

REVIEWS

Provider-to-Provider Electronic Communication in the Era of Meaningful Use: A Review of the Evidence

Colin Walsh, MD^{1,2*}, Eugenia L. Siegler, MD³, Erin Cheston, MPA⁴, Heather O'Donnell, MD, MSc⁵, Sarah Collins, RN, PhD^{6,7,8}, Daniel Stein, MD, MA¹, David K. Vawdrey, PhD¹, Peter D. Stetson, MD, MA^{1,2,4}, for the Informatics Intervention Research Collaboration (I2RC)

¹Department of Biomedical Informatics, Columbia University, New York, New York; ²Department of Medicine, Columbia University, New York, New York; ³Division of Geriatrics and Gerontology, Weill Cornell Medical College, New York, New York; ⁴ColumbiaDoctors, New York, New York; ⁵Department of Pediatrics, Albert Einstein College of Medicine/Children's Hospital at Montefiore, New York, New York; ⁶Partners Healthcare Systems, Well-esley, Massachusetts; ⁷Brigham and Women's Hospital, Division of General Internal Medicine and Primary Care, Boston, Massachusetts; ⁸Harvard Medical School, Boston, Massachusetts.

BACKGROUND: Electronic communication between providers occurs daily in clinical practice but has not been well studied.

PURPOSE: To assess the impact of provider-to-provider electronic communication tools on communication and healthcare outcomes through literature review.

DATA SOURCES: Ovid MEDLINE, PubMed, Google Scholar, Cumulative Index to Nursing and Allied Health Literature, and Academic Search Premier.

STUDY SELECTION: Publication in English-language peer-reviewed journals. Studies provided quantitative provider-to-provider communication data, provider satisfaction statistics, or electronic health record (EHR) communication data.

DATA EXTRACTION: Literature review.

DATA SYNTHESIS: Two reviewers conducted the title review to determine eligible studies from initial search

results. Three reviewers independently reviewed titles, abstracts, and full text (where appropriate) against inclusion and exclusion criteria.

LIMITATIONS: Small number of eligible studies; few described trial design (20%). Homogeneous provider type (physicians). English-only studies.

CONCLUSIONS: Of 25 included studies, all focused on physicians; most were observational (68%). Most (60%) described electronic specialist referral tools. Although overall use has been measured, there were no studies of the effectiveness of intra-EHR messaging. Literature describing the effectiveness of provider-to-provider electronic communications is sparse and narrow in scope. Complex care, such as that envisioned for the Patient Centered Medical Home, necessitates further research. *Journal of Hospital Medicine* 2013;8:589–597. © 2013 Society of Hospital Medicine

INTRODUCTION

Coordination of care within a practice, during transitions of care, and between primary and specialty care teams requires more than data exchange; it requires effective communication among healthcare providers.^{1–3} In clinical terms, data exchange, communication, and care coordination are related, but they represent distinct concepts.⁴ Data exchange refers to transfer of information between settings, independent of the individuals involved, whereas communication is the multistep process that enables information exchange between two people.⁵ Care coordination, as defined by O'Malley, is “integration of care in consultation with patients, their families and caregivers

across all of a patient's conditions, needs, clinicians and settings.”³

Strong collaboration among providers has been associated with improved patient outcomes.^{2,6} Yet, despite the significant role of communication in healthcare, communication may not take place at all, even at high-stakes events like transitions of care,^{7,8} or it may be done poorly at the risk of substantial clinical morbidity and mortality.^{9–16}

Proof of the global effectiveness of health information technology (HIT) to improve patient care is lacking, but data from some studies demonstrate real improvements in quality and safety in specific areas,^{17–19} especially with computerized physician order entry²⁰ and electronic prescribing.²¹

The limited information about the effect of HIT on communication focuses largely on the anticipated improvements in patient-physician communication^{22–27}; provider-to-provider communication within the electronic domain is not as well understood. A recent review of interventions involving communication devices such as pagers and mobile phones found limited high-quality evidence in the literature.²⁸ Clinicians have described what they consider to be key characteristics of clinical electronic communications systems

*Address for correspondence and reprint requests: Colin Walsh, MD, Instructor in Clinical Medicine, Department of Medicine, Postdoctoral Fellow, Department of Biomedical Informatics, Columbia University, 622 W 168th St, VC5-538, New York, NY 10032; Telephone: 212-342-1644; Fax: 212-305-3302; E-mail: cgw2106@columbia.edu

