2017

Telemedicine and its Utilization in the Management of Chronic Heart Failure Patients

Adejoke Sotome
sotome@marshall.edu

Chirra Pooja
chirra.pooja21@gmail.com

Adejoke Sotome and Chirra Pooja – HCA-695
Draft-3-December 7th, 2017- Dr. Alberto Coustasse

TELEMEDICINE AND ITS UTILIZATION IN THE MANAGEMENT OF CHRONIC HEART FAILURE PATIENTS.

ABSTRACT

Introduction: Telemedicine is well developed and very useful for heart failure patients in emergencies. Many cases of heart failures are due to inability of reaching the physicians on time and failure of assessing the patient disease condition at earlier stage.

Methodology: The methodology for this study was a literature review. Electronic databases used included EBSCO Host, Google Scholar, Academic Search Premier, PubMed, ProQuest, and Marshall Digital Scholar. A total of 32 sources were referenced.

Results: This literature review examined several studies and research articles on the significance of Telemedicine in the treatment of chronic heart failure patients with what forms of telemedicine technology was utilized in the treatment processes. In addition, to the benefits, potential outcomes and utilization rate of telemedicine technologies in the care coordination process.

Discussion: Significance, utilization and effectiveness of Telemedicine in the treatment of chronic heart failure patients is discussed as an effective technology in the care delivery process with benefits of decreased re-hospitalization and mortality rates, increased patient satisfaction, effective care monitoring, decreased errors and better care coordination are further discussed.

Conclusion: Evidence suggests that the utilization of Telemedicine in the care process has potential benefits, yet care providers still want the emergence of new technologies and strategies to better improve the care delivery processes for the patients.

Key Words: "Telemedicine," and "Re-hospitalization" or "Mortality", "Heart failure Patients", "Significance", "Utilization", "Outcomes".

INTRODUCTION

Telemedicine development started with a huge investment by US government, which includes public health department, defense and health department drove to an innovation of telemedicine (Kleinpell, et al., 2005). Almost 17.3 million deaths have been accounted in 2005 for cardiovascular diseases due to in appropriate management of inpatient and outpatient leads to heart failures and there were high chances for re-hospitalization of heart patients. The higher level of responsibility has been on the patient to play active role in maintaining their health. (Straub C, et al., 2006).

. The main advantage of the telemedicine was to get 24/7 medical care with contracted doctor availability (Conway A, et al., 2014). Patients have expected convenient care along with less time consumption to had better care this especially lead to telemedicine. Virtual visits of physicians to their patients in emergency conditions with the help of medical professional's persons that include nurse or any health care professional. By using mobile health applications and medical devices, patients were benefited by using this and helps in tracking their health details like vitals, glucose levels, measuring Blood pressure can be done without going to the physicians (Kleinpell, et al., 2005).

Telemedicine has dealt with remote patient monitoring that allows healthcare professionals to monitor and track their health details through online. Telemedicine obviously have helped in monitoring the warning signs of the disease conditions of the patients and helps in providing precautions for the patients in the early conditions in an easier way. Recently, many aged people were living alone with no help with them has proved telemedicine is helpful for such people as the health care professionals came to their residence when required or they can observe the patient

through online, so the treatment can be made done properly at correct time (Mozaffarian D, et al., 2015). Several types of telemedicine are used which includes

Networked programs: High speed internet links are specially used for this program and this is majorly used in metropolitan hospitals. In United states, around 200 telemedicine programs were granting access to 3000 rural sites (Kvedar J, et al., 2014)

Point to point connections: This program link to small remote health center through one large central health facility through internet (Boccuti C, et al., 2015). This point to point centers mainly focus on unstaffed or smaller clinics as they didn't have expertise health professionals. This is majorly used for tele radiology, tele psychiatry and urgent care services.

Monitoring center links: Mainly used for remote patient monitoring as this has a digital connection between patient's house and health care professional monitoring facility. The medical data of patient can be determined at home and transmitted electronically to medical monitoring facility (Broderick A, et al., 2013). This is mainly used for monitoring patients of cardiac, pulmonary and fetal medical data.

Creation of software for telemedicine was major aspect to store the data of patient and comparing of the clinical information when required. The speed of the data transmission should also be high in such a way that it leads to decrease in risk and misuse of data in terms of confidentiality and data protection in such a way that it recognizes the urgency of the patient who are in actual need (Singh, et al., 2014).

