Lessons From Tele-Emergency: Improving Care Quality And Health Outcomes By Expanding Support For Rural Care Systems

ABSTRACT Tele-emergency services provide immediate and synchronous audio/video connections, most commonly between rural low-volume hospitals and an urban “hub” emergency department. We performed a systematic literature review to identify tele-emergency models and outcomes. We then studied a large tele-emergency service in the upper Midwest. We sent a user survey to all seventy-one hospitals that used the service and received 292 replies. We also conducted telephone interviews and site visits with ninety clinicians and administrators at twenty-nine of these hospitals. Participants reported that tele-emergency improves clinical quality, expands the care team, increases resources during critical events, shortens time to care, improves care coordination, promotes patient-centered care, improves the recruitment of family physicians, and stabilizes the rural hospital patient base. However, inconsistent reimbursement policy, cross-state licensing barriers, and other regulations hinder tele-emergency implementation. New value-based payment systems have the potential to reduce these barriers and accelerate tele-emergency expansion.

Medical emergencies in rural settings are often challenging. The time and distance needed to reach definitive health care are often longer in rural areas than in suburban or urban settings. And low-volume rural hospitals may have fewer resources to care for emergencies.

Tele-emergency can provide rural hospitals with timely and high-quality emergency services that improve patient care and increase staff support during critical medical events. For the purposes of this article, tele-emergency is defined as an immediate, real-time, interactive audio/video connection between an urban “hub” emergency department (ED) and a rural hospital. Our research supports the claim that tele-emergency can extend emergency care in rural hospitals.

First, we summarize the tele-emergency literature and identify three tele-emergency models and associated outcomes. Then, to advance an understanding of tele-emergency, we describe our evaluation of a large tele-emergency service in the upper Midwest. Our evaluation included a widely distributed user survey and interviews with a large sample of rural clinicians and hospital administrators. We discuss our findings in terms of public policy implications and barriers to the use of tele-emergency and then summarize tele-emergency’s role in connected health.

Analysis Of Tele-Emergency Use
Rates of tele-emergency use have not previously been reported. Our analysis of the most recent data set from HIMSS Analytics\(^1\) shows that 32 percent of the 4,727 reporting hospitals use at least one telehealth service. The HIMSS Analytics data set is the most comprehensive survey of information technology adoption in US health
care organizations, although its information on telehealth is limited to a few variables.

Telehealth is most frequently implemented in radiology departments (15.7 percent of which use telehealth); emergency or trauma care departments (7.5 percent); and cardiology, stroke, or heart attack programs (6.8 percent). Telehealth in radiology departments predominantly involves transmitting images such as magnetic resonance imaging or computed tomography scans to radiologists at a distant site for reading and consultation. In contrast, telehealth services in emergency or trauma care departments and cardiology, stroke, or heart attack programs employ a wide range of information and communication technologies that are used by a variety of health care professionals.

Telehealth has been categorized according to functionality (consultation, diagnosis, monitoring, and mentoring), applications (medical specialty, disease entity, site of care, and treatment modality), and technological issues (synchronicity, network design, connectivity). We focus here on tele-emergency because its prevalence and the variety of services it includes make it an informative example of a range of telehealth applications in connected health, and because of its special importance in hospital services for rural communities.

**Review Of Tele-Emergency Studies**

A recent compilation of systematic reviews of telehealth reported inconsistent findings on its effectiveness and none that covered tele-emergency. To examine the degree to which tele-emergency affects health outcomes and the quality of patient care, we conducted our own systematic review.

We used “tele-emergency” or “telehealth/telemedicine” and “emergency room” as terms to search PubMed, CINAHL, Embase, and the Cochrane Database. Our searches returned 334 unique citations, of which 36 were studies evaluating tele-emergency implementation. We categorized these 36 studies according to setting, patient population, communicating parties, and technology used. These categories yielded three primary models of tele-emergency use.

The first tele-emergency model links a physician in a hub ED to one or more distant sites staffed by nonphysician clinicians. For example, in multiple areas of the United Kingdom, minor treatment units and minor injury clinics have been established that are typically staffed by specially trained nurses or nurse practitioners. Patients with minor injuries or illnesses are encouraged to seek care at these facilities instead of traveling to more distant EDs.

In this model, tele-emergency consultation can be divided into four nearly equal types: diagnoses, treatment decisions, requests for inpatient admission, and case disposition decisions. Consultation between the clinician in the outlying facility and the physician in the hub ED usually involves a live video connection with the capability to review x-ray images. Studies show that this arrangement permits accurate and efficient diagnosis and treatment and reduces unnecessary transfers.