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such as security/reliability, cross coverage, overall convenience, and message prioritization.²⁹ Although the electronic health record (EHR) is expected to assist with this communication,³⁰ it also has the potential to impede effective communication, leading physicians to resort to more traditional “workarounds.”^{31–33}

Measuring and improving the use of EHRs nationally were driving forces behind the creation of the Meaningful Use incentive program in the United States.³⁴ To receive the incentive payments, providers must meet and report on a series of measures set in three stages over the course of five years.³⁵ In the current state, Meaningful Use does not reward provider-to-provider communication within the EHR.^{36,37} The main communication objectives for stages 1 and 2 concentrate on patient-to-provider communication, such as patient portals and patient-to-provider messaging.^{36,37}

Understanding the current evidence for provider-to-provider communication within EHRs, its reported effectiveness, and its shortcomings may help to develop a roadmap for identifying next-generation solutions to support coordination of care.^{38,39} This review assesses the literature regarding provider-to-provider electronic communication tools (as supported within or external to an EHR). It is intended as a comprehensive view of studies reporting quantitative measures of the impact of electronic communication on providers and patients.

METHODS

Definitions and Conceptual Model of Provider-to-Provider Communication

We conducted a systematic review of studies of provider-to-provider electronic communication. This review included only formal clinical communication between providers and was informed by the Coiera communications paradigm.⁵ This paradigm consists of four steps: (1) task identification, when a task is identified and associated with the appropriate individual; (2) connection, when an attempt is made to contact that person; (3) communication, when task-specific information is exchanged between the parties; and (4) disconnection, when the task reaches some stage of completion.

Literature Review

We examined written electronic communication between providers including e-mail, text messaging, and instant messaging. We did not review provider-to-provider telephone or telehealth communication, as these are not generally supported within EHR systems. Communication in all clinical contexts was included among providers within an individual clinic or hospital and among providers across specialties or practice settings.⁴⁰ We excluded physician handoff communication because it has been extensively reviewed elsewhere and because handoff occurs

TABLE 1. Search Strategies

Database	Strategy	Items Reviewed
Ovid MEDLINE	Query terms: exp medicine/ or physicians or exp outpatient clinics/ or exp hospitals/ AND *communication/ or *computer communication networks/ or *interprofessional relations/ or *continuity of patient care/ AND electronic mail or referral and consultation or text messaging/ or reminder systems.	1513
PubMed	Healthcare, provider, communication, messaging, e-mail, texting, text messaging, instant messaging, paging, coordination, referral, EHR, EMR, electronic health record, electronic medical record, electronic, and physician. Excluding patient-provider and patient-physician	340
Google Scholar	Physician-physician electronic communication excluding physician-patient	940
CINAHL	Medical records and communication; or computerized patient records and communication	None
Academic Search Premier (peer-reviewed journals)	Electronic health record and communication Communication and electronic health record Physician-physician communication Physicians and electronic health records	54 80 2 88

NOTE: Abbreviations: CINAHL, Cumulative Index to Nursing and Allied Health Literature; EHR, electronic health record; EMR, electronic medical record; exp, explode. *Focus.

largely through verbal exchange not recorded in the EHR.^{41,42} Communication from clinical information systems to providers, such as automated notification of unacknowledged orders, was also excluded, as it is not within the scope of provider-to-provider interaction.

Data Sources and Searches

A comprehensive literature search was conducted in Ovid MEDLINE with the input of a medical librarian, and a parallel search was performed using PubMed. The Ovid MEDLINE query and parallel database search terms are documented in Table 1. Subsearches were conducted in Google Scholar, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Academic Search Premier for peer-reviewed journals. Subsequent studies citing the initially detected articles were found through citation maps.

Study Selection

Paper Inclusion Criteria

Requirements included publication in English-language peer-reviewed journals. Included studies provided quantitative provider-to-provider communication data, provider satisfaction statistics, or EHR communication data. Provider-to-staff communication was also included if it fell within the scope of studies of communication between providers.

