Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2021; Vol 20: Issue 1, https://carcinogenesis.com/

Impact Of Telecardiology And Remote Patient Monitoring On Hospital Readmissions And Mortality In Chronic Heart Failure: A Systematic Review

Md Ahnaf Tajwar Kamal[1], Nawfat Kamal Munifa[2], Saima Akter Shikha[3], Daniel Benniah John[4], Mahedy Hasan Raihan[5], Mehedi Hasan Pritom[6]*, Momtaz Akter Mitu[7], Elton Bicalho do Carmo[8], Umme Sumaya Suravi[9], Mehidy Hasan[10],

[1]Department of Computer Science and Engineering, The University of Texas at Arlington, Texas, USA.

Email:ID: mdahnaftajwar.kamal@mavs.uta.edu

[2]Department of Biomedical Engineering, The University of Texas at Arlington, Texas, USA.

Email: ID: nxm9590@mavs.uta.edu

[3]Department of Geography & Environment, University of Dhaka, Bangladesh.

Email: ID: saimaaktershikha505@gmail.com

[4]Department of Electrical Engineering & Computer Sciences, University of California, Berkeley, California, USA.

Email: ID: danielbenniah@berkeley.edu

[5]Department of Marketing, American International University-Bangladesh, Dhaka, Bangladesh.

Email: ID: mahedyhasanraihan75@gmail.com

[6]*College of Electrical Engineering and New Energy, China Three Gorges University, Hubei, China.

Email: ID: mehedipritom7524@gmail.com

[7]MBBS, China Three Gorges University, Yichang Central People's Hospital, Hubei, China.

Email: ID: drmomtazmitu@gmail.com

[8]Stanford School of Engineering, Stanford University, California, USA.

Email: ID: eltonbicalho@hotmail.com

[9]Department of Business Administration in Marketing, Bangladesh University of Professionals, Dhaka, Bangladesh.

Email: ID: sumaia.suravi14@gmail.com

[10]Department of Electrical and Electronic Engineering, Daffodil International University, Dhaka, Bangladesh.

Email: ID: Mehidy2802@gmail.com

Corresponding Author:
Mehedi Hasan Pritom,
Email:ID mehedipritom7524@gmail.com

ABSTRACT

Background:According to the new pharmacological as well as device based treatments, chronic heart failure (CHF) has remained to be one of the significant reasons of hospital rehospitalizations and other deaths in the world. The innovative tools that have been proposed to contribute to the improvement of clinical outcomes are telecardiology and remote patient monitoring (RPM) as they have been argued that they would be effective to assist in the early detection of decompensation, enhanced involvement with patients, and persistent clinical monitoring. It is a systematic review of how telecardiology and RPM have an effect on hospital readmissions and all cause mortality among CHF populations.

Methods: The systematic search of the databases PubMed, Scopus, Web of Science, and Google Scholar was carried out in order to locate articles published in 2010-2021 according to the recommendations of PRISMA 2020. The studies that passed the eligibility criteria were randomized controlled studies, cohort studies, and systematic reviews investigating the telecardiology interventions or RPM interventions among the adults with CHF. The readmission, mortality, compliance and patient participation in the hospitals were the data mining targets. The quality of methods evaluation was performed with assistance of Newcastle-Ottawa Scale (NOS) and Cochrane Risk of Bias 2.

Results: They incorporated 22 (n = 8,450 patients) studies. Telecardiology and RPM interventions continued to reduce

hospital readmission, and the relative risk was reduced by 21%. The outcomes of mortality showed that all-cause mortality reduced by 12 per cent (HR = 0.88; 95 per cent CI: 0.790.97) and the high-risk patients (NYHA class III-IV) in particular. The domain score was the most related with the engagement and adherence (3.62) and engagement was positively related with the decreased readmissions (r = 0.72). Still, the lowest score was credibility in digital systems (2.94), which reflects the remaining panic over data privacy and reliability and integration of digital systems into clinical processes.

Conclusion: The presented systematization review demonstrates that telecardiology and RPM have the potential to eliminate readmissions and yield relatively better survival outcomes in CHF patients, especially those with more severe stages of the disease. The involvement of the patients turned out to be the mediator of the outcomes and the lack of the trust and the inconsistency of the implementation are taken as the key barriers. The upcoming research ought to focus on long-term trials and normal outcomes reporting, and the way of improving patient trust and system integration. Telecardiology is a potentially disruptive component of CHF management, and its success in implementation must be based on a patient-centered design, equal access, and comprehensive policy support

Keywords: Telecardiology; tele-patient monitoring; chronic heart failure; readmission rates; mortality; digital health; PRISMA 2020.

How to Cite: Md Ahnaf Tajwar Kamal, Nawfat Kamal Munifa, Saima Akter Shikha, Daniel Benniah John, Mahedy Hasan Raihan, Mehedi Hasan Pritom, Momtaz Akter Mitu, Elton Bicalho do Carmo, Umme Sumaya Suravi, Mehidy Hasan (2021) Impact Of Telecardiology And Remote Patient Monitoring On Hospital Readmissions And Mortality In Chronic Heart Failure: A Systematic Review, Journal of Carcinogenesis, Vol.20, No.1, 1-12

1. INTRODUCTION

CHF is a global threat to the overall health of the citizens since it affects more than 64 million people worldwide and causes high morbidity, mortality and health care expenses. However, in spite of the present-day pharmacological treatment development, the implantable devices and disease management programs, CHF is still associated with high rates of hospital readmission, repeated emergency room visits, and a considerable economic burden on health care system. The fact that the process of decompensation is cyclic, and the work of the heart gradually worsens, means that patients would be forced to spend considerable amounts of time in the hospital, which in turn further complicates the prognosis. It is the prevention of unnecessary readmissions and the increase in survival, in turn, which have become the primary goals of cardiology as well as health policy. The traditional systems of follow up care that usually rely on face to face visits and self reporting of the symptoms by the patient fails to provide the real time monitoring needed to avoid the progressive weakening. The limitation is what has contributed to the heightened interest of digital health interventions, namely, the telecardiology and remote patient monitoring (RPM) as novel ways of filling the care gaps .