The second tele-emergency model connects a large hub ED with multiple smaller and distant hospital EDs. In this model, the hub ED physician participates in a live consultation with the provider in the distant ED, who is usually a primary care physician, nurse practitioner, or physician assistant. The live consultation frequently concerns a patient who might be a candidate for transfer. Such patients may have complex traumatic injuries (for example, from a motor vehicle accident) or serious acute illnesses requiring rapid diagnosis (such as stroke and acute myocardial infarction, or heart attack).

Research has found that providers at both the hub ED and the distant facilities believe that such live consultations improve patient care. Studies have also shown that this model of tele-emergency care is comparable to traditional care in terms of patient outcomes. In one study, tele-emergency consultation changed the diagnosis in 18 percent of cases and the treatment in 52 percent of cases, and it provided useful confirmation of diagnosis, treatment, or both in the remaining cases.

Compared to usual care, tele-emergency frequently reduces unnecessary transfers from remote EDs to hub EDs. This model of tele-emergency support has produced cost savings through reducing unnecessary transfers and allowing rural hospitals to be staffed with less expensive personnel.

The third model connects distant ED physicians to cardiac, neurological, ophthalmological, trauma, and other specialists for consultation regarding specific clinical conditions. In these cases, specialists provide live video consultations, often connecting through computers in their offices or homes to the physicians in distant EDs.

Important outcomes include confirmation of diagnosis and treatment, guidance in preparing a patient for transfer, and recommendations for local care that reduce the rates of unnecessary transfers. For example, burn center specialists and ophthalmologists viewed high-quality im-
Real-time telehealth consultation with specialists helped stabilize serious trauma cases before transfer.16,17 In some cases, specialists employ tele-presence—that is, the use of high-fidelity audio/video communication—to guide local providers step-by-step through specialized procedures, such as stabilizing a trauma patient before transfer.16,18 Tele-emergency has been shown to enhance the skills of local providers.13,15 Tele-emergency consultations also improved adherence to clinical protocols for patients with stroke or acute myocardial infarction and reduced morbidity and mortality.18,20 compared to usual care.

In studies of this third delivery model, both local providers and hub specialists view tele-emergency as improving care.16,17,20 Studies have demonstrated comparable or improved patient care processes and health outcomes,13,15,19 including evidence of lives saved in trauma cases16,17 when this type of telehealth service was available to connect remote providers with hub specialists. Cost savings have been achieved13,15,19 by reductions in unnecessary air transport13,15 and in inpatient stays at distant hospitals.13–15 These evaluations show why tele-emergency has considerable appeal as a useful and potentially lifesaving technology.15–17

Study Data And Methods
To improve the understanding of tele-emergency, we conducted an evaluation of a widely implemented tele-emergency service in the upper Midwest that provides 24/7 connection between a hub ED and seventy-one remote hospitals (an example of the second model described above). At any time, clinical staff members at the remote hospitals can press a button for immediate, synchronous audio/video connection to the tele-emergency hub ED.

The technology allows staff members, patients, and family members located at the distant hospital to communicate with the hub ED’s staff members, including board-certified emergency medicine physicians and ED nurses. The connection also provides the hub clinicians with access to patients’ medical records.

SURVEY AND INTERVIEWS In 2011 we conducted phone interviews and site visits with a sample of ninety clinicians and administrators at twenty-nine rural hospitals that used this tele-emergency service. The tele-emergency hub provided a list of fifteen hospitals that might be willing to allow us to interview staff members, and we interviewed the CEOs of thirteen hospitals.

In 2012 Keith Mueller and Clinton MacKinney conducted site visits at eight of these thirteen hospitals, based on their geographic location to allow two of the authors to travel to a maximum of two sites in a limited period.

Based on the findings from our interviews and site visits, we designed a survey to collect users’ perceptions of telehealth care. In February 2013 we sent an electronic link to the survey to a single contact person at each of the seventy-one hospitals subscribing to the tele-emergency service. The contact people were asked to share the survey with all staff members in their hospital and to encourage them to complete the survey. We accepted survey responses through April 2013.

For questions about tele-emergency benefits, respondents indicated that they agreed or disagreed strongly, moderately, or slightly. A total of 292 respondents indicated that they were familiar with the tele-emergency service in use at their hospital and anonymously completed the survey, with at least one response from each of the seventy-one hospitals contacted.