Paper Exclusion Criteria

Studies excluded in this review were articles that reviewed EHR systems without any focus on

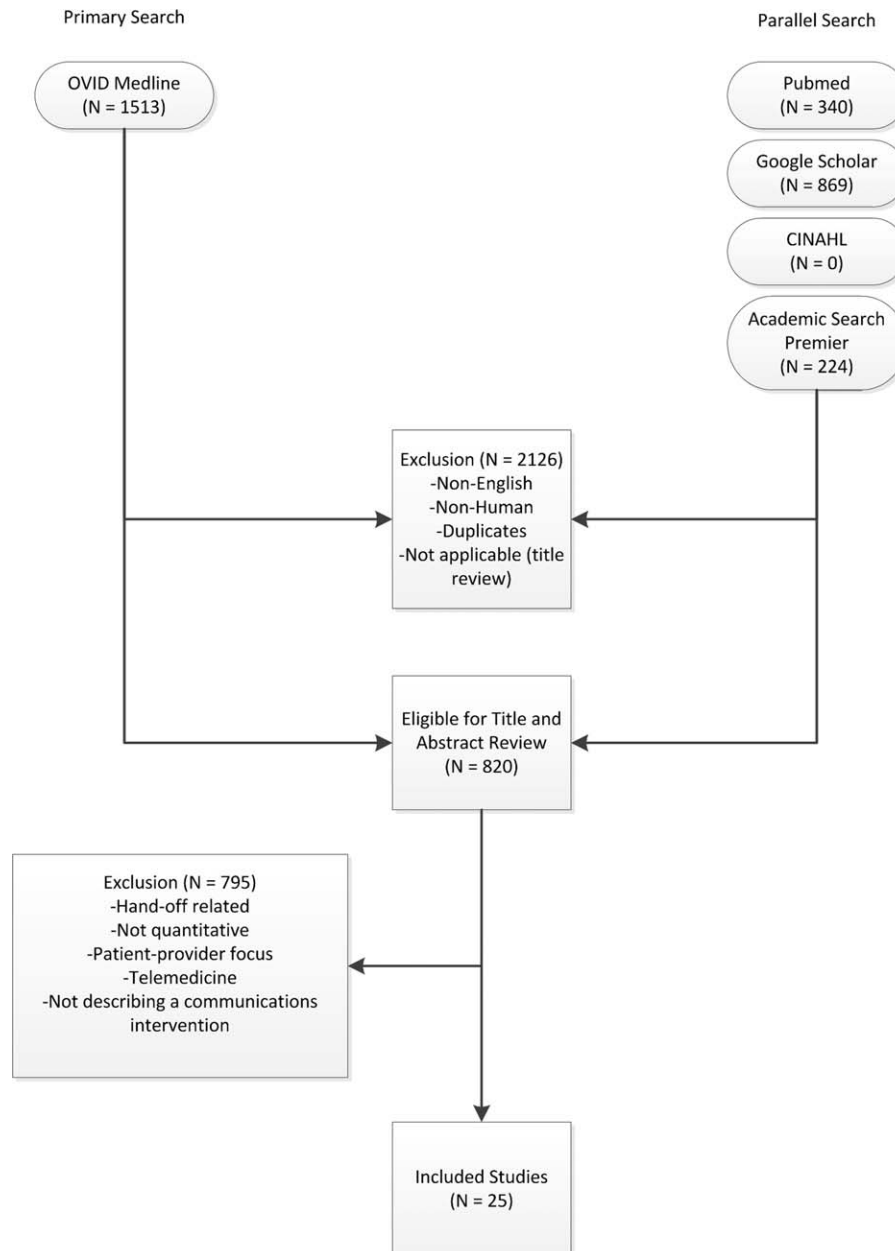


FIG. 1. Literature flow diagram. Abbreviations: CINAHL, Cumulative Index to Nursing and Allied Health Literature.

communication between providers and those that discussed EHR models and strategies but did not include actual testing and quantitative results. Results that included nontraditional online documents or that were found on non-peer-reviewed websites were also discarded. Duplicate records or publications that covered the same study were also removed. The most common reason for exclusion was the lack of quantitative evaluation.

Data Extraction and Quality Assessment

Three authors (Walsh, Siegler, Stetson) reviewed titles and abstracts of resultant studies against inclusion and exclusion criteria (Figure 1). Studies were evaluated qualitatively and findings summarized. Given the het-

erogeneous nature of data reported, statistical analysis was not possible.