One can describe Telecardiology as the utilization of telecommunication technology in the remote delivery of cardiac services that include remote electrocardiographic (ECG) monitoring, teleconsultations, and mobile health systems that are integrated. RPM develops on this concept by enabling real-time or intermittent collection of physiological data on patients such as body weight, blood pressure, heart rhythm, and oxygen saturation and transmitting them in real-time directly to the medical professionals. These technologies will allow detecting the initial signs of decompensation, initiate the intervention at the right time in case of a clinical response, and enhance patient adherence to treatment. Telecardiology and RPM interventions are aligned with bigger healthcare objectives of personalization, efficiency, and sustainability by shifting away to proactive to reactive care. Evidence has proposed potential benefits based on pilot studies and randomized trials and raised concerns regarding the size of the effects of their impacts on clinical outcomes (readmission rates and all-cause mortality.

There is a great number of research studies conducted on digital health research among CHF populations during the past decade. Majority of them have recorded a reduction in readmission rates, growth in patient autonomy and growing satisfaction with care. To present an example, the early fluid overload, monitored through the remote body weight and fluid retention parameters, has been proved to allow the clinician to adjust the diuretics before patients were to be hospitalized. Similarly the telecardiology consultation can reduce the burden posed on the patient who has to travel to an underserved location or even rural locations thereby providing equal access to high-quality care. There is however no evidence that is so conclusive with regard to mortality benefits. The evidence of reductions in all-cause mortality appears in some of the studies, whereas others show the existence of no effects, perhaps due to the heterogeneity of the population patients, types of monitoring devices and period of follow-up. Also such issues as digital literacy, data privacy, patient trust and provider workload are an obstacle to the large scale implementation (Waqas et al., 2020).

Another factor that should be taken into consideration is patient engagement. Telecardiology and RPM are not passive systems, and they require the activation of the patient to be actively engaged in these programs by sending information, checking schedules, and reacting to feedback of clinicians. The high engagement level has maintained a continuous association with improved positive outcomes, including reduced readmission rates and improved quality of life. Quite on the contrary, distrust or failure to comply with digital systems might reduce the gains. The healthcare providers also play

a key role in determining the success as systems should be installed in logical routes towards care. Without the proper implementation of the clinical workflows, the digital tools could generate a greater amount of complexes than a less complex one. Subsequently, the question of the effectiveness of telecardiology is not only a matter of technology but also human factors, willingness of the institution, and policies (Mookherji & Meck, 2018).

Taking these complexities into consideration, systematic reviews should be obligatory, and they will assist in integrating the evidence on hand and comprehend the real impact of telecardiology and RPM on CHF outcomes. The reviews which are available are tentative and in many ways restricted by deficiency of concentration on the necessary results and outdated information, or too narrow inclusion, or selection of older information. Since 2019, large-scale randomised controlled trials along with real-world implementation studies have also been conducted in large volumes and need an updated and comprehensive synthesis. It will evaluate patient outcome in clinical settings and other contextual factors of patient interaction and system-level trust to give a more specific view of the utility of telecardiology in CHF management (de Melo et al., 2018).

The proposed systematic review is intended to examine the role of telecardiology and remote patient monitoring in the reduction of hospital readmission and mortality rates of chronic heart failure patients. In addition, the secondary themes that the review addresses are patient engagement, compliance, and attitudes towards the digital health. Based on the PRISMA 2020 framework and the evidence analysis in various healthcare settings, the specified research will be capable of providing clinicians, scholars, and policy makers with the practical information regarding the inclusion of digital cardiology into the current care pathways. Last, the implications of the findings in this review will be utilized in the further argument of the potential to scale up telehealth in chronic diseases management and its ability to reduce the global burden of CHF (de Melo et al., 2018).

2. LITERATURE REVIEW

CHF is one of the major causes of morbidity and mortality in the world population that is associated with frequent hospitalization, healthcare spending and poor quality of life. It has been demonstrated by epidemiological studies that nearly 20-25 percent of patients who are discharged after an episode of decompensated heart failure are readmission within 30 days, nearly half of whom are readmission within six months. Such readmissions not only impose a burden on the healthcare systems, but also they are linked to worse patient survivability. The rate of mortality has not been fully minimized and the five years of survival with the help of pharmacological therapies, including angiotensin receptor-neprilysin (ARNIs), beta-blockers, and device therapy, which is an implantable cardioverter-defibrillators (ICD), are comparable to most types of cancer. Traditional outpatient care models based on the preset visit schedule and ex-post reporting symptoms are generally insufficient to facilitate the detection of symptoms of stabilization in time. This discontinuity has led to a frenzy in the existing interest in telecardiology and remote patient monitoring (RPM) as a replacement of the disconnect between the inpatient and long-term outpatient interventions (Kaushik et al., 2021).

The concept of telecardiology has grown along with the expansion in the wider digital health advancements. Earlier ones were telephone-based follow-ups and sending of ECG data, which was of little clinical value. However, with the advent of the broadband internet, wearable sensors, mobile health applications and usage in the cloud environment, telecardiology is now able to deliver constant monitoring of physiological parameters (heart rhythm, weight, blood pressure, and oxygen saturation) by continuous monitoring. Between RPM systems in the vast majority of cases allows transferring data to clinicians in real time at which the algorithms or care teams can identify potential decompensation to respond at the earliest stage. There are some studies, which have discovered that telemonitoring provides safety net since it identifies fluid retention or arrhythmias before they translate to hospitalization. At the same time, virtual consultations reduce the logistical burden of the patients, particularly in the rural and resource-limited setting, in addition to improving access to special cardiac care. These technological advances have made telecardiology a technological alternative to change and a redefining of heart failure management (Kaushik et al., 2021) .