Because of the way in which the survey was distributed, we do not know how many individuals were contacted and thus cannot calculate a response rate. Statistical differences between groups of respondents were tested using non-parametric generalized estimating equations for ordinal responses and the statistical software SAS, version 9.3.

In fall 2013, after the survey, Clinton MacKinney and Marcia Ward conducted on-site interviews at thirteen additional hospitals drawn from the complete list of seventy-one hospitals contacted for the survey, also chosen for logistical reasons.

All interviews were recorded and subsequently transcribed. Deidentified transcripts were read by all of the authors, and Andrew Potter identified interviewees’ statements that were related to quality of care and separated those statements into direct statements of tele-emergency’s impact on quality and statements about how tele-emergency changes processes of care. Based on a reading of these two sets of statements, we identified the themes reported below.

The University of Iowa Institutional Review Board approved the survey and interview protocols.

LIMITATIONS Our evaluation of a large tele-emergency service in the upper Midwest was both quantitative and qualitative, but it relied on staff perceptions, which might differ from other measures of quality.

Because of the methods used to distribute the survey and schedule the interviews, our analysis may suffer from nonresponse bias. In other

ages to separate patients who needed to be transferred to specialist care from those whose conditions could be managed in a local facility.13,14 Real-time telehealth consultation with specialists helped stabilize serious trauma cases before transfer.16,17

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words, people unfavorable to, or unfamiliar with, the tele-emergency service might have been less likely to complete the survey or agree to be interviewed.

We were encouraged by receiving 292 completed user surveys that included all seventy-one participating hospitals. We found significant concordance between blinded user survey responses and interview results, which strengthened the internal validity of our study findings.

**Study Results**

Ninety-five percent of the survey respondents agreed, and 61 percent strongly agreed, with the statement that “tele-emergency improves the quality of care at my facility” (Exhibit 1). Significant majorities also strongly agreed with ten other specific items regarding the positive effect of tele-emergency on patient care quality and expressed overall satisfaction with tele-emergency services.

Our analyses found almost no differences between respondents with administrative roles \((n = 131)\) and respondents with clinical roles \((n = 158)\), indicating that both groups acknowledged the value of tele-emergency. The only exceptions were that clinicians agreed more strongly than administrators with the statements that “tele-emergency is well-integrated in patient care at my facility” and “overall, I am satisfied with tele-emergency services.”

Interviewees fleshed out the survey responses by describing several ways in which tele-emergency improves the quality of care in rural EDs. The major themes identified in the interviews are described below.

**ACCESS TO SPECIALIZED CLINICIANS** The physicians we interviewed appreciated the opportunity that tele-emergency provides for getting a second opinion in circumstances they encountered infrequently. Interviewees also mentioned that

<table>
<thead>
<tr>
<th>Item</th>
<th>Agree</th>
<th>Disagree</th>
<th>Don’t know, not applicable</th>
<th>Total</th>
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<tr>
<td>Tele-emergency improves the quality of care at my facility</td>
<td>176</td>
<td>64</td>
<td>31</td>
<td>287</td>
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<td>Tele-emergency improves the timeliness with which patient care services are provided</td>
<td>165</td>
<td>67</td>
<td>29</td>
<td>287</td>
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<tr>
<td>Tele-emergency is well-integrated in patient care at my facility</td>
<td>120</td>
<td>81</td>
<td>36</td>
<td>287</td>
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<tr>
<td>Tele-emergency helps us provide the appropriate level of care for patients at our hospital</td>
<td>164</td>
<td>83</td>
<td>24</td>
<td>287</td>
</tr>
<tr>
<td>Tele-emergency support allows staff at my facility to more confidently care for critical care patients</td>
<td>197</td>
<td>54</td>
<td>21</td>
<td>285</td>
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<tr>
<td>Tele-emergency adds to my hospital’s capacity to care for my community’s patients</td>
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<td>270</td>
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<td>Tele-emergency makes caring for patients in the ED less burdensome</td>
<td>179</td>
<td>70</td>
<td>25</td>
<td>290</td>
</tr>
<tr>
<td>Tele-emergency decreases the burden at our hospital in caring for our patients</td>
<td>210</td>
<td>33</td>
<td>11</td>
<td>287</td>
</tr>
<tr>
<td>Tele-emergency’s availability helps with recruitment and retention of healthcare professionals in my hospital</td>
<td>104</td>
<td>47</td>
<td>33</td>
<td>285</td>
</tr>
<tr>
<td>Tele-emergency benefits the community by allowing more patients to be treated locally</td>
<td>127</td>
<td>70</td>
<td>52</td>
<td>286</td>
</tr>
<tr>
<td>Tele-emergency services are an important part of health care in my community</td>
<td>201</td>
<td>55</td>
<td>22</td>
<td>291</td>
</tr>
<tr>
<td>Overall, I am satisfied with tele-emergency services</td>
<td>203</td>
<td>54</td>
<td>16</td>
<td>282</td>
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</tbody>
</table>

