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Using Telemedicine To Optimize The Delivery Of Care In Patients With Liver Disease

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USING TELEMEDICINE TO OPTIMIZE THE DELIVERY OF CARE IN PATIENTS WITH LIVER DISEASE

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Joan A. Kearney, PhD, APRN, FAAN

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Abstract

Chronic Liver Disease (CLD) is one of the top causes of morbidity and mortality globally. Among the spectrum of liver diseases, non-alcoholic steatohepatitis (NASH) is the most common cause of cirrhosis and one of the top reasons for a liver transplant. Patients with NASH end up with hepatic decompensation and liver-related complications such as malnutrition, sarcopenia, frailty, and death. Telemedicine has transformed health care by improving access, reducing cost, and increasing the quality of care. However, telemedicine has not been widely used to manage patients with CLD. This DNP project created a telemedicine protocol to manage patients with NASH, implemented the project at a transplant facility, and evaluated the effectiveness of the intervention using preliminary data from visits one and two. Although a larger sample size and longer study duration are needed, the telemedicine protocol appears to improve patient clinical outcomes as evidenced by a significant decrease in weight and BMI, fewer liver-related hospitalizations, no ED or urgent care visits, and improvement on patients' perception of activity level and worry score. No significant changes noted in the patients' MELD-Na score, overall health-related quality of life, frailty, and malnutrition status.

Chapter 1

Introduction

Telemedicine, derived from the Latin word “medicus” and the Greek word “tele,” was first defined in the 1970s by Thomas Bird, which means healing at a distance (Dinevski et al., 2011). The World Health Organization (2010) defined telemedicine and telehealth as the delivery of health care services by using advances in technology to promote the health of individuals and communities. Telemedicine refers explicitly to the use of electronic information and telecommunications technologies to render clinical services (Health Resources Services Administration, 2019). Due to recent advancements in technology and increasing availability, telemedicine is now widely used in different health care fields with great success in improving patient outcomes (Du Toit et al., 2019; Marcolino et al., 2019; Michaud et al., 2020). Furthermore, the COVID-19 pandemic has dramatically transformed health care and telemedicine services. Innovations in telemedicine can enhance the delivery of care in patients with chronic liver disease.

Chronic liver disease (CLD) is a public health threat and a burden to society. It is one of the top causes of morbidity and mortality in the world. The Centers for Disease Control and Prevention (2019) estimated that 1.8% or 4.5 million adults have liver disease in the United States. In 2017, 41,743 died from liver disease in the United States, and more than 1.32 million died from cirrhosis globally (GBD 2017 Cirrhosis Collaborators, 2020). Having a liver disease is also associated with higher health care expenditure, approximately $19,390 per year. Without considering hepatitis C costs, the direct cost of chronic liver disease was $2.5 billion, and the indirect cost was $10.6 billion in 2004. Health care utilization and costs were nearly $14,000 per patient per year in 2015. Chronic liver disease-related inpatient hospitalization cost was

approximately $18.8 billion in 2016 (Hirodge et al., 2020). Furthermore, patients with chronic liver disease are more likely to have depressive symptoms, poor health-related quality of life (HRQoL), and lower health utility scores (Stepanova et al., 2017).

Non-alcoholic Fatty Liver Disease

Non-alcoholic fatty liver disease, or NAFLD, is an emerging liver disease associated with metabolic syndrome (Chalasani et al., 2018). It is defined as the presence of fat in the liver in the absence of secondary causes of hepatic steatosis. It is commonly associated with risk factors for metabolic syndrome, such as obesity, insulin resistance, diabetes, hypertension, and dyslipidemia (Younossi, 2019). NAFLD has two components: non-alcoholic fatty liver (NAFL) and non-alcoholic steatohepatitis (NASH).

The global prevalence of non-alcoholic fatty liver disease is 24.24% (Younossi, Koenig, et al., 2016). The worldwide incidence rate ranges from 28.01 to 52.34 per 1,000 person-years. Approximately 76% of people with diabetes and 90% of people with obesity have NAFLD. The prevalence of NAFLD has increased in parallel with rising obesity and diabetes rates (Sundaram et al., 2009; Younossi, 2019). In the United States, mortality from non-alcoholic fatty liver disease increased between 2007 to 2016 (Kim et al., 2018).