The daily activities of the heart failure patients have been addressed through mobile phones, tablets, handheld and wearable sensors which have been connected to the software and this data collection and has been reviewed by the health care professional helps the patient to notice their

physiological changes and quantify and manage their disease condition. (F. Wu, H. Zhao, et al., 2015).

In a survey, it was reported that, tele monitoring had reduced 30-35% mortality and 15-20% hospitalization. Early identification of disease symptoms can be done by tele monitoring (P. Pierleoni, et al., 2014). Even heart failure patients with implantable device can be monitored by tailor alarms that triggers the alarms and activates the interventions

Telemedicine is well developed and very useful for heart failure patients in emergencies. Many cases of heart failures are due to inability of reaching the physicians on time and failure of assessing the patient disease condition at earlier stage (Mozaffarian D, et al., 2015)..

The main goal of the telemedicine was to clear down the traditional walls that enclose patients and enable the health care for patient's convenience (Conway A, et al., 2014). The technology has developed ultimately in such a way that by using robotics, cyber surgeons operate patients at distant locations. It is determined that definitely, telemedicine will change the United states health care system.

The purpose of this research was to examine the effect of telemedicine and tele monitoring devices on re-hospitalization rates, mortality rates, and analyze the utilization rates as well as overall patient outcomes for chronic heart failure patients.

METHODOLOGY

The primary hypothesis of this research is that the utilization of telemedicine in managing the chronic heart failure patients provides direct positive care coordination and monitoring benefits to the chronic heart failure patient population. A secondary hypothesis is that the implementation of certain telemedicine technologies has improved patient outcomes in terms of decreased rehospitalization and mortality rates. The conceptual framework for this research conformed to the

steps and research framework used by Yao, Chu, and Li (2010). The framework helped shed light on the significance of the utilization of Telemedicine technologies.

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Step 1: Literature Identification and Collection

The methodology used was literature review for this research and done in different stages and this stage can be as follows 1) Identifying the history of tele monitoring, 2) Monitoring the resources that uses tele monitoring or telemedicine. 3) Assessment of software based on requirements of customers.

The important search words for this research include “Tele Medicine”, ‘Tele monitoring”, “Wire-less life sciences”, “Cost reducing”, “Re-hospitalization”, “Mortality,” “Utilization rate”, “ICDs”, “Chronic disease”, “Multiple sensors” and “Self-monitoring”.

Step 2: Establishment of Inclusion Criteria and Literature Analysis

The search strategy was limited to papers published between 2007 and 2017 in the English language. A total of Forty (40) articles were searched and Thirty-two 32 relevant articles were selected, their abstracts were reviewed, and the entire articles read. In addition, we had a semi-structured interview on the 1st of November 2017 with a tele medicine expert who is an Electrophysiologist in the cardiology department of Marshall health. The literature search was conducted by AS, CP and validated by AC.

RESULTS

Significance of Tele Medicine Technology for Chronic Heart Failure Patients

Telemedicine practices for chronic heart failure patients have been increasingly cost-effective alternative in the era of integrated technology which have been used to consult with patients, diagnose conditions and recommend treatment plans, extend access to specialists and monitor patient recovery process through devices which transfer care indices data for analysis in hospitals, physician offices and patient homes across geographic boundaries. (Kvedar, Coye and Everett, 2014). Randomized studies have also indicated a 90% - 95% acceptance rate of these tele medical devices by heart failure patients and small negative feedback of about 2% of the total population was received concerning patient satisfaction. (Schmidt, Sheikzadeh, Beil, Pattern & Stettin, 2008).

The significance of these devices in tele medicine cannot be over emphasized from having helped patients adhere to medication regimes to reducing referral wait times from 2 weeks to immediately having a video chat with the specialist, with patient self-care management to reduced cost of care. (Cutler and Everett, 2010). Compelling data has shown that patients who have adhered to treatment regimens for their chronic heart failure illness had fewer clinical problems in terms of rehospitalization and the cost of care was much lower overtime (a drop of about 30% in total episode care cost) when compared to their non-adherent counterparts. (Cutler & Everett, 2010). This was made possible through tele medical phone application reminders which had the pill caps connected to the internet and the remote care giver who ordered refills as they got exhausted (Bartolini & McNeil, 2012).

