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Review article

Systematic review of telemedicine applications in emergency rooms

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ABSTRACT

Context: Despite the frequency of use of telemedicine in emergency care, limited evidence exists on its impacts at the patient, provider, organization, and system level. Hospital-based applications of telemedicine present a potentially important solution, particularly for small and rural hospitals where access to local specialists is rarely available.

Purpose: We conducted a systematic review of telemedicine applications for hospital-based emergency care, which aims to synthesize the existing evidence on the impact of tele-emergency applications that could inform future efforts and research in this area.

Basic procedures: A search of four databases (PubMed, CINAHL, EMBASE, Cochrane) using a combination of telemedicine and emergency room (ER) keywords for publications yielded 340 citations. Four coders independently determined eligibility based on initial criteria and then extracted information on the 38 resulting articles based on four main categories: study setting, type of technology, research methods, and results.

Main findings: Of the 38 articles, 11 studies focused on telemedicine for diffuse patient populations that typically present in ERs, 8 studies considered telemedicine in the context of minor treatment clinics for patients presenting with minor injuries or illnesses, and 19 studies focused on the use of telemedicine to connect providers in ERs to medical specialists for consultations on patients with specific conditions. Overwhelmingly, tele-emergency studies reported positive findings especially in terms of technical quality and user satisfaction. There were also positive findings reported for clinical processes and outcomes, throughput, and disposition, but the rigor of studies using these measures was limited. Studies of economic outcomes are particularly sparse.

Principal conclusions: Despite limitations in their research methodology, the studies on tele-emergency indicate an application with promise to meet the needs of small and rural hospitals to address infrequent but emergency situations requiring specialist care. Similarly, studies indicate that tele-emergency has considerable potential to expand use of minor treatment clinics to address access issues in remote areas and overcrowding of urban ERs.

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1. Introduction

Definitions of telemedicine by the Institute of Medicine (IOM), World Health Organization, and American Telemedicine Association [1–3] vary somewhat, but the core of most definitions is “the delivery of health care services at a distance, using information and communication technology”, where information and communication technology encompasses a broad range of potential applications [4]. Many telemedicine applications connect patients directly to providers. Other applications focus on clinicians but employ asynchronous communication only, or largely use videoconferencing for educational purposes. An extremely important area of telemedicine connects clinicians during an acute episode of patient care, usually linking small, rural hospital settings that have limited resources to larger, urban medical centers. Telemedicine applications in emergency rooms (tele-emergency) are a prime example. In a recent analysis of the 2011 Health Information and Management Systems Society (HIMSS) Analytics dataset [5], which aimed at deriving national estimates of hospital-based telemedicine use, we found that two of the three most frequently used services were in emergency/trauma care departments and in cardiology/stroke/heart attack programs [6].

Despite this reported frequency of use of telemedicine in emergency care, limited evidence exists on its impacts at various levels related to the technical quality, users’ perceptions, clinical processes and outcomes, disposition and throughput of patients, and economic effects. Hospital-based applications of telemedicine present a potentially important solution, particularly for small and rural hospitals where access to local specialists is rarely available [7]. Yet, a PubMed search for meta-analyses and systematic reviews on telemedicine and telehealth yielded 55 citations, of which only three are focused on hospital-based applications [8–10]. Interestingly, all three were on telemedicine in intensive care units (ICU). A systematic review on a broad range of applications [11] found generally positive results with the strongest evidence among hospital-based applications in pediatric cardiology, intensive care, and emergency care/trauma. Surprisingly, no

meta-analyses or systematic reviews of telemedicine in specific hospital-based applications other than those covering tele-ICU [12] were found. Thus, in view of the relatively frequent use of telemedicine in emergency/trauma care departments and cardiology/stroke/heart attack programs, we undertook a systematic review of the empirical studies of telemedicine applications for hospital-based emergency care to synthesize the existing evidence on the impact of tele-emergency applications, which could inform future efforts and research in this area. This paper presents a systematic review of published research evidence on tele-emergency applications, which synthesizes existing evidence and identifies knowledge gaps in this area. It further provides stakeholders, researchers, and funding agencies with knowledge that focuses attention on priority areas for future investigation, as well as highlights various evidence-based interventions of telemedicine applications in emergency room settings.

2. Materials and methods

According to Moher et al., a systematic review represents a type of literature review that employs systematic and explicit methods for the identification, selection, and critical appraisal of relevant research in a specific field [13]. It summarizes the results of the empirical studies qualitatively, in a narrative approach, in order to present information on the direction, size, strength of evidence, and consistency of the “effect” across the included studies [14]. Unlike a critical review, which usually involves a selective or representative search of existing literature and focuses on critical assessment and explanations, a systematic review adopts a comprehensive search/inclusion of empirical studies and integrates and synthesizes existing literature in a specific domain [14].

The PRISMA guidelines [13] and existing systematic review articles identified the most commonly used databases for a comprehensive search of the literature on this topic as PubMed, CINAHL, EMBASE, and the Cochrane Database. “Telemedicine” and “telehealth” are often used interchangeably; as such, both were used as search terms. Thus, the

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