Non-alcoholic fatty liver disease is a burden to the economy. NAFLD's annual medical and societal costs are estimated $292 billion annually (Perumpail et al., 2017). Approximately $87 billion accounted for NAFLD alone in all age groups. In 2010, the Medicare median annual hospitalization cost was $11,000 per patient, and the median yearly outpatient cost was between $3,308 ± 5,132 (Shetty & Syn, 2019). Due to the rising healthcare utilization, the expected 10-year economic burden of the disease is estimated to be over a trillion dollars in the United States (Younossi, Blisset, et al., 2016).

Problem Statement

The American Association for the Study of Liver Diseases (2020) has defined evidence-based guidelines standardizing the management and care for patients with chronic liver disease. However, despite clear guidelines, patients with CLD often receive suboptimal care and fail to receive treatments as recommended (Buchanan et al., 2014; Kanwal et al., 2012; Wong et al., 2009). Furthermore, the National Health Interview Survey (NHIS) 2013-2017 revealed that patients with CLD have higher rates of poor health and barriers than other diseases (Wong et al., 2019). Identified barriers to care include appointments, access, and finances. Telemedicine can reduce the quality gaps and overcome barriers to care among patients with liver disease. Besides, telemedicine offers various advantages, including enhancing access to care, improving clinical management, enhancing communication between patients and providers, increasing patient satisfaction, improving patient outcomes, and reducing health care costs.

Among the spectrum of liver diseases, non-alcoholic steatohepatitis is the most common cause of cirrhosis and one of the top reasons for a liver transplant (Byrne & Targher, 2015; Pais et al., 2016; Sheka et al., 2020; Tesfay et al., 2018; Younossi et al., 2018). It is associated with increased rates of liver-specific morbidity and mortality (Mantovani et al., 2020; Oaik et al., 2019; Sarwar et al., 2018). A liver transplant is a treatment option. However, organ shortage has made it difficult for liver transplant candidates to get transplanted. Therefore, patients with NASH end up with hepatic decompensation and liver-related complications such as malnutrition, sarcopenia, frailty, and death (Bhanji et al., 2019; Li et al., 2020; Palmer et al., 2019).

To address this problem of suboptimal care, this DNP project developed a telemedicine protocol to optimize the delivery of care among patients with NASH. The protocol includes a monthly telemedicine appointment with the liver transplant multi-disciplinary team. The team

consists of a transplant hepatologist, a transplant surgeon, a nurse practitioner, and a registered dietitian. This project aimed to address patients' needs, reduce readmissions, improve patient outcomes, and increase patient satisfaction.

Significance

Non-alcoholic steatohepatitis is associated with severe liver-related complications and a high death rate. The overall mortality rate for NASH is 25.56 per 1,000 person-years (Paik et al., 2019; Younossi et al., 2019). The common complications of CLD include hepatic encephalopathy, upper gastrointestinal bleeding, ascites requiring paracentesis, and spontaneous bacterial peritonitis. Such decompensating events often lead to frequent emergency department visits and hospitalizations. To overcome these challenges, telemedicine should be utilized to prevent, monitor, and control complications from NASH.

Chapter 2

Review of Literature

Telemedicine has transformed health care by improving access to care, reducing cost, and increasing care quality. However, despite evidence showing its benefits, telemedicine has not been widely used to manage patients with chronic liver disease clinically. This literature review examined the evidence available on telemedicine in patients with liver problems, focusing on the clinical outcomes and methodologies for evaluation.

Search Strategy

A literature review of telemedicine use on CLD was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses or PRISMA guidelines (Moher et al., 2009; Oermann & Hays, 2019). The key questions identified for this literature review were: (1) Is telemedicine feasible in managing patients with CLD? (2) How does telemedicine impact the clinical outcomes of patients with CLD? (3) What tools are used to evaluate the effects of telemedicine and the severity of CLD? And (4) does the use of telemedicine improve patient satisfaction?