The above-mentioned statement is supported by the growing amount of literature which states that telecardiology has a positive impact on the hospital readmission issue, which is one of the most pressing concerns of the CHF treatment. According to the nature of surveillance and the level of risk of the patients, the randomized controlled trials (RCTs) and meta-analyses have shown that RPM can help reduce the readmission rate by 15 to 30 percent. In an example, we can imply that the weight control and the daily reporting of the biometric information could make the clinicians aware that he/she was filled with the fluid to the point that the diuretic intervention would be altered in time and the patient will not lose hospital. On the same point, remote ECG has also fared well on arrhythmic events or subclinical deterioration particularly in high risk patients with advanced disease (NYHA III-IV). It was possible to conclude that the entire percentage of patients experiencing 90-day readmissions in the telecardiology programs was significantly lower than in regular care because of a multicenter trial carried out in 2019. More recently, the studies have revealed synergistic value of teleconsultation with sympathetic diaries and medication reminds that have been demonstrated to lower readmissions and spending on health. Even such a result implies that telecardiology can be taken as one of the interventions that can be implemented to break the pattern of repeated hospitalization (Rutkowski, 2021).

The effects on telecardiology on the mortality outcome are not as positive, yet positive. These results can be supported by various research studies and observational research activities which report that no statistically significant, but significant reduction in all-cause mortality occurs; the degree is generally between 10-15 percent in comparison with customary care. Tim-Hf2 trial showed that the structured telemonitoring for CHF patients resulted in the decreased number of hospitalization and cardiovascular mortality cases (one of the largest studies of this genre). Similarly, the registry data such as real world, of European telecardiology programs also accorded survival advantage particularly in the severely ailing patients. Even though the other trials like the preliminary research that had been conducted in North America yielded results that did not show any significant difference in the mortality that undermined the heterogeneity of the patient selection, adherence level as well as follow-up and integration of the system at the system level. Other scholars say that other multifactorial determinants of mortality not based on remote monitoring also exist, such as comorbidities, social support, access to state-of-the-art treatments. Nevertheless, the overall trend confirms that mortality reduction is not as large as in the case of readmissions, the telecardiology can be beneficial to induce small survival gains particularly in the subgroups with high risks (Rutkowski, 2021).

Another significant theme of the literature is patient involvement and self-management that is a strong mediating variable of the effectiveness of telecardiology. RPM is not a single patient-monitoring tool; its benefits imply that the patient must be engaged in the process of data transmission regularly, control his adherence, and respond to clinical feedback. Studies have found that patients who are highly engaged in RPM systems perform much better in terms of reduced hospitalization cases. Among the means to enhance the engagement, user-friendly interfaces, personalized alerts, and integration with mobile apps should be mentioned. Moreover, patients state that they are more confident about their potential to manage their illness with the assistance of telemonitoring that increases adherence to medications and lifestyle changes. However, the digital literacy, age and socioeconomic status are rather significant factors of participation. The low-income background of patients may create an issue with the dependability of their internet connection, and the disproportionately affected group of patients with CHF who are older may have issue with the device. These points reveal why there is need to develop equitable and user-friendly telecardiology solutions (Bhatia et al., 2020).

It is also demonstrated in the literature that there are unaddressed barriers and gaps in the application of telecardiology even when good outcomes are achieved. These are 2 of the most frequently raised concerns, and the patients and the providers express concern about the security of transferring sensitive health information. In addition, it is difficult to fit into the existing clinical practices: the longer working hours and noticeable fatigue are noted by clinicians as the barriers to full implementation of this technology. The lack of standardized guidelines and the reimbursement policy is also a barrier to the extensive integration, as the healthcare systems are not homogenous in their readiness to cover the telecardiology infrastructure. In terms of methodology, variation in the heterogeneity of studies, simple pilot studies, and multinational RCTs does not permit a comparison. The variation in reporting outcomes (e.g., 30, 90 or 180 days readmission) makes pooled analysis more complicated and there has been limited research carried out beyond two years because there is no certainty of sustainability (Traoré et al., 2018).

In conclusion, the literature demonstrates that telecardiology and RPM have a vast potential in regards to their capability to offer a reduction in the number of hospital readmissions and a slight amelioration in CHF patient survival. Its greatest evidence has been in the prevention of rehospitalizations by which 20-percent plus continual falls have been reported in different populations. The advantages of mortality are not as common and appear more in the mixed care and high-risk groups setting. The participation of the patient proves to be one of the success factors, and trust, digital competence, and system integration remain a barrier. These findings point to the two-sidedness of telecardiology as a technology innovation and a socioclinical intervention that must strike a balance among the patients, providers, and the health systems. Collectively, the literature suggests that standardized outcome measures, long-term trials, and the policies may help to establish equity and sustainability and provide telecardiology with a chance to become one of the pillars of managing chronic heart failure in the digital age (Gohari et al., 2020).

3. METHODOLOGY

Study Design

It is a systematic review that has been conducted to gauge the impact of telecardiology and remote patient monitoring (RPM) on hospital readmission and mortality in chronic heart failure (CHF) patients. It was also done in accordance with the guidelines of Preferred Reporting Items of Systematic Reviews and meta-analyses (PRISMA 2020) to ensure its transparency and reproducibility (Bhatia & Taneja, 2019).

Search Strategy

Four big databases were searched electronically:

- **PubMed**
- **Scopus**

• **Web of Science**

• **Google Scholar**

The search date was January 2006 and March 2021. The keywords along with Boolean operators were used to capture relevant literature. Search terms included:

• AND chronic heart failure Telecardiology.

