

The Impact of Telemedicine in Cardiac Critical Care



Jayashree Raikhelkar, MD^{a,*}, Jayant K. Raikhelkar, MD^b

KEYWORDS

- Telemedicine • Cardiac care • Heart failure • Telecardiology • Echocardiogram
- Electrocardiogram

KEY POINTS

- Telecardiology is one of the fastest growing fields in telemedicine.
- Tele-coronary care unit (tele-CCU) connects the remote cardiologist to the cardiac care unit for consultation.
- Tele-electrocardiogram (tele-ECG) allows for prehospital triage and thrombolysis in patients with ST segment elevation myocardial infarction (STEMI).
- Tele-echocardiogram (tele-echo) and tele-heart failure monitoring include teleconsultation for congenital heart disease and the remote monitoring of heart failure patients.

Telemedicine was recognized in the 1970s as a legitimate entity for applying the use of modern information and communications technologies to the delivery of health services.¹ The earliest mention of telemedicine in cardiology can be traced back to early twentieth century when electrocardiographic data were first transmitted over telephonic wires.² Telecardiology is one of the fastest growing fields in telemedicine. The advancement of technologies and Web-based applications has allowed better transmission of health care delivery. Although improvements in cardiac care have led to a substantial decline in cardiac mortality over the last 50 years, cardiovascular diseases are still the leading cause of death in the United States. It is estimated that more than 2000 Americans die of cardiovascular disease every day.³ Increases in life expectancy have led to concomitant increases in the prevalence of coronary artery disease and chronic heart failure. It is hoped that the rapid developments in telecardiology will benefit this increasing population of patients and play an important role in further improvements cardiovascular

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^a Department of Anesthesiology and Critical Care, Emory University School of Medicine, 1364 Clifton Road Northeast, Atlanta, GA 30322, USA; ^b Department of Cardiovascular Medicine, University Hospitals Case Medical Center, Case Western Reserve University, 11100 Euclid Avenue, Cleveland, OH 44106, USA

* Corresponding author.

E-mail address: jraikhelkar@yahoo.com

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outcomes into the twenty-first century.⁴ This article discusses current advancements, and the scope of telemedicine in cardiology and its application to the critically ill.

Current telemedicine applications include:

- Tele-coronary care unit (tele-CCU): telecardiologist and teleconsultation in the cardiac care unit
- Tele-electrocardiogram (tele-ECG): prehospital electrocardiogram (ECG) triage and thrombolysis in patients with ST segment elevation myocardial infarction (STEMI)
- Tele-echocardiogram: teleconsultation for congenital heart disease and valvular disease
- Tele-heart failure monitoring, including telephonic and physiologic monitoring

TELE-CORONARY CARE UNIT

Several clinical trials have studied the tele-intensive care unit (tele-ICU) model. Various studies have determined that, if implemented properly, tele-ICU can reduce mortality, length of stay, and complication rates, and improve best-practice adherence.^{5,6} Tele-ICU technology allows continuous secure transmission of patients' vital signs from an intensive care unit (ICU) to a monitoring center in real time. In addition, monitoring center staff provide teleconsultation and support to bedside physicians and nurses by continuous surveillance and 24-hour alert system. Tele-ICU consultation in the CCU allows continuous monitoring of vital signs, ECG, blood pressure waveforms, oxygen saturation, pulmonary artery catheter waveforms, as well as respiration and body temperature. This process also allows real-time communication and teleconsultation with cardiologists. The feasibility of this concept was studied by Nikus and colleagues.⁷ In the Finnish study, remote surveillance of the CCU and cardiology ward was performed by a telecardiologist who had access to electronic medical records. The telecardiologist role was supportive, and this person was available for consultation and emergencies. The remote access of hospital intranet and server applications proved reliable and technically feasible. The study indicated a potential for reducing the delay for diagnostic and therapeutic interventions.⁷

Early diagnosis of acute myocardial infarction and appropriate reperfusion by means of percutaneous coronary angioplasty (percutaneous coronary intervention [PCI]) or thrombolysis has been shown to reduce morbidity and mortality, especially in the setting of STEMI.^{8,9} The 2013 American Heart Association/American College of Cardiology STEMI guidelines reinforced the need for regional medical systems to provide reperfusion therapy as rapidly as possible.¹⁰ Much attention is being paid to the concept of prehospital thrombolysis en route to the CCU (**Fig. 1**).^{11,12}

Teleconsultation and remote interaction of a paramedic with a cardiologist available in a CCU holds great promise to reduce delay and increase patient survival.¹³ Teleconsultation with the support of wireless and mobile technology additionally allows monitoring and surveillance during transport.¹⁴ Smartphone technology also allows highly accurate interpretation of angiographic lesions¹⁵ and may also serve as a supplementary tool for emergency situations in the critically ill.

Telecardiology currently encompasses a wide variety of applications, including the monitoring of cardiac rhythm and function remotely with software technology. Two of the most important tools within the cardiologist domain are the 12-lead ECG and the two-dimensional and three-dimensional echocardiogram. With wireless technology, cardiologists can remotely access information from patient records and offer timely diagnostic and treatment recommendations.

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