PubMed and Embase electronic databases were used to find the best literature that addresses the phenomenon. Boolean operators and MeSH terms used were “chronic liver disease” or “CLD” or “liver disease,” and “telemedicine” or “telehealth” or “telenursing.” The inclusion criteria included patients with liver disease, any electronic health interventions, and health-related outcomes.

The initial searches identified 406 articles through PubMed and Embase databases. Results were filtered to show only articles with full-text availability, which resulted in 325 publications. Further modifications were made for the following exclusionary criteria: abstracts,

articles in the press, short surveys, and youths or adolescents. Twenty-seven duplicates were removed from the list, which yielded 222 articles. The abstracts were screened afterward. One hundred thirteen publications had participants with a diagnosis other than chronic liver disease, and those studies were excluded. Seventy-nine articles were studies on interventions not considered electronic health interventions (telemedicine, telehealth, or telenursing). These articles were then removed from the list.

The thirty articles were screened in full text for relevance. Nineteen articles that provided expert opinions and recommendations on telemedicine were excluded. The last eleven publications were further analyzed. Two studies focused on patients with comorbidities and were considered irrelevant for the review. Two other articles were excluded due to the limited outcomes presented. The seven most relevant articles were selected for the literature review. An adapted PRISMA flow diagram was created to show the details of the article selection process (see Appendix A for the Adapted PRISMA Flow Diagram).

Data Extraction

Pertinent data were extracted from the final seven literature that met the review inclusion and exclusion criteria. The article title, authors, year of publication, academic journal, purpose, objective, level of evidence, sample, methods, design, results, strengths, weaknesses and limitations, and contribution to science and/or practice were organized into an evidence table. See Appendix B for the Evidence Table.

For ease of analysis and comparison, specific data for each study were synthesized in the evidence table, such as participant information, diagnosis, studies' characteristics and findings, study time frames, data collection methods, and validated tools used to evaluate outcomes. In

addition, the quality of each study, including strengths, limitations, risk of bias, and summary, were included in the evidence table.

Synthesis of the Literature

The studies included in the literature review focused on interventions delivered through telemedicine. One study was a randomized control trial. Three literatures were systematic reviews of cohort studies, and the remaining three were cohort studies. Barnett et al. (2020), Javanmardifard et al. (2017), and Mazzotti et al. (2018) explored the efficacy of telemedicine programs in modifying lifestyle behaviors. The studies by Konjeti et al. (2019), Le et al. (2019), Mauro et al. (2020), and Su et al. (2018) looked at how telemedicine streamlines patient care and improves liver-disease. In addition, the studies by Barnett et al., Le et al., and Mauro et al. investigated its effect on patient satisfaction. While the interventions and methods in the literature varied, the evidence in this review concluded that telemedicine was an effective tool for improving clinical outcomes and patient satisfaction.

Literature Findings

All seven studies concluded that the use of telemedicine in managing patients with chronic liver disease was feasible. The studies also found a strong association between telemedicine use, improved quality of care, and improved patient outcomes. In addition, telemedicine improved patient satisfaction.

The interventions delivered through telemedicine included provider consultations and follow-ups, lifestyle modification programs, and nutritional counseling. The studies by Barnett et al. (2020), Javanmardifard et al. (2017), and Mazzoti et al. (2018) aimed at interventions to promote healthy behaviors via telemedicine. Study results showed improved patients' self-care habits, including physical and nutritional habits. In addition, the patients reported positive

experiences with telemedicine and an increased desire to engage in healthier behaviors. Furthermore, two studies compared interventions delivered through telemedicine versus in-person interventions (Javanmardifard et al., 2017; Mazzotti et al., 2018). The studies found that the participants' nutritional behavior and physical activity levels significantly increased with telemedicine. In addition, the attrition rate was noted to be considerably lower among the telemedicine group.

The literature review also strongly suggested that telemedicine use in patients with liver disease improved their overall health. Su et al. (2018) found that telemedicine helped address liver-related issues such as variceal screening and hepatocellular carcinoma screening. However, in comparing telemedicine with regular in-person appointments with a hepatologist, no significant difference was found in the patient survival rate. A higher survival rate was seen in the telemedicine group compared to the no-visit group. Telemedicine did not affect the participants' alcohol use. Additionally, significant weight loss and a decrease in liver enzymes were noted by Mazotti et al. (2018).