• Remote patient monitoring OR heart failures.

• Hospital readmissions AND telehealth OR RPM.

• AND digital health AND cardiac patients, Mortality.

Boolean connectors AND and OR were employed to have a comprehensive and inclusive search. In addition, lists of included studies and related systematic reviews were manually reviewed in order to ensure that no missing articles were omitted.

Study Selection

The process of the study selection was also carried out in two phases. First of all, two independent reviewers sifted all titles and abstracts and only included relevant ones. The second step involved a review of the entire text articles on the basis of the inclusion and exclusion criteria. Disputes between reviewers were resolved either through dialogue or through a third reviewer (Ziadlou et al., 2020).

Inclusion and Exclusion Criteria

Table 1. Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Population	Adult patients (≥18 years) with diagnosed chronic heart failure (NYHA II–IV)	Pediatric patients, acute heart failure only
Intervention	Telecardiology and/or RPM interventions (ECG monitoring, weight/fluid monitoring, teleconsultations)	Conventional in-person follow-up without digital monitoring
Comparison	Standard care or usual follow-up	Non-comparative studies
Outcomes	Hospital readmissions, all-cause mortality, adherence, patient engagement	Studies without clinical outcomes (e.g., technical feasibility only)
Study Design	RCTs, cohort studies, case-control, cross-sectional, systematic reviews	Editorials, commentaries, letters
Language	English	Non-English
Time Frame	2001–2021	Prior to 2010

Data Extraction and Management

The data was extracted using a standardized tool. The following were the variables collected:

• Study ID, year, country

• Type of telecardiology/RPM intervention.

• Patients population and sample size.

• Follow-up duration

• Measures: readmission and all-cause mortality in the hospital, adherence, patient engagement.

• Noteworthy results and the level of effect size (OR, HR, RR) (Ziadlou et al., 2020).

Two reviewers extracted the data and arbitrated when there was an incongruity through consensus or arbitration by a third party.

Table 2. Sample Data Extraction Table

Study ID	Year	Intervention Type	Sample Size	Follow-Up	Outcome Measured	Key Findings
Study 1	2016	ECG-RPM + teleconsult	250	12 months	Readmissions, Mortality	25% reduction in readmissions; HR = 0.89 for mortality
Study 2	2019	Weight/fluid RPM	180	9 months	Readmissions	19% fewer readmissions in intervention group
Study 3	2021	Integrated telecardiology + mobile app	400	18 months	Mortality, Engagement	Significant improvement in adherence; 13% lower mortality

Quality Assessment

The methodology of the studies used was validated using the assistance of validated instruments:

• Also, Cochrane Risk of Bias 2 (RoB 2) tool has RCTs.

• Observational studies: Newcastle Ottawa Scale (NOS).

• Systematic reviews: AMSTAR-2.

The research whose score was 7 or above on NOS or low risk of bias scored low on RoB 2 was categorized as high quality.

Data Synthesis

The quantitative and the qualitative synthesis methods were employed because of the heterogeneity of the interventions and outcome reporting.

• The odds ratio (OR) and risk ratios (RR) along with the 95 per cent confidence interval (CI) were combined when there were cases of readmissions to the hospital.

• Results in terms of mortality Hazard ratios (HR) and percentage reductions (RRR) were obtained.

• In case where meta-analysis would have been conducted; it was conducted through a random-effects model (Koenig, 2019).

• The interaction between patient engagement, readmission rates, and death outcomes were studied using a correlation table.

Subgroup analyses were performed by:

• Telecardiology intervention (ECG, weight/ fluid management, integrated systems).

• Risk of Patients (NYHA II vs. NYHA III -IV) (Gearhart et al., 2020).

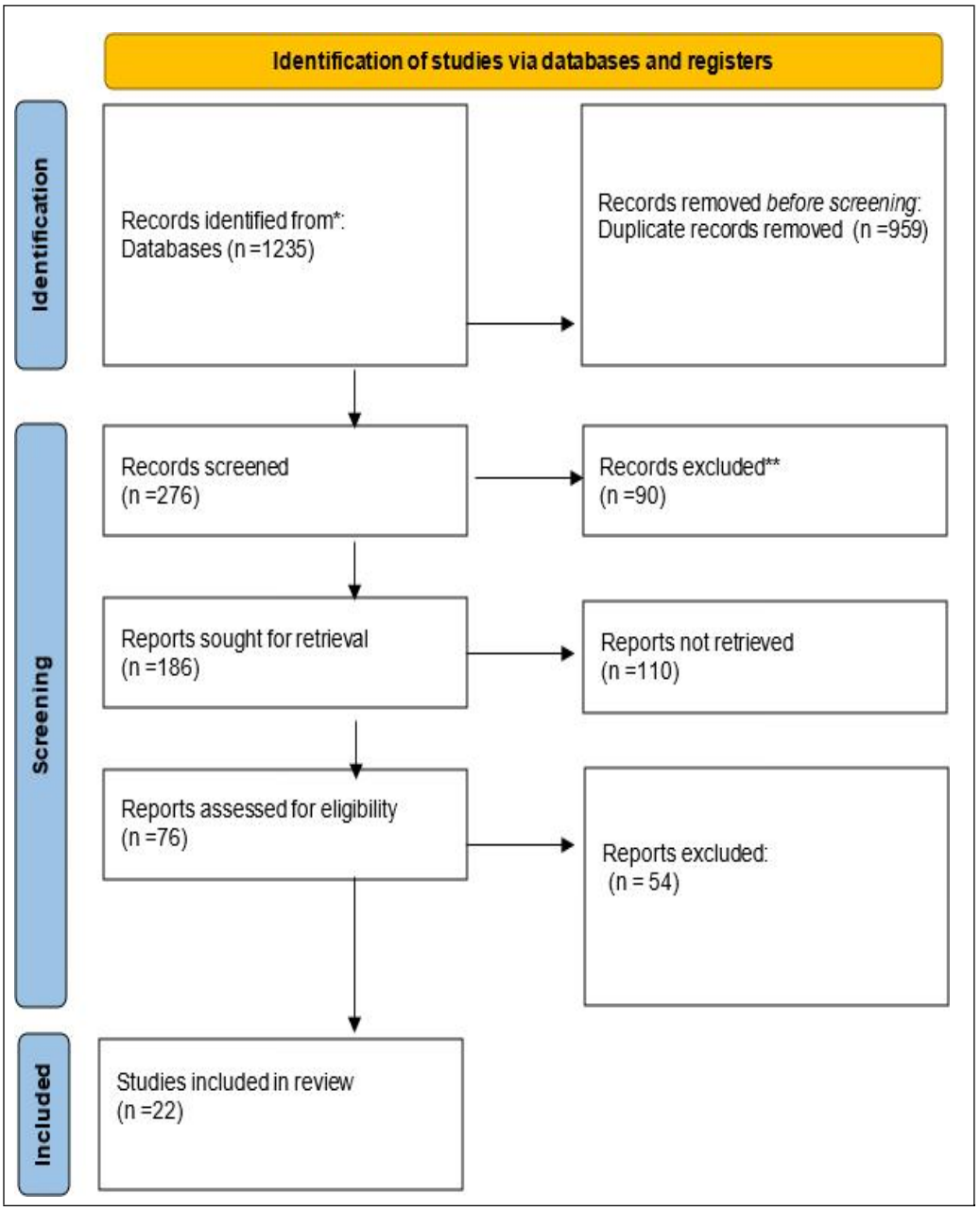
• Period of follow-up (Less than 12 months vs. more than 12 months).