RESULTS

The primary and parallel searches produced 2946 results that were weaned through title review and exclusion of duplicates, non-English-language, and nonhuman studies to 820 articles for title and abstract review (Figure 1). After careful review of the articles' titles, abstracts, or full content (where appropriate), twenty-five articles met inclusion criteria and presented data about provider-to-provider electronic communication, either within an EHR or through a system designed to promote provider-to-provider communication. All of the studies that met inclusion

TABLE 2. Studies of Electronic Provider-to-Provider Communication by Clinical Need

Primary Author, Year	Design	Intervention	Measurement	Results
Need: Communicate care across clinical settings (inpatient-outpatient)				
Branger, 1992 ⁴⁶	Observational study	Introduction of electronic messaging system in the Netherlands between hospital and PCPs.	Satisfaction survey data using Likert scale of "usefulness."	Free text messaging to exchange patient data was rated "very useful" or "useful" by 20 of 27 PCP respondents.
Reponen, 2004 ⁶⁶	Observational study	Finnish study of electronic referrals—XML messages between EHRs or secure web links.	User questionnaire. No description of respondents was provided.	Internists surveyed estimated that electronic referrals accelerate the referral process by 1 week.
Need: Communicate care across specialties (primary care physicians-specialists)				
Kooijman, 1998 ⁶⁷	Observational study	Survey of 45 PCPs who received notes from specialists via Electronic Data Interchange.	User questionnaire with 5-point Likert scale of satisfaction, from 1 ("much better") to 5 ("much worse").	Highest satisfaction scores for speed (1.5–1.8) and efficiency (1.5–1.7) for electronic messages, with lower scores for reliability (2.5–2.7) and clarity (2.5).
Harno, 2000 ⁴⁸	Nonrandomized trial	Eight-month prospective comparative study in Finland of outpatient clinics in hospitals with and without intranet referral systems.	Comparison of numbers of electronic referrals, clinic visits, costs.	There were 43% of electronic referrals and 79% of outpatient referrals that resulted in outpatient visits. A 3-fold increase in productivity overall and 7-fold reduction in visit costs per patient using e-mail consultation.
Moorman, 2001 ⁴⁷	Observational study	Supersedes Branger, 1999. ⁶⁸ Analyzes intra-EHR communications between PCPs and consultant in Netherlands re: diabetes management of patients (1994–1998).	Descriptive statistics of number of messages, content, whether message had been copied into EMR; survey of PCPs (12 of 15 responded).	Decline in integration by PCPs of messages in the EHR from 75% to 51% over first 3 years. Despite this, most PCPs wanted to extend messaging to other patient groups.
Bergus, 2006 ⁶⁹	Observational study	Follow-up of Bergus, 1998 ⁵⁴ ; evaluated formulation of clinical referrals to specialists at the University of Iowa by retrospective review of e-mail transcripts.	Analyzed taxonomy of clinical questions; assessed need for clinical consultation of 1618 clinical questions.	Specialists less likely to recommend clinic consultation if referral specified the clinical task (OR: 0.36, $P < 0.001$), intervention (OR: 0.62, $P = 0.004$), or outcome (OR: 0.49, $P < 0.001$). This effect was independent of clinical content ($P > 0.05$).
Dennison, 2006 ⁷⁰	Pilot study	Construction of an electronic referral pro forma to facilitate referral of patients to colorectal surgeons.	Descriptive statistics. Comparisons of patient attendance rate, delays to booking and to actual appointment between 54 electronic referrals and 189 paper referrals.	Compared to paper referrals, electronic referrals were booked more quickly (same day vs 1 week later on average) and patients had lower nonattendance rates (8.5% vs 22.5%). Both results stated as statistically significant, but P values were not provided.
Shaw, 2007 ⁴⁹	Observational study	Dermatology electronic referral in England.	Content of 131 electronic vs 139 paper referrals to dermatologists (NHS Choose and Book). ⁷¹	Paper superior to electronic for clinical data such as current treatments (included in 68% of paper vs 39% of electronic referrals, $P < 0.001$); electronic superior for demographic data.