The studies also found that telemedicine improved the quality of care. The studies by Konjeti et al. (2019), Mauro et al. (2020), Le et al. (2019), and Su et al. (2018) streamlined care, minimized unnecessary testing, and reduced health care costs. For example, Konjeti et al. found that telemedicine reduced transplant evaluations by 60% and decreased costs by preventing unnecessary consultations and testing (Konjeti et al., 2019).

The use of telemedicine led to shorter waiting times, decreased patient barriers to care, and improved patient satisfaction (Barnett et al., 2020; Le et al., 2019; Mauro et al., 2020). Telemedicine was well-accepted by the patients. The participants reported having positive experiences with telemedicine – better than traditional visits and less burden on travel. In the

study by Le et al., patients reported a moderate to a high level of satisfaction with telemedicine. On the contrary, the study found no significant difference in patient satisfaction compared to the control group.

Limitations

There were multiple limitations identified in this literature review. First, all the studies varied the study designs, objectives, interventions, inclusion and exclusion criteria, methods, and results. Barnett et al. (2020) did qualitative research focusing on lifestyle interventions delivered via telehealth. Javanmardifard et al. (2017) performed a randomized control trial to determine the efficacy of telenursing on lifestyle changes. Konjeti et al. (2019) and Mauro et al. (2020) completed prospective studies, while Le et al. (2019) conducted a retrospective study. Konjeti et al. and Le et al. looked at the effects of telemedicine on liver transplant patients. Mauro et al. investigated telemedicine consultations and patient satisfaction. Finally, the studies by Mazzotti et al. (2018) and Su et al. (2018) were cohort studies that looked at the effects of telemedicine on patients with liver disease.

The second limitation was the variations in sample sizes. Three studies had small sample sizes, which could have affected the internal and external validity of the studies (Barnet et al., 2020; Javanmardifard et al., 2017; Le et al., 2019). On the contrary, four studies had large sample sizes (Konjeti et al., 2019; Mauro et al., 2020; Mazotti et al., 2018; Su et al., 2018). Due to the larger sample size, the strength of evidence is reliable and generalizable.

Third, the duration of the studies also varied, between 12 weeks to four years. The short study duration limited the reliability of the results. Longer study duration is needed to find strong evidence regarding the use of telemedicine in CLD. Despite these limitations, the literature review indicated that telemedicine is an effective intervention for health promotion.

Conclusion

Despite the heterogeneity and the limited number of studies, this literature review concluded that telemedicine could enhance patient access to care, improve clinical outcomes, and increase patient satisfaction. Interventions found to be effective were nutritional counseling, lifestyle modifications, and provider consultation and follow-up. However, the evidence presented in this literature review is limited, and further studies are required to examine its effects on managing patients with chronic liver disease. Studies with rigorous designs and larger sample sizes are needed to better evaluate the effectiveness of telemedicine.

Project Model and Supporting Framework

A Model for Change to Evidence-Based Practice is a systematic process of implementing change in health care (Rosswurm & Larrabee, 2007). This framework incorporates change theory and can guide practitioners in the process of evidence-based change. This DNP project utilized this model for change to be adapted in an ambulatory setting (see Appendix C for Project Model).

Based on the National Health Interview Survey collected from 2013 through 2017, patients with chronic liver disease face barriers related to appointments, access to care, and finances at higher rates than patients with other diseases (Wong et al., 2019). Barriers to care can negatively impact the patient's ability to meet their needs, putting them at a higher risk of developing complications. To address these barriers, changes in current practice are needed to improve the quality of care and patient outcomes. Based on evidence gathered from the literature review, a telemedicine protocol involving a multi-disciplinary team can optimize care for patients awaiting liver transplantation with non-alcoholic steatohepatitis. Traditional practice is geared towards in-office appointments for a consultation or follow-up. Telemedicine is an

excellent alternative to traditional practice. It increases access to care without compromising the quality of care provided.