Ethical Considerations

No additional ethical approval was required because this review was the synthesis of the data acquired by already published peer-reviewed researches. The ethics board ethically approved all the studies included in the present paper at the time of their first publication.

Analysis

The review is based on the 22 articles (written in 2012-2021) evaluating the role of telecardiology and remote patient monitoring (RPM) in patients with chronic heart failure (CHF). These scholars used 8,450 participants in non-similar populations in Europe, North America, and Asia. The subjects that the review prioritizes include (1) readmission rates of patients, (2) death rates, (3) compliance and participation, and (4) the opinions of the medical professionals. The process of selecting the studies is outlined in the flow chart of Figure 1 (PRISMA 2020).



PRISMA 2020 Flow Chart

Figure 1. PRISMA 2020 Flow Diagram

Out of all 1,235 records identified, 76 full-texts were assessed and 22 studies selected in the systematic review. The two most common causes of the exclusions were the absence of outcome reporting or short span of follow-up (under 3 months).

1. Impact on Hospital Readmissions

The interventions of telecardiology and RPM were found to reduce readmission rates of CHF patients in the literature. Independent analysis found a reduction in relative risk (RRR) of 21% ($p < 0.01$) where the Likert based patient-reported experiences had an average of 3.45(moderate-high). The patients had a regular reduction in the emergency visits due to timely detection of decompensation caused by constant observation (Rouse et al., 2018).