Gandhi, 2008 ⁵⁰	Nonrandomized trial	Electronic referral tool in the Partners Healthcare System in Massachusetts that included a structured referral-letter generator and referral status tracker. Assigned to 1 intervention site and 1 control site.	Survey assessment. Fifty-four of 117 PCPs responded (46%), 235 of 430 specialists responded (55%), 143 out of 210 patients responded (69%).	Intervention group showed high voluntary adoption (99%), higher information transfer rates prior to subspecialty visit (62% vs 12%), and lower rates of conflicting information being given to patients (6% vs 20%).
John, 2008 ⁷²	Pilot study	Validation study of the Lower Gastrointestinal e-RP (through the Choose and Book System in the United Kingdom) intended to improve yield of colon cancers diagnosed and to reduce delays in diagnosis.	Comparison of actual to simulated referral patterns through e-RP for 300 patients divided into colorectal cancer, "2-week wait" suspected cancer, and routine referral groups.	e-RP was more accurate than traditional referral at upgrading patients who had cancer to the appropriate "suspected cancer" referral group (85% vs 43%, $P = 0.002$).
Kim, 2009 ⁷³	Observational study	Electronic referrals via a portal to San Francisco General Hospital. Included reply functionality and ability to forward messaging to a scheduler for calendaring.	Impact of electronic referral system as measured by questionnaire to referring providers. A total of 298/368 participated (24 clinics); 53.5% attending physicians.	Electronic referrals improved overall quality of care (reported by 72%), guidance of presubspecialty visit (73%), and the ability to track referrals (89%). Small change in access for urgent issues (35% better, 49% reported no change).
Scott, 2009 ⁷⁴	Pilot study	Pilot of urgent electronic referral system from PCPs to oncologists at South West Wales Cancer Centre.	Satisfaction statistics (10-point Likert scale) collected from PCPs via interview.	Over 6 months, 99 referrals submitted; 81% were processed within 1 hour with high satisfaction scores.
Were, 2009 ⁷⁵	Nonrandomized trial	Geriatrics consultants were provided system to make electronic recommendations ("consultant-recommended orders") in the native CPOE system along with consult notes in the intervention vs consult notes alone in the control.	Rates of implementation of consultant recommendations. Qualitative survey of users of the new system.	Higher total number of recommendations (247 vs 192, $P < 0.05$) and higher implementation rates of consultant-recommended orders in the intervention group vs control (78% vs 59%, $P = 0.01$). High satisfaction scores on 5-point Likert scale for the intervention system with good survey response rate (83%).
Dixon, 2010 ⁵²	Observational study	Comparison of 2 extra-EHR systems (NHS Choose and Book, Dutch ZorgDomein) for booking referrals. Patients choose doctor or hospital and the system transfers demographic and clinical information between PCP and specialist.	National data, patient and provider surveys, focus groups, observational studies. Focus was on patient choice, but evaluations included all aspects of the systems.	Resistance from PCPs during implementation; 78% of ZorgDomein PCPs felt referrals took more time; general displeasure on the part of specialists re: quality of referrals, although not quantified.
Patterson, 2010 ⁵¹	Observational study	E-mail referral system to a neurologist in Northern Ireland. Referrals were template based and recorded as clinical episode in the patient administration system. Comparison of this system to conventional referrals to another neurologist.	Evaluated effectiveness, cost, safety for period 2002–2007.	Decreased referral wait times (4 vs 13 weeks) and 35% cost reduction per patient for the e-mail referral vs conventional referrals. No diminution in safety. Limitation: single neurologist participated.
Singh, 2011 ⁷⁶	Observational study	Chart review of electronic referrals to specialist practices in a Veterans Affairs outpatient system.	Follow-up actions taken by subspecialists within 30 days of receiving referral.	An intra-EHR referral system was still affected by communication breakdowns. Of 61,931 referrals, 36.4% were discontinued for inappropriate or incomplete referral requests.