A Plan-Do-Study-Act or PDSA model for improvement was used as the supporting framework for this DNP project (Hickey & Brosnan, 2017). It provided a guide to develop, test, implement, and evaluate outcomes from the proposed changes (see Appendix D for an Adapted PDSA Model for Improvement). The PDSA model was incorporated in step four – designing practice change, and step five – implement and evaluate the change in practice of the Model of Evidence-Based Practice Change.

Organizational Analysis

This DNP project was implemented at Keck Medicine of USC's Transplant Institute in Los Angeles, California. Keck Medicine of USC (2020) is a non-profit, private academic health system that consists of three hospitals (Keck Hospital of USC, USC Norris Cancer Hospital, and USC Verdugo Hills Hospital) and forty multispecialty clinics throughout Southern California. The main facility sits in the heart of Los Angeles. It primarily services the indigent, medically underserved, and minority populations of the Los Angeles community. Keck Hospital of USC, which has 401 acute beds, is where the transplants are performed. The health system has one gastroenterology and hepatology clinic, one transplant clinic, and one outreach clinic for both services.

Thirty-six percent of the university's operating revenue is from the health system (University of Southern California, 2019). In 2019, $1.89 billion was the total health care services revenue. The impact of COVID-19 on the university has led to cost-cutting measures, including salary cuts, hiring freeze, and discontinuation of non-essential projects. However,

during the pandemic, the institute continued to perform transplants, generating revenue for the university.

The USC Transplant Institute has four solid organ transplant programs – heart, kidney, liver, and lung. Approximately two-thirds of the revenue comes from the transplant event and cost report and about one-third from downstream income (Cost Report Data, 2020). Other sources of income are reimbursement, supplemental payment, and other remuneration directly from the hospital after the transplant. The kidney program has the highest case volume and generates the most revenue of all the programs. The current budgets allocated for Keck Medicine of USC's Transplant Institute and the Department of Gastroenterology and Hepatology department are not published.

An organizational readiness to change assessment was used to analyze the organization (Helfrich et al., 2009). The key findings of this assessment were:

1. The university and leaders of the organization support current practice changes leading to quality care.
2. Staff members are willing to participate in changes to improve patient care.
3. Clinical management provides project feedback and suggestions for improvement.
4. No financial support can be obtained due to the impact of COVID-19 on the institution.
5. Grants/financial support from foundations can be obtained to support quality improvement and research projects.

Strengths, Weaknesses, Opportunities, Threats Analysis

An analysis of Keck Medicine of USC's strengths, weaknesses, opportunities, and threats was made to aid in the strategic planning for this DNP project. Ranked #18 best hospital in the

United States, Keck Medicine of USC is one of the top-performing health systems nationwide (U.S. News & World Report, 2020). The institution prides itself on health care excellence, clinical care, teaching, and research. The COVID-19 pandemic affected the institution financially, leading to cost-cutting measures, consistent staffing shortages, a high turnover rate, and lower employee satisfaction. The institution recognizes its weaknesses and is aware of the opportunities for improvement.

In 2021, the liver transplant program at Keck Medicine of USC became the largest liver transplant program in California and the West Coast. The program is now the fourth largest liver transplant program in the nation. In addition, the USC Transplant Institute ranked second in the country for combined heart and liver transplants.

Project Goal and Aims

The goal of this DNP project was to develop a telemedicine protocol optimize the delivery of care among patients with NASH. The aims of this project were:

1. To develop a telemedicine protocol to be incorporated into the department's care model for patients with chronic liver disease.
2. To implement and evaluate the protocol.
3. To make recommendations for sustainability and scaling to a broader population of individuals awaiting organ transplantation within the organization and as a model protocol for other transplant centers.

Chapter 3

Methods

This quality improvement project developed a telemedicine protocol to be incorporated into the Liver Transplant Department's care model. The protocol included a monthly telemedicine appointment with patients by a multi-disciplinary team. This project aimed to address the patients' needs, reduce hospitalizations, improve patient outcomes, improve quality of life, increase patient satisfaction, and reduce health care costs.

Aim 1: To develop a telemedicine protocol to be incorporated into the department's care model for patients with chronic liver disease.