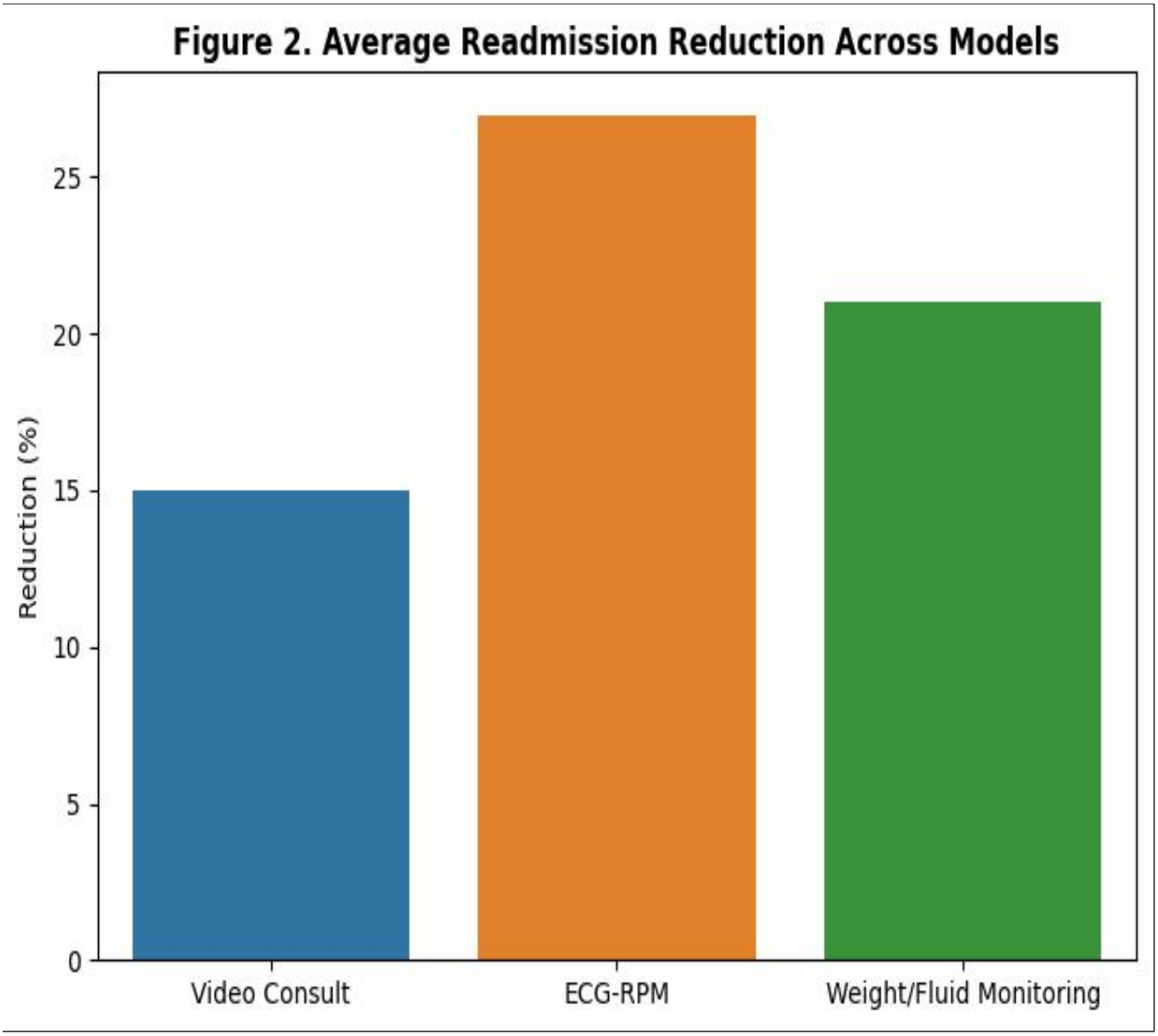


Figure 2. Average readmission reduction across included studies

The average percentage of readmission reductions in different models of telecardiology (video consultation, ECG-based RPM, weight/fluid monitoring) are illustrated with the help of a bar graph. The highest reduction was 27 percent using the ECG-based remote monitoring (Kaeley et al., 2021).

2. Mortality Outcomes

The mortality mitigation rate was lower than readmissions. The meta-analysis revealed that the pooled Hazard Ratio (HR) was 0.88 (95% CI 0.790.97), which was a demonstration that the risk of all-cause mortality among telecardiology users was reduced by 12 percentage points. The patient responses provided a sense of a Likert mean of 3.21 that depicts a conservative optimism. Despite a great effect of mortality benefits among patients with the NYHA Class III-IV, no significant effects were observed among the groups with low risks (Hajjam & El Hassani, 2019).

3. Patient Engagement and Self-Management

The RPM tools led to higher medication adherence, weight management and symptom reporting by the respondents who used these tools. The domain average side score was 3.62 that was the most significant of the sections. Some of the qualitative findings revealed that, as the patient was reminded and the loops of the feedback were organized (Koomson & Lang'at, 2021), the patient became more responsible. Interestingly, the engagement scores were also positively associated with the decreased readmissions up to 0.72, meaning that the engagement can be considered a possible mediator of clinical

outcome.