**Source** Authors’ analysis of survey responses.
tele-emergency facilitates the diffusion of evidence-based protocols to remote hospitals. For example, some hospital administrators noted that a program in which rural hospitals consulted with the tele-emergency hub for every patient complaining of chest pain improved adherence to evidence-based clinical protocols, including the timely delivery of electrocardiograms.

More Clinical Resources During Critical Events Multiple traumas, acute myocardial infarctions, and other critical events tax not only physicians, but other ED staff members as well. Rural hospital staff members have multiple responsibilities and may feel overextended during crises. Tele-emergency gives ED staff members various types of support in such situations—including assistance with charting, arranging patients’ transfers, and other tasks that can be completed remotely—which allows local clinicians to focus on hands-on patient care.

Shorter Time to Care Physicians working in rural EDs commonly take calls at their homes and can reach the ED within thirty minutes if necessary. However, a tele-emergency care team can provide immediate support to rural nurses caring for a patient whose condition is critical. Interviewees reported that immediate access to a team in the hub ED resulted in care processes’ being initiated sooner, which led to better patient outcomes.

Improved Care Coordination Transfers from rural hospitals are common.21 Through tele-emergency, rural hospitals were able to reduce the number of transfers because more specialized care could be provided locally. When transfers did occur, interviewees reported improved quality of care because of better coordination between the transferring ED and the receiving hospital (which was often the tele-emergency hub).

One interviewee told us that in one case “the tele-emergency doc and the emergency doc at the receiving hospital had an idea that we had a very serious situation. As soon as the patient hit the ground at the receiving hospital, they...took the patient directly to surgery with the cardiac surgeon, rather than spending time reevaluating the patient.”

More Patient-Centered Care Patients seeking emergency care were more likely to receive care locally and in a timely manner with tele-emergency than with usual care, because of the enhanced clinical resources available with an expanded care team. Interviewees also noted that local care was more patient centered than care at a hub ED, permitting patients to remain close to their families, remain at home near the end of life, and avoid travel costs and inconvenience for both patients and family members.

Improved Family Physician Recruitment and Retention Interviewees reported that tele-emergency improved the recruitment and retention of family practice physicians by easing the burden of emergency call responsibilities and providing support from specialist physicians. One interviewee told us: “Our last physician here was kind of on an island. Now [the current physician] can go in and push the tele-emergency button and say, ‘I’m thinking this but I’d like a second opinion.’”

Stabilized Patient Base Tele-emergency increases the scope of medical care that a rural hospital can provide and improves its reputation among community members. Both factors reduce patients’ tendency to bypass local hospitals, maintaining those hospitals as viable community resources.

One interviewee said: “An amazing number of people, prior to telemedicine, were getting their services thirty, forty, fifty, sixty miles away because they were going, ‘Well, we always have to go there anyway.’ Telemedicine created a huge turnaround for us, with a 35 percent increase in patient volume.”

Public Policy Implications

Public policies can inhibit the spread of tele-emergency and other types of telehealth. Barriers to implementation include Medicare policies related to payment and conditions of participation, state policies including licensing and credentialing regulations, Medicaid payment and on-site staffing requirements, and private-sector payment policies. Conversely, other public policies—such as shared savings programs, value-based purchasing, and regulatory policy changes specifically designed to accommodate telehealth—can encourage its use. This mixed policy environment can engender confusion but also creates opportunities for the expansion of telehealth.

For services delivered via tele-emergency, Medicare reimburses critical-access hospitals based on the cost of providing care, including fees paid to a tele-emergency hub. However, Medicare does not reimburse hospitals for their initial purchase of tele-emergency equipment, and other private and public payers do not generally reimburse critical-access hospitals on a cost basis.

Thus, under current policies, the full cost of tele-emergency care is not recoverable solely through reimbursement for services rendered. With tele-emergency, the total cost of care may well be less than alternatives involving transit to another site to receive care that could have been
provided locally with the involvement of clinicians at a hub site, although it is difficult to confirm the cost savings from reduced patient transfers. With additional financial benefits to the critical-access hospital and health system resulting from more patient care (including inpatient care following the intervention in the emergency room), total revenues may outweigh costs despite underpayment for the telehealth service.

