications of e-consults is also critical as the demand for and cost of cardiology care continues to rise. The studies reviewed in this article, including one randomized control trial, demonstrate that cardiology e-consults are associated with cost savings. However, the limited number of studies have been conducted within varied health care systems with different business models and reimbursement strategies, reducing their external validity. Lastly, finding the most appropriate time for physicians to complete e-consultations will be critical. By virtue of their design, cardiologist can perform e-consults during unanticipated gaps in time, offering increased flexibility with respect to the timing of completion.

New payment policies are requiring providers to re-think how specialty services – including cardiology – should be delivered. The organizational and reimbursement structure of policy initiatives like ACOs and bundled payments provide new incentives for providers to reduce costs.[41,42] By allowing specialists to screen appointments based on appropriateness, necessity, and urgency, while also aiding and empowering primary care physicians to more fully manage their patients without unnecessary face-to-face specialty visits, e-consults provide a compelling response to the new policy landscape.[43,44] As pointed out in a policy brief from the Commonwealth Fund, national health policy could further promote the use of e-consult technology by including it as part of the meaningful use objectives in the Health Information Technology for Economic and Clinical Health Act.[45] Finally, CMS recently issued a proposed rule that would allow separate Medicare payments for certain physician-to-physician electronic communication, such as e-consults.[37] Final approval of this rule could lead to substantial growth in cardiology e-consult programs.

Limitations

The studies in this systematic review originated from a relatively small sample of health systems, limiting the generalizability of our findings. Our review was limited to peer-reviewed literature and therefore may have overlooked other e-consult systems and publications of interest. Finally, the majority of our studies evaluated multi-specialty e-consult systems that included cardiology. Future investigation should aim to examine quality and cost outcomes of dedicated cardiology e-consult systems.

Conclusion

Early experience with cardiology e-consults suggests that e-consults can be successfully implemented in different practice settings with high patient and provider

satisfaction. E-consultation may be able to provide greater and timelier access for patients who require cardiology consultation. The appropriateness of individual consults and their effect on hard clinical end-points should be further evaluated to understand how cardiology e-consults influence the quality of care. Finally, cardiology e-consults appear to result in absolute cost savings. Cardiology seems well suited to lead in the further exploration and adoption of e-consults. The overall cost of care is high and access is constrained, requiring more efficient care models in the ambulatory setting. In that context, e-consults could emerge as a genuinely disruptive tool in outpatient cardiology.

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