TABLE 2. Continued

Primary Author, Year	Design	Intervention	Measurement	Results
Kim-Hwang, 2010 ⁷⁷	Observational study	Electronic referrals via a portal to San Francisco General Hospital. Follow-up to Kim, 2009. ⁷³	Survey of medical and surgical subspecialty consultants.	Statistically significant differences in clarity of consult request in both medical and surgical clinics, in decreased inappropriate referrals in surgical clinics, in decreased use of follow-up appointments by surgical specialists, and in decreased avoidable follow-up surgical visits.
Warren, 2011 ⁵³	Observational study	Electronic referrals from general medical practices to public referral network of Hutt Hospital in New Zealand (2007–2010).	Retrospective analysis of transactional data from messaging system and from general inpatient tracking system. Qualitative data collection via interviews.	Estimated 71% of 10,367 referrals were electronic referrals over 3 years. Statistically significant improvement in referral latency without change in staffing. Clinicians appreciate shared transparency of referrals but cite usability issues as barriers.
Need: Curbside consults (primary care physicians-specialists)				
Bergus, 1998 ⁵⁴	Observational study	Evaluation of the ECS for curbside consultations between family physicians and subspecialists.	Descriptive statistics of usage data; survey of users.	Median response time 16.1 hours; 92% of questions answered; almost 90% concerned specific patients. Both groups expressed satisfaction.
Abbott, 2002 ⁵⁵	Observational study	Evaluation of Department of Defense "Ask a Doc" physician-to-physicians e-mail consultation system over network of 21 states (1998–2000).	Descriptive statistics; qualitative assessment.	There were 3121 consultations. Average response time <12 hours. Minimal cost and effort to initiate and sustain. Felt to mirror clinical practice. Barriers were security and assignment of credit for consultation.
Need: Communication of results (primary care physicians -specialists)				
Singh, 2007 ⁵⁶	Nonrandomized trial	Concurrent prospective evaluation of responses to 1017 critical imaging alert notifications in a Veterans Affairs outpatient system (2006). Radiologists generated alerts. Included receipt system.	Measured percentage of unacknowledged alerts and imaging lost to follow-up.	There were 368 of 1017 transmitted alerts unacknowledged (36%); 45 were completely lost to follow-up. There were 0.2% outpatient imaging results lost to follow-up overall.
Singh, 2009 ⁵⁷	Nonrandomized trial	Concurrent evaluation of responses to 1196 critical imaging alert notifications in a Veterans Affairs outpatient system (2007–2008). Similar coding system to Singh, 2007. ⁵⁶	Measured percentage of alerts acknowledged, timely follow-up; compared electronic alerts alone to combination of alerts and phone calls or admission.	Percentage of alerts acknowledged did not differ by type of communication; combination of electronic alerts with phone follow-up (OR: 0.12, $P < 0.001$) or admission (OR: 0.22, $P < 0.001$) decreased likelihood of delayed follow-up. Alerts to 2 providers increased the likelihood of delayed follow-up (OR: 1.99, $P = 0.03$).
Abujudeh, 2009 ⁵⁸	Observational study	Retrospective review of e-mail-based alert system for abnormal imaging results at Massachusetts General Hospital 2005–2007. E-mail alerting by radiologist to ordering physician of nonurgent findings.	Descriptive statistics; survey of referring physicians (12/26).	There were 56,691 out of 1,540,254 reports for important but not urgent findings; 93.3% generated e-mail message (6.7% failure rate); 80% of alerts were viewed. Higher satisfaction for e-mail alerts over conventional methods (eg, facsimile) for nonurgent but important findings.
Need: Communicate within 1 care setting (primary care physicians)				
Lanham, 2012 ⁷⁸	Observational study	Comparison of practice-level EHR use with communication patterns among physicians, nurses, medical assistants, practice managers, and nonclinical staff within individual practices in Texas.	Observation and semistructured interviews. Within-practice communication patterns were categorized as fragmented or cohesive. Practice-level EHR use was categorized as homogeneous or heterogeneous.	Clinical practices with cohesive within-practice communication patterns were associated with homogeneous patterns of practice-level EHR use.
Murphy, 2012 ⁷⁹	Observational study	Review of note-based messaging within the EHR in outpatient clinics of large tertiary Veterans Affairs facility. Clinic staff send "additional signature request" alerts linked to parent notes in the EHR to primary care physicians.	Reason for and origin of alerts. Parent note linked to alert was also reviewed for 3 "value attributes": urgency; potential harm if alert was missed; subjective value to PCP of the alert.	Of the alerts reviewed, 53.7% of 525 were deemed of "high value" but required PCPs to review significant amounts of extraneous text (80.3% of words in parent notes) to get relevant information. Most alerts (40%) were medication, prescription, or refill related.