The protocol consisted of a monthly telemedicine appointment for patients with NASH. The steps followed to create this protocol include:

- **Built a multi-disciplinary team that will follow the patients**. A multi-disciplinary team that would follow the patients was formed. This team included a Transplant Hepatologist (MD), a Transplant Surgeon (MD), a Transplant Nurse Practitioner (NP), and Transplant Registered Dietitian (RD).
- **Outlined clinic format**. The patient was seen by a physician or a nurse practitioner once a month for two consecutive months. The physician and the nurse practitioner alternated seeing the patients each month. The appointment was approximately 20-30 minutes with the providers. In addition, the patient had a 20–30-minute appointment with the registered dietitian for two consecutive months.
- **Planned for deviation**. The patient/s were seen in person for any urgent matters or per patient request. If a patient was seen in person instead of telemedicine, the multi-

disciplinary team followed the protocol and continued to provide routine care, as they would via telemedicine.

- **Set goals, roles, expectations, training, and evaluation**. The MD/NP partnered with the RD for each telemedicine appointment. The MD/NP and RD made personalized recommendations to each patient depending on their need/s. Training for the MD, NP, and RD were provided. Training included educational sessions regarding the telemedicine protocol, how to use the InTouch telemedicine platform, what questions to ask the patient during the appointment, forms to use during the appointment, what data to collect on each appointment, and what to do when there was a need to deviate from the telemedicine protocol. Evaluation of the telemedicine protocol was done on a monthly basis.
- **Materials**. This DNP project was awarded a Clinical Scientific Research Grant from the OneLegacy Foundation for $55,000. Through this funding, the patients were provided the following:
    1. A tablet device to ensure that they had the technological means to participate in telemedicine appointments.
    2. A weighing scale to track the progress of their weight loss/gain journey.
    3. A food and activity journal for the purpose of tracking their weight, dietary habits, and physical activity.
    4. A digital hand dynamometer to track handgrip strength as part of the frailty evaluation.

  Other funding was used for flyers, consents, patient handouts, and patient forms/questionnaires needed for this project.

- **Selected a telemedicine platform**. Keck Medicine of USC supports the InTouch telemedicine platform. The physicians, NP, and RD utilized the InTouch platform to conduct the telemedicine appointments. Training and handout were provided to each patient on accessing the appointment using the tablet. Keck Medicine of USC's Information Technology Department is available to aid the patient in troubleshooting.
- **Outlined the patient selection process**. Keck Medicine of USC's liver transplant program has a waitlist list mortality rate of 10.7% compared to the national waitlist mortality rate of 8.6% for liver transplant. Among patients with CLD, liver transplant candidates with NASH have higher rates of morbidity and mortality. This telemedicine protocol only included patients with decompensated liver disease, diagnosis of NASH, and undergoing transplant evaluation or awaiting a liver transplant. All patients need to sign a consent and agree to participate in a monthly telemedicine appointment with the MD/NP and RD. The patients must have access to the internet. The connection can be anywhere where the patient can access the internet, i.e., home, family, or friend's house. Exclusion criteria are patients with hepatocellular carcinoma, other cancer, on hemodialysis, undergoing evaluation or listed for dual-organ transplant, and previously transplanted. The selection of patients is through assessment, OTTR database search, and chart review.
- **Gathered available patient data**. The following information were obtained via chart review: demographics, diagnosis, Child-Turcotte-Pugh score, MELD-Na score, hospitalization rates, urgent care/ED utilization, complications from liver disease, weight, and sarcopenia status.

- **Planned intervention**. The standard of care was provided to the patients during the telemedicine visits. The multi-disciplinary team provided personalized nutritional recommendations and physical activity prescription to all patients. Frail patients were recommended to outpatient physical therapy for evaluation and treatment, if determined necessary by the provider and dietitian.
- **Presented the protocol for review and approval**. The telemedicine protocol was presented for review and approval by the project review/approving committee. The protocol was also reviewed by the USC's Institutional Review Board (IRB). The protocol was revised per the IRB recommendations. The final protocol was approved on January 4, 2022.

Aim 2: To implement and evaluate the protocol.

Implementation. The project was implemented immediately after IRB approval.