E-referral has been a type of service model used in tele medicine for consultations and referral between physicians which has been mostly privacy-protected and this program was developed in San Francisco General Hospital in 2005 when the wait times there was between 7 to 11 months but after the introduction of this tele medicine technology for these chronic patient's,

in-patient specialty visits dropped by 20% and70% patient satisfaction ratings increase and similar programs have also been established at Mayo clinic, UCSF and UCLA. (Kvedar, Coye and Everett, 2014).

According to the expert in Telemedicine, a telemedicine technology in form of a life vest and wearable defibrillators has aided the provision of effective care and monitoring for chronic heart failure patients thereby reducing the risk of sudden death to about 25%. The expert also agreed with other authors on the effectiveness of these technologies and in his practice, he had recorded increased patient satisfaction ratings in his opinion by 90% due to effective monitoring and reduced frequent in-patient visits from quarterly to once a year since patients could communicate with providers from the comfort of their homes and their heart rate transmissions could be viewed in the hospital. (Expert in Telemedicine, 2017).

Utilization and Effectiveness of Tele medicine in Chronic Heart Failure Patients

Tele medicine in the form of Tele monitoring has been a promising strategy for the future of bringing about improved outcomes by 30% for chronic heart failure patients by enabling remote monitoring for early intervention for these patients. (Chaudhry et al., 2010)

Several studies have explored the effect of the utilization of Tele monitoring to manage patients with chronic heart failure. A Cochrane review of Inglis, et al., (2010) concluded that tele monitoring of chronic patients with heart failure reduced the rate of death from any other related cause by 44% and also reduced the rate of heart failure- related hospitalization by 21%. To further ascertain this fact Chaudhry et al., (2010) also conducted a multi-center trial which involved 33 cardiology practices across the US and used a randomized controlled trial with a Tel-Assurance commercial system which was selected based on its technical quality in the area of telemedicine

at that time. This trial determined that tele monitoring on chronic heart failure patients showed no significant effect on readmission or death from any other cause for chronic heart failure patients. This trial had 826 randomly Tele monitored chronic patients in which readmission for any cause occurred in 407 patients (49.3%), 11.1% (92 patients) recorded deaths during a 180-day period and 827 usual care chronic patients with readmission rate of 47.4% (392 patients) and recorded death of 11.4% (94 patients). Chaudhry, et al., (2010) also noted in their study that tele monitoring through the use of telephone based interactive voice-response system in patients with heart failure after being discharged had neutral effectiveness when compared with patients who utilized the traditional methods of care delivery.

In addition to previous research about the neutral effectiveness of tele medicine/ tele monitoring of chronic heart failure patients, Inglis and research colleagues conducted a meta-analysis study with 8323 patients using external telemedicine devices with telephone support devices reported no hospital readmission for 30 days and no significant beneficial difference with those in the closed group. (Inglis et al., 2010).

Hindricks et al., (2014) also highlighted in their controlled trial of 664 patients which comprised of 333 tele monitored patients with Implantable Cardioverter-Defibrillators (ICDs) implanted in them which were used to automatically detect worsening heart failure after discharge with a 65% decrease in re-hospitalization rates and enabled pre-emptive medical intervention also a controlled group of 331 usual care chronic heart failure patients were chosen all in 36 tertiary clinical centers. Their study noted that 8 deaths were recorded for the tele monitoring group versus 21 for the control group and 6 patients who utilized the ICDs had worsened heart failure conditions as compared to 15 in the control group.

However, an observation study carried out by Saxon, Hayes & Gilliam, (2010) on 10272 patients with ICDs also implanted in them reflected a 50% lower 1 and 5-year mortality rate as compared with the heart failure patients who were treated through the usual care method. Also, the use of ICDs as further options for patients with chronic heart failure resulted to a 35% reduced risk of sudden cardiac death in some patients. (Schmidt, Schuchert, Krieg & Oeff, 2010). (see table 1)

According to in Telemedicine, the use of ICDs on his newly diagnosed systolic dysfunction patients have helped reduce the risk of sudden cardiac death by about 50%. This reduction has been due to the fact that patients usually have ICDs on which is connected to a transmitter and transmits data in form of heart rhythm from the patient to the hospital, so the hospital can be alerted in case of heart dysfunction and the patient is then transferred to the hospital immediately for appropriate care. (Expert in Telemedicine, 2017).