NOTE: Abbreviations: CPOE, computerized physician order entry; ECS, Email Consultation Service; EHR, electronic health record; EMR, electronic medical record; eRP, Electronic Referral Protocol; NHS, National Health Service; OR, odds ratio; PCP, primary care physician; XML, extensible markup language.

criteria focused on physicians as providers. Five studies (20%) described trial design, three (12%) were pilot studies, and seventeen (68%) were observational studies. Thirteen of twenty-five articles (52%) described studies conducted in the United States and twelve in Europe.

Most of the studies (56%) focused on electronic referrals between primary care and subspecialty providers. The clinical need was to communicate information on a specific patient with a specialist who shared responsibility for the overall plan of care. Only

two studies evaluated "curbside consultation," where providers ask for clinical recommendations without formally engaging a specialist in the plan of care for a particular patient. Table 2 summarizes included studies and has been organized with respect to clinical need under evaluation. The major themes that emerged from this review included: studies of penetration of communication tools either within the EHR system (intra-EHR IT) or external to the EHR (extra-EHR IT); electronic referrals; curbside consultations; and test results reporting (results notification).

Extra-EHR IT

A review of electronic communication in 2000 examined electronic communication among primary care physicians but notably did not distinguish between communication and data exchange.⁴³ Of the thirty included publications in that review, seventeen publications dealt with electronically communicated information in general; the remaining studies focused on notifications of test results or transitions of care, reports from specialists, or electronic communication as replacement of traditional referral.⁴³ Although many studies of electronic communication described positive benefits, few included objective data, and most did not analyze provider-to-provider communication specifically. A survey of IT use outside of the EHR in 2006 documented that approximately 30% of clinicians used e-mail to communicate with other clinicians, fewer than those who consulted on-line journals (40.8%), but many more than those who communicated with patients by e-mail at that time (3.6%).⁴⁴

Intra-EHR IT

A comparison of two physician surveys of EHR use in Massachusetts (the first in 2005 and the second in 2007) documented an increase in the percentage of practices with an EHR, from 23% to 35%; in those practices with EHRs, only the use of electronic prescribing increased over time. Use of secure electronic referrals or messaging including secure e-mail remained unchanged; of note, referrals and messaging were considered a singular clinical function in that study. Between 2005 and 2007, referrals or clinical messaging were available in 62% and 63% of EHR systems, respectively, and they were used most or all of the time by 29% to 33% of the physicians who had an EHR.⁴⁵

Electronic Referrals

Fourteen articles focused on electronic referrals. Two had a pre-post or longitudinal study design,^{46,47} and five included a control group.⁴⁸⁻⁵¹ The rest were descriptive. In most cases, electronic referral improved the transfer of information, especially when standardized message templates were created. Use of electronic referral appeared to result in reduced waiting time for appointments and enabled more efficient triage.

Barriers to integration of electronic referral in the EHR were also assessed. An intra-EHR communication system requiring a primary care physician to integrate information e-mailed by the consultant into the record showed the percentage of integrated notes decreasing over time.⁴⁷ Practitioners had mixed feelings about the system; although the majority (92% of respondents) felt that the system improved patient care and wanted to extend messaging to other patient groups, they also felt that electronic messaging

decreased the ease of reviewing data (83%) and confused tasks and responsibilities (59%). A study of British and Dutch electronic referral systems described significant resistance on the part of practitioners to electronic referrals and concern on the part of specialists about the quality of referrals.⁵² Another study demonstrated improvement in quality of demographic data but degradation in quality of clinical information when referrals were submitted electronically.⁴⁹ A recent transactional analysis of electronic referrals in New Zealand showed high uptake and reduced referral latency compared to conventional referral; clinicians cited usability concerns as the major barrier to use.⁵³

Curbside Consultations via E-mail

Two studies evaluated curbside consultations via e-mail and documented high provider satisfaction and rapid turnaround.^{54,55} The preliminary nature of these studies raises questions of sustainability and long-term implementation.

Results Notification

Three studies focused on test-result reporting from radiologists. In these studies, a radiologist could designate a result as high priority and have an e-mail notification sent to the ordering physicians.⁵⁶⁻⁵⁸ Urgent results were relayed by telephone. Lack of acknowledgement of alerts impacted the results of every study, and in one of these studies, alerting two physicians, rather than just one, decreased the likelihood that the results would be followed up.⁵⁷ Providers did prefer e-mail to fax notification.⁵⁸

DISCUSSION

The principal findings of the literature review demonstrate the paucity of quantitative data surrounding provider-to-provider communication. The majority of studies focused on physicians as providers without emphasis on other provider types on the care team. Most of the quantitative studies investigated electronic referrals. Data collected largely represented measures of provider satisfaction and process measures. Few quantitative studies used established models or measures of team coordination or communication.