Because clinicians in tele-emergency hubs serve multiple distant sites, cross-state clinician licensing is another challenge to tele-emergency implementation. Efforts to address this issue include the National Council of State Boards of Nursing’s interstate nurse licensure compact, through which twenty-four states have agreed to accept another state’s license for nurses.23

States have also explored using limited licenses for telehealth and expedited permission to practice in one state for physicians licensed in another state. In 2006 the Office for the Advance-ment of Telehealth in the Health Resources and Services Administration created the Licensure Portability Grant Program to fund state medical boards’ efforts to eliminate barriers resulting from cross-state licensing issues.24

Many of our interviewees mentioned the Emergency Medical Treatment and Active Labor Act (EMTALA) of 1986, which requires EDs to provide stabilizing treatment to patients, as a barrier to realizing the full benefits of tele-emergency implementation. Until the Centers for Medicare and Medicaid Services issued guidance in 2013, rural hospital administrators we interviewed believed that they were required to use an on-call staff physician to back up a physician assistant or nurse practitioner in the ED, even when immediate access to physician backup was available via tele-emergency.

The new regulatory guidance permits critical-access hospitals to meet all obligations under EMTALA and the Medicare conditions of participation with an on-site physician assistant or nurse practitioner and a physician available via tele-emergency technology.25 Our interviewees suggested that this regulatory interpretation has eased the emergency call burden in rural areas, eliminating another barrier to recruiting and retaining rural physicians.

**Tele-Emergency’s Role In Connected Health**

Taken together, our literature review and original research suggest that tele-emergency increases access to high-quality, integrated, patient-centered care, especially in rural areas. Tele-emergency expands access to specialty care in rural areas directly by adding resources to the care team. Tele-emergency’s indirect effects are also significant. In rural hospitals, tele-emergency can increase both the support for local clinicians and community members’ confidence in their care—a process that stabilizes the patient base and clinical resources on which rural hospitals depend for their continuing viability.

Tele-emergency promotes integration between critical-access hospitals and urban emergency clinicians and can improve care quality by giving providers in different locations access to multiple health care delivery assets. Coordinating care through tele-emergency is patient-focused and gives patients the right care at the right time. Preestablished communication strategies facilitate emergency transfers of patients to the appropriate setting quickly and effectively. The strategies also decrease the number of unnecessary transfers for patients who—through the use of tele-emergency—can be safely treated in their community hospitals.

In an era of increasing competition for physicians and nurses, tele-emergency is a means of retaining essential local providers. By providing backup support to nurses in rural EDs, tele-emergency can distribute nursing resources efficiently across a number of rural settings. Tele-emergency facilitates the recruitment and retention of physicians in rural areas, many of whom work as family practitioners when not taking calls in the ED. As a result, tele-emergency may be a way not only to increase rural access to emergency care but also to retain family practitioners in rural areas.

Tele-emergency care connects clinicians in ways that expand the team of providers caring for a patient at a time of crisis, improving clinical quality and patients’ confidence in the treatment provided. In addition, patients’ favorable experiences with local care in a hospital ED helps create a sense that other services are also of high quality because local providers are connected to additional expertise as needed. Patients are also likely to feel that they need not travel away from their local support network for care. Telehealth establishes connections between clinicians and between patients and distant providers, creating the possibility of integrated care within regional delivery systems—either single organizations or affiliations of independent providers.

Financial benefits accrue from reduced patient transfers and from providing care in the least costly setting. However, cost-based reimbursement may not cover all costs of care. As payment systems, such as those based on total care value or shared savings, evolve to support cost-effective models of integrated care, telehealth will become more financially attractive for individual providers and health care systems.
Conclusion
Tele-emergency improves patient care through integrated services that deliver the right care at the right time and the right place. Public payers increasingly reward health systems for such innovations, both through changes in the payment system that are promoted by the Affordable Care Act—for example, programs related to value-based purchasing, bundled payment, and accountable care organizations—and through unrelated trends such as state Medicaid programs’ expanded managed care contracting and continued growth in the Medicare Advantage program.

Telehealth technology, including tele-emergency, addresses shortcomings in health care delivery and facilitates improvements in patient care. If its potential is realized, telehealth will be integral to transforming the delivery system in ways that are consistent with an emphasis on increasing value and reducing the total cost of care.

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NOTES