For chronic heart failure patients, many studies have either agreed on the impact of tele medicine and tele monitoring on health outcomes on these patients. While some researchers have noted that there has been not so significant different between these patients and those who utilized traditional care, Partners Health Care have disagreed with this notion and reported that about 3,000 chronic heart failure patients receive in-home care through the aid of tele medicine technologies and with this approach a 44% drop have been seen in hospital readmissions and a cost savings of $10 million within a 6-year period. (Kulshreshtha, Kvedar, Goyal, Halpern & Watson, 2010; Polisena et al., 2010). (See Table 1)

To further stress the improved health outcomes in chronic heart-failure patients using tele medicine devices; Baker, Johnson, Macaulay & Birnbaum, (2011) conducted a controlled trial of 1,767 patients in US Northwest for 2 years with a group utilizing tele medicine as the intervention

group and the other the control group. Mortality rate in the first year displayed a 0.2% decrease in the intervention group and a 2.5% decrease in the second year as compared to the control group, also spending reductions was noted to about 7.7-13.3% ($312-$542) per beneficiary per quarter among the intervention group as compared to the control group. (Table 1)

Similarly, fewer deaths were also recorded with heart-failure patients who utilized tele medicine/monitoring as compared with those in the control group. Number of deaths fell from 150 per 1000 to 100 per 1000 which also transpired from reduced readmissions which reported a drop from 285 per 1000 in the control group to 225 per 1000 and the utilization of a telephone structured support to these patients reported a 164 per 1000 drop from 213 per 1000 as also was an improvement in their quality of life in addition with their health care costs. (Inglis et al., 2010).

Several multi-disciplinary reports and studies have either shown the effectiveness of tele medical devices in the form of tele monitors and tele diagnostic devices and technological applications for chronic heart failure patient care while some have recorded no significance difference as compared to the conventional care method. A study by Klersy, (2009) have also shown an advantage of tele monitoring over the usual care management of these patients with regards to reduced re-hospitalization indices and mortality rates. (Clark, et al., 2007). As agreed by Mclean et al., (2011) who in their study recorded a 15% significant improvement in re-hospitalization rate and 5% decrease in mortality rate. (Table 1).

In Clarke, Shah & Sharma (2011), Shulman, O'Gorman & Palmert (2010) study, relative figures were recorded in terms of significant improvement of the chronic patients studied with a reduced re-hospitalization of 30% and 10% mortality rates. Unlike Polisena, Tean, & Cimon 2010

who recorded significant improvement of 20% drop only in mortality rates of the chronic heart failure patients studied as same re-hospitalization rates with the controlled group. (Table 1).

A study by Kotb, Cameron, Hsieh, and Wells, (2015) also reported that in comparison to usual care, structured telephone support and telemonitoring have significantly reduced the mortality rates by more than 45% and constant hospitalization due to heart failure.

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As much as studies revealed positive outcomes in care delivery with reduced mortality of 12% and a drop-in re-hospitalization rate by 20% for the utilization of tele medicine in the care of chronic heart failure patients, its cost-effectiveness in the management of the illness has not been too assertive with nearly over 20 years of randomized trial works. (Wooton, 2012). (See Table 1).

DISCUSSION

The purpose of this research was to examine the effect of Telemedicine on re-hospitalization and mortality rates in chronic heart failure patient as well as to evaluate what forms of Telemedicine have been utilized in the healthcare industry. The results of the literature review and interview with an expert in the field have revealed that Telemedicine had had a positive impact in patient outcomes and overall care delivery of chronic heart failure patients. The literature review conducted have supported an increased utilization of these technology devices, patient satisfaction as well as reduced mortality and rehospitalization rates which is relative to decreased cost of care delivery for these chronic heart failure patients.

With the progressive nature of the various forms of chronic heart failure illnesses and the constant need for the extensive management of these patients and their respective conditions, it has therefore been a top priority to professional's especially cardiologists to employ adequate

person-centered monitoring using Telemedicine technologies as reported by Swedberg, Wolf and Ekman, (2011) in agreement with Klersy, Silvestri, Gabutti, Regoli, and Auricchio, (2009) study. As noted previously by many studies, patients with chronic heart failure have recorded a decrease both in rehospitalization and mortality. While one literature review, Chaudhyy et al., (2010) identified one study that found no decrease in re-hospitalization rates as compared to the control group and the authors also noted that if Telemedicine were to be successful and give the desired patient outcomes in terms of rehospitalization these criteria must be met which include adequate product assurance for the patient, alignment of outcomes to financial incentives and more research should be done on cost and corresponding value derived from these devices for the chronic patients.