This study extends the work of others by compiling a comprehensive view of electronic provider-to-provider communication. A recent review of devices for clinical communication tells a part of the story,²⁸ and our review adds a comprehensive, device-agnostic look at the systems physicians and other providers use every day.

Limitations of this review include the small number of eligible studies and a homogenous provider type (physicians). The latter is both an important finding and a limitation to generalizability of our results. Reviewed studies were in English only. The literature review by its nature is subject to publication bias.

Intra-EHR communication cannot serve all purposes, and is it not a panacea for effective care

coordination. One recent qualitative study warns about the pitfalls of electronic communication. Interviews with physicians from twenty-six practices elicited some concerns about the resulting decrease in face-to-face communication that has resulted from the adoption of electronic communication tools.³² This finding brings implications: (1) a false sense of security may reduce verbal communications when they are needed most—during emergencies or when caring for complex patients who require detailed, nuanced discussion; and (2) fewer conversations within a practice can reduce both knowledge sharing and basic social interactions necessary for the maintenance of a collaboration. Last, privacy and confidentiality are top priorities. Common electronic communication tools are susceptible to security breaches,^{47,59} and innovations within this domain must conform to Health Insurance Portability and Accountability Act of 1996 and Health Information Technology for Economic and Clinical Health Act regulations.⁶⁰

Although electronic communication is not a complete solution for clinical collaboration, it is difficult to use face-to-face communication and telephone communication to convey large amounts of patient information while simultaneously generating a record of the transaction. Moreover, paging functions, telephone calls, and face-to-face encounters can be highly interruptive, increasing cognitive load, burdening working memory, and shifting attention from the task at hand.¹⁴ Interruptions contribute to inefficiency and to the potential for errors.⁶¹

Effective coordination of care for the chronically ill is one of the essential goals of the health system; it is an ongoing process that depends on constant, effective communication. Bates and Bitton have recognized this and described the crucial role that HIT will play in creating an effective medical home by enumerating seven domains of HIT especially in need of research.⁶² In particular, they note that effective team care and care transitions will depend on an EHR that promotes both implicit and real-time communication: “it will be essential to develop communication tools that allow practices to record goals shared by providers and patients alike, and to track medical interventions and progress.”⁶²

Future research could investigate a number of open questions. Overall, an emphasis should be placed on rigorous qualitative and quantitative evaluation of electronic communication. Process measures, such as length of stay, hospital readmission rates, and measures of care coordination, should be framed ultimately with respect to patient health outcomes. Such data are beginning to be reported.⁶³

It is unclear which types of communications would be best served within the EHR and which should remain external to it. Instant communication or “chat” has not been studied sufficiently to show a demonstrable impact on patient care. Cross-coverage

and team identification within the EHR can be further studied with respect to workflows and best practices. Studies using structured observation or time-and-motion analysis could provide insight into use cases and workflows that providers implement to discuss patients. Future research should incorporate established models of communication⁵ and coordination.⁶⁴ Data on unintended consequences or harms of provider-to-provider electronic communication have been limited, and this area should be considered in subsequent work. Finally, although the scope of this review focused on communication between providers, transformative electronic communication systems should bridge communication gaps between providers and patients as well.

As adoption of EHRs in US hospitals has increased from 15.1% of US hospitals in 2010 to 26.6% in 2011 for any type of EHR and 3.6% to 8.7% for comprehensive EHRs,⁶⁵ it is worth noting that Meaningful Use, as it stands, incentivizes patient-provider communication, but not communication between providers. Inclusion of certification criteria focused on provider-to-provider communication may spur additional innovation.

CONCLUSIONS

The optimal features to support electronic communication between providers remain under-assessed, although there is preliminary evidence for the acceptability of electronic referrals. Without better understanding of electronic communication on workflow, provider satisfaction, and patient outcomes, the impact of such tools on coordination of complex medical care will be an open question, and it remains an important one to answer.

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