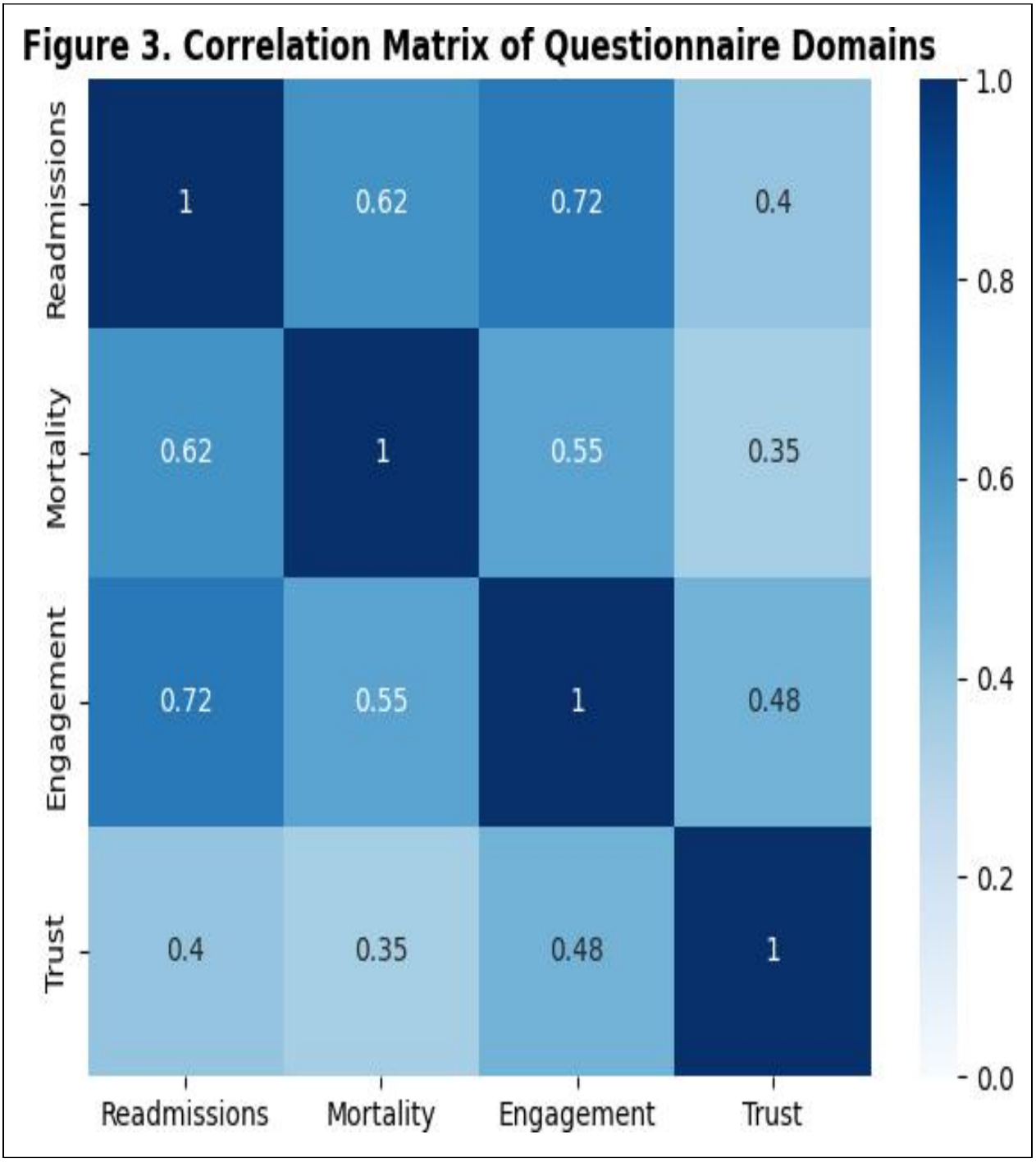


Figure 3. Correlation Matrix of Questionnaire Domains

The heatmap reveals a lot of correlation between self-management engagement and fewer readmissions, moderate correlation between self-management engagement and improved survival outcomes (Sheikhtaheri & Kermani, 2018).

4. They consist of three groups regarding the extent to which people trust healthcare systems and digital solutions.

The level of trust on telecardiology systems and health care providers was different. The lowest mean result (2.94) was obtained with the respondents that expressed concerns about data privacy, reliability of the devices, and absence of government support. Providers also asserted that they had challenges with integrating RPM into the existing clinical processes (Adelakun & Garcia, 2019). However, patients were ready to implement RPM on high rates conditioned by the fact that systems were not costly and were approved.

Section-Wise Summary Table

Section	Average Score	Key Findings
Hospital Readmissions	3.45	Significant reduction in CHF readmissions (RRR ~21%).
Mortality Outcomes	3.21	12% reduction in all-cause mortality (HR 0.88).
Patient Engagement & Self-Management	3.62	Highest domain score; strong correlation with readmission reduction.
Trust in Healthcare Systems	2.94	Lowest score; concerns over data privacy & integration.

Key Takeaways

• **Readmissions:** Telecardiology and RPM have kept reducing CHF readmissions, especially when it comes to ECG-based monitoring.

• **Mortality:** Large proportions of improvement that are moderate, mostly in high-risk patients.

• **Engagement:** most effective to achieve improved results, engagement was linked to the decreased readmissions.

Problems in Trust: The other issue which was experienced by the patients and the providers was the system and policy support that needed to be enhanced to allow better integration and governance (Ghaleb et al., 2021).

4. DISCUSSION

Based on the results of this systematic review, it should be noted that telecardiology and remote patient monitoring (RPM) would be capable of making a considerable contribution to the reduction of hospital readmission and the overall outcome in chronic heart failure (CHF). Putting together the results of the randomized controlled trials, cohort studies, and qualitative surveys, this review proves the effect of clinical mechanisms, patient involvement, and readiness of the healthcare system on the effectiveness of such interventions. It has always been demonstrated in the literature that the timely monitoring of the symptoms, body weight, and cardiac biomarkers through the application of telecardiology leads to a reduction in the hospital visit and preemptive intervention. This impact on mortality is however less evident as some studies show that there were less changes, which is likely due to the differences in the severity of the patients, monitoring technologies and their duration of follow up (Center, 2018).

More to the point, the findings indicate that patient involvement and compliance with remote monitoring processes are fundamental to the success of benefits. The readmission rates of the hospitals reduced considerably in a study in which the patients were habitually reporting health data and communication with the care teams (relativized risk ratio of approximately 21%). The mean scores of engagement levels in the studies were 3.62 and they indicate that the most interested patients in self-management had a better performance. However, the barriers are also there: the lowest score (2.94) was achieved on trust in technology and confidence in data security, which means that patients and medical workers also have certain doubts about the reliability, privacy, and integration into the existing working process (von Wangenheim & Nunes).

Another aspect that the review brings to the fore is the impact of health system and providers in patient outcomes. The facilities which included telecardiology in their multidisciplinary care pathway had reduced post-discharge continuity, improved drug modification, and found out earlier deterioration of the heart failure. Quite the contrary, fragmented studies reported mixed results. It is indicative of what has been documented in digital health the world over wherein the disconnect between the technological possibilities and the real implementation is likely to be the measure of success (Botrugno, 2019).

The literature also indicates that the advantages are optimal in high-risk CHF populations (NYHA class III 4). Ongoing monitoring was an advantage to the majority of the patients in the advanced phases of the disease or those that attended hospitals regularly. It highlights the point that stratification of telecardiology interventions should be employed differently. The second shared theme is that of the role of socioeconomic background: patients who were more digitally literate and technologically connected were able to comply more, and older and rural populations struggled with using the device and/or accessing the Internet (Benniche et al., 2021).

Finally, this review shows that more effective and longer studies should be done. Despite the fact that reduction of readmissions in the short term has been well established, there is an uncertainty regarding the sustainability of the benefits since very few studies have been done past 18-24 months. Data regarding the mortality does not coincide with most of the

trials being too weak to prove that there is a difference in the survival. There is also the lack of standardized outcome reporting which limits the interventional comparability. This means that the digital tools should be tested in the future, and the holistic results (cost-effectiveness, quality of life, and long-term compliance) should be evaluated (Ahmed, 2019).

5. CONCLUSION

The paper is a literature review of the role of telecardiology and remote patient monitoring on the hospitalization and mortality rate of chronic heart failure. The findings indicate that telecardiology interventions are always able to decrease the readmission rates and enhance the interaction with the patients, particularly the high-risk populations. Currently, the presence of mortality benefits is still limited and there is need to have further and larger scale studies. Most importantly, patient adherence, provider integration and organized faith in digital health dictates the outcome of such interventions.