The most significant review of the use of Telemedicine was the semi-structured interview with the expert who identified certain draw backs in the effective monitoring of the heart failure patients from their homes especially those with the life vest and the ICDs. Heart rate transmissions to the hospitals have not been able to be monitored 24 hours of the day as the staff in charge of monitoring these transmissions works restricted hours and cost of stationing a professional throughout the day is very cost intensive. This drawback was the only barrier identified by the expert and in agreement with the study of Chaudhyy et al., (2010). Although the utilization of these devices by patients is still high.

Study Limitation

Limitations of the literature review were due to restrictions in the literature search strategy because of the following reasons. Peer-reviewed literature on Telemedicine was limited due to the number of electronic databases utilized. Although additional databases were searched; however, limited

and similar information was found in those databases. Furthermore, while more research exists generally in Telemedicine but not so much exists in terms of research for Telemedicine effect on chronic heart failure patients and even fewer researchers examined the drawbacks associated with its utilization. In addition, researcher and publication bias could not be ruled out.

Practical Implication

The most important practical implication for the utilization of Telemedicine have been to enhance the care delivery process and health outcomes of chronic heart failure patients ultimately revolves round the patient's interpretation of the use of this technology. It is important in the current healthcare industry where value for the patient have been emphasized upon that Telemedicine technologies improve patient outcomes, is cost efficient and provide value to the patient which would be in the form of reduced rehospitalization rates, in-patient frequent checkups, mortality rates and effective heart monitoring and proactive care in emergency cases.

CONCLUSION

The utilization of Telemedicine in the treatment of chronic heart failure patients has gained a lot of awareness with many treatment and management options being available during the care process. Developers are continuously working to improve these technologies, provide adequate and effective monitoring which would aid better care coordination process for the Cardiologists and other providers.

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Figure 1: Conceptual Frame work

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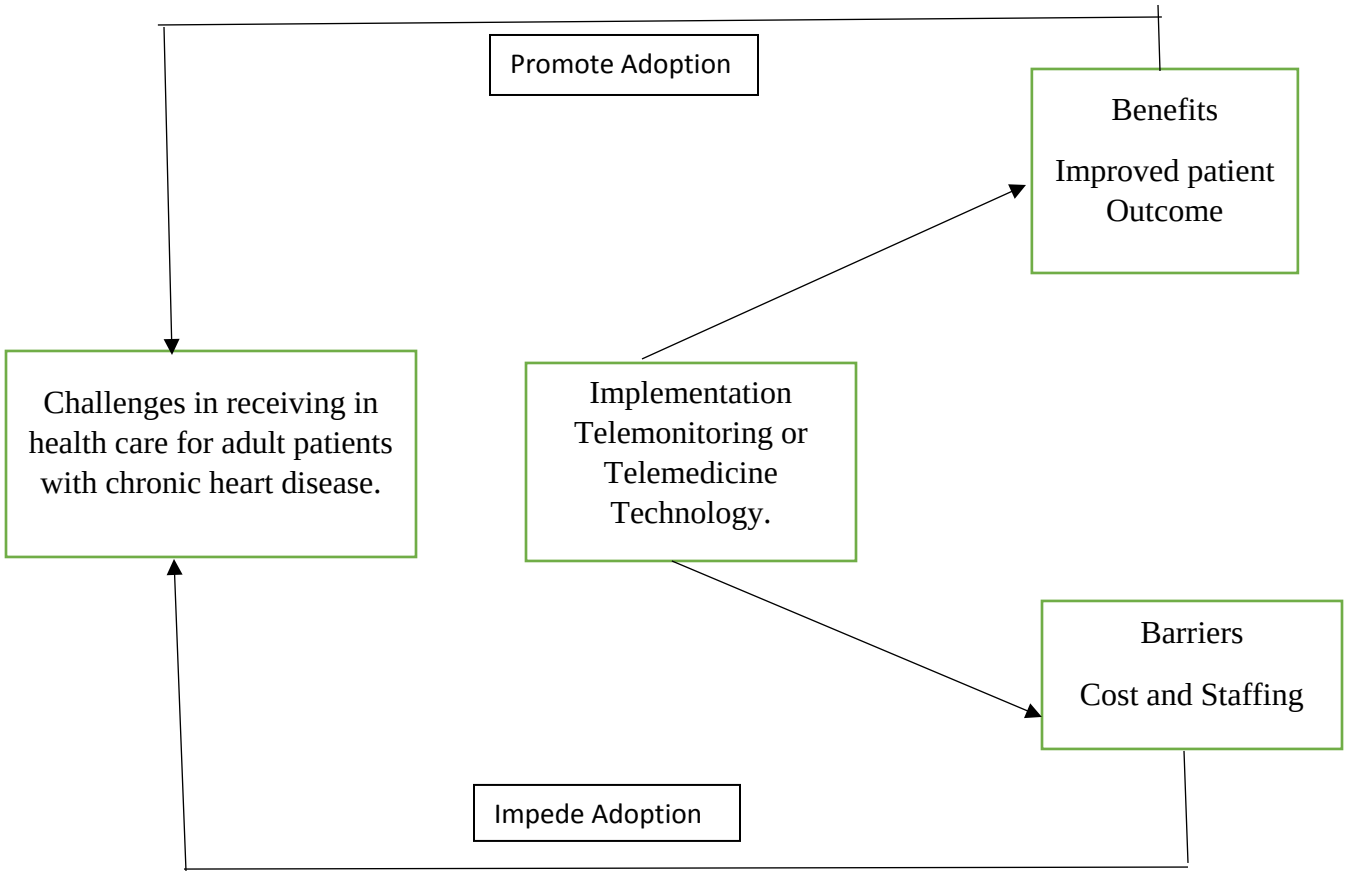