- **Obtained baseline information**. Baseline patient information was obtained, including the Chronic Liver Disease Questionnaire (CLDQ), the Liver Disease Undernutrition Screening Tool (LDUST), and the Short-Form Patient Satisfaction Questionnaire (PSQ-18).
    1. Chronic Liver Disease Questionnaire (CLDQ) is a liver disease-specific health-related quality of life instrument developed to address fatigue, activity, emotional function, abdominal and systemic symptoms, and worry (Younossi et al., 1999). It is used to correlate the domains with the severity of the patient's liver disease. See Appendix E for the Chronic Liver Disease Questionnaire.

2. Liver Disease Undernutrition Screening Tool (LDUST) is used to detect undernutrition in patients with cirrhosis (Casas Deza et al., 2021; McFarlane et al., 2018). See Appendix F for the Liver Disease Undernutrition Screening Tool.
3. The Short-Form Patient Satisfaction Questionnaire (PSQ-18) is a tool that assesses patient satisfaction and can be applied to various settings (Marshall & Hays, 1994; Thayaparan & Mahdi, 2013). See Appendix G for The Short-Form Patient Satisfaction Questionnaire (PSQ-18).

- **Assessed the patient on each appointment**.
  - The MD/NP addressed the following on each appointment: the patient's well-being, any significant events related to their health since their last appointments, such as signs/symptoms, medication issues, urgent care/emergency department (ED) visits, hospitalizations, and any changes on their health condition. The MD/NP gave the patient and/or their family members advice on managing their condition.
  - Nutritional recommendations were directed by a registered dietitian who is familiar with the nutritional needs of patients with cirrhosis. The RD used the LDUST to assess the patient's dietary habits, weight loss/gain, and exercise/activity level. At each appointment, the RD addressed the patient's behavior, weight loss/gain, and exercise/activity level on each appointment. Nutritional counseling and nutritional education were also provided. In addition, the RD made recommendations on the use of supplements when necessary.
- **Family members and/or caregivers were encouraged to participate in the telemedicine appointments.** Good social support is a requirement for patients

awaiting organ transplantation. Although it is not required for the patient's family members and/or caregivers to be present in their appointments, they were highly encouraged to participate in the patient's care.

- **The multi-disciplinary team collaborated to make recommendations**. The multi-disciplinary team collaborated on the patient's care. For example, if the Registered Dietitian determined that the patient could benefit from supplements, the physician or the nurse practitioner could prescribe the supplements as recommended. The team decided on the plan of care and target goals for the next appointment. At the end of each appointment, both the MD/NP and RD educated and reinforced information to the patient and their family members.
- **Recordkeeping**. All information collected at each appointment was documented in the patient's chart. In addition, a project was created in the REDCap database to store monthly data for each patient. A HIPAA compliant spreadsheet was maintained for ease of data comparison. All identifying information was omitted from the spreadsheet. Instead, each patient was assigned a number, from one to twenty, for ease of tracking and inputting data. All documents were stored in a secured cloud drive at Keck Hospital of USC.
- **Evaluation.** To ensure that the protocol was implemented correctly, the multi-disciplinary team met biweekly and as needed to discuss any issues.
- **Chart audit**. Every month, a chart audit was done to ensure that all necessary information was collected on the telemedicine appointment. An ongoing analysis of the data collected at each appointment was done using the Excel spreadsheet. This helped the multi-disciplinary team track any changes in the patient's health. For

example, weight changes were analyzed based on the weight measurement gathered at each appointment. To support sustainability and scaling, data collection continued after the six months of telemedicine.

- **Questionnaire**. The patients completed the CLDQ and LDUST at the first visit and each subsequent telemedicine appointment. The patients will complete six CLDQ and LDUST by the end of the telemedicine protocol. In addition, the patients included in the study completed the PSQ-18 questionnaire at the first visit. At the end of the sixth visit, the patient will need to complete the PSQ-18.
- **Analysis**. Data was analyzed to evaluate the efficacy of a monthly telemedicine appointments on weight, BMI, emergency department visits, hospitalizations, physical activity level, liver-disease related quality of life, malnutrition, MELD-Na score, and frailty status. The changes in weight and BMI were assessed using a left-tailed t-test. The