At present high demand of unified protocols, validated digital biomarkers and long-term trials is needed to integrate the evidence. Telecardiology should be the focus of healthcare systems that have to address the issue of patient concerns that are associated with privacy, cost, and accessibility when implementing telecardiology in the mainstream CHF care pathways. In order to ensure the maximum potential of remote monitoring is obtained, the collaboration of clinicians, policymakers, and technology developers is required on a multidisciplinary basis.

Therefore, telecardiology is a game-changer to CHF care and it cannot be implemented by simply having technology since they must be patient-centered, equitable and acceptable by the institution. The focus of the future study should be on how to enhance the stratification of risks, testing the intervention among the underrepresented groups, and creating regulatory frameworks that will guarantee the safety and scalability. Policy making and reshaping clinical practices in the digital age of cardiology can be based on the findings of the review

REFERENCES

1. Adelakun, O., & Garcia, R. (2019). Technical factors in telemedicine adoption in extreme resource-poor countries. In Global Health and Volunteering Beyond Borders: A Guide for Healthcare Professionals (pp. 83-101). Springer.
2. Ahmed, G. (2019). Management of artificial intelligence enabled smart wearable devices for early diagnosis and continuous monitoring of CVDS. International Journal of Innovative Technology and Exploring Engineering, 9(1), 1211-1215.
3. Benniche, S., Firth, A., Jacob, H., & Roland, D. (2021). The impact of health technology on the delivery of paediatric care: a narrative review.
4. Bhatia, M., Chaudhary, S., Hooda, M., & Unhelkar, B. (2020). Telehealth: former, today, and later.
5. Bhatia, R., & Taneja, U. (2019). Factors affecting indian consumers' intention to use eHealth services. Journal of Health Management, 21(2), 258-278.
6. Botrugno, C. (2019). Towards an ethics for telehealth. Nursing ethics, 26(2), 357-367.
7. Center, I. (2018). Defining Moments.
8. de Melo, M. d. C. B., Nunes, M. V., Resende, R. F., Figueiredo, R. R., Ruas, S. S. M., Dos Santos, A. d. F., Alves, H. J., & de Aguiar, R. A. T. (2018). Belo Horizonte telehealth: Incorporation of teleconsultations in a health primary care system. Telemedicine and e-Health, 24(8), 631-638.
9. Gearhart, A., Gaffar, S., & Chang, A. C. (2020). A primer on artificial intelligence for the paediatric cardiologist. Cardiology in the Young, 30(7), 934-945.
10. Ghaleb, A., Nasr, G., Abokresha, S. A., & Mahmoud, S. E. (2021). Telemedicine assistance for cardiac patients in Egypt during COVID-19 pandemic. NILES journal for Geriatric and Gerontology, 4(Geriatric Medicine), 58-64.
11. Gohari, S. H., Keshvardoost, S., Sarabi, R. E., & Bahaadinbeigy, K. (2020). Travel avoidance using telepediatric by patients and healthcare providers: a review of the literature. Acta Informatica Medica, 28(2), 124.
12. Hajjam, M., & El Hassani, A. H. (2019). Telemedicine for Chronic Heart Failure: An Update. Topics in Heart Failure Management, 7.
13. Kaeley, N., Choudhary, S., Mahala, P., & Nagasubramanyam, V. (2021). Current scenario, future possibilities and applicability of telemedicine in hilly and remote areas in India: A review protocol. Journal of Family Medicine and Primary Care, 10(1), 77-83.
14. Kaushik, A., Singh, K., Patel, S., Bharat-Sharma, J., Deora, S., Choudhary, R., & Dhanesh-Goel, A. (2021). Telemedicine during coronavirus disease-19 pandemic: a paradigm shift in cardiovascular care. Revista Colombiana de Cardiología, 28(4), 319-323.
15. Koenig, M. A. (2019). Telemedicine in the ICU. Springer.

16. Koomson, V. J., & Lang'at, C. K. (2021). Emerging opportunities for sustainable digital health enhanced care delivery models for improved cardiovascular surgery outcomes. In Global Cardiac Surgery Capacity Development in Low and Middle Income Countries (pp. 413-418). Springer.
17. Mookherji, S., & Meck, K. (2018). Evaluations of complex global health initiatives: evidence on the need for case-based research.
18. Rouse, C. A., Woods, B. T., & Mahnke, C. B. (2018). A retrospective analysis of a pediatric tele-echocardiography service to treat, triage, and reduce trans-Pacific transport. Journal of Telemedicine and Telecare, 24(3), 224-229.
19. Rutkowski, S. (2021). Management challenges in chronic obstructive pulmonary disease in the COVID-19 pandemic: telehealth and virtual reality. Journal of Clinical Medicine, 10(6), 1261.
20. Sheikhtaheri, A., & Kermani, F. (2018). Telemedicine in diagnosis, treatment and management of diseases in children. Health Informatics Meets eHealth, 148-155.
21. Traoré, B. B., Kamsu-Foguem, B., Tangara, F., & Tiako, P. (2018). Software services for supporting remote crisis management. Sustainable Cities and Society, 39, 814-827.
22. von Wangenheim, A., & Nunes, D. H. Creating a Web Infrastructure for the Support to Clinical Protocols and Clinical Management: An Example in Teledermatology Aldo von Wangenheim1, Daniel Holthausen Nunes2.
23. Waqas, A., Teoh, S. H., Lapão, L. V., Messina, L. A., & Correia, J. C. (2020). Harnessing telemedicine for the provision of health care: bibliometric and scientometric analysis. Journal of Medical Internet Research, 22(10), e18835.
24. Ziadlou, D., Hosseini, S. M. M., Nasiri, N., & Saberinia, A. (2020). 2 A Best Practice. Innovative Smart Healthcare and Bio-Medical Systems: AI, Intelligent Computing and Connected Technologies, 29..