Source: Yao, Chu, Li (2010)

Table 1: Tele medicine utilization and outcomes in terms of re-hospitalization and mortality rates as compared to conventional care delivery.

Authors	Re- Hospitalization rate	Mortality rate
McLean et al., 2011	15% lower	5% lower mortality rate
Saxon, Hayes & Gilliam, 2010	5% reduction among patients	35% reduction, much higher than rehospitalization rates.
Clarke, 2011	30% lower compared to the control group	10% lower mortality rate
Shulman, O'Gorman & Palmert , 2010	30% reduction of re-hospitalization	10% reduction and significant improvement as compared to the control groups
Polisena, Tran, Cimon, 2010	No record provided	Significant improvement
Inglis et. al., 2010	21% lower re-hospitalization rate	44% reduction in mortality rate
Chaudhry et al., 2010	No significant difference between both patient groups	No significant difference between both patient groups
Hindricks et al., 2014	65% lower in reduced risk patients	38% lower as compared with the group with zero telemedicine utilization
Schmidt, Schuchert, Krieg & Oeff, 2010	35% lower when compared to the control group	5% lower when compared to the controlled group
Kulshreshtha, Kvedar, Goyal, Halpern & Watson, 2010; Polisena et al., 2010	No record provided	44% lower mortality rate for chronic heart failure patients compared to the controlled group
Baker, Johnson, Macaulay & Birnbaum, (2011)	25% reduction	0.2 % - 2.5% reduction
Wootton, 2012	28% reduction in inpatient rehospitalization and checkups	12% reduction in mortality rates.

APPENDIX A

Questions asked during the Semi-Structured Interview of an Expert in Telemedicine management in chronic heart failure patients on 1st November, 2017.

- How has been the incorporation of Tele medicine into your practice assisted in effective care delivery of chronic heart failure patients?
- What forms of tele medicine have been utilized in this hospital for the chronic heart failure patients and why were the particular ones chosen?
- Who is involved in the coordination and ensures these technologies are appropriately used on and by the patients and why?
- As an expert in this field, how has the utilization of tele medicine faired in terms of patient outcomes, re-hospitalization and mortality rates and what is the underlying cause of the numbers?
- What has the patient satisfaction response/rating been for the patients?
- How do you monitor the device's utilization and effectiveness after discharge of these chronic patients and why?
- What particular and significant advantages have been recorded in your patients who used one form or the other of tele medicine?
- In your own opinion how has tele medicine faired over the years in particular to your chronic heart failure patients and why?
- What do you think the tele medicine industry still needs to work on to improve the care delivery process and why?
- What has been the cost implication of these devices/services as compared to the quality of care being received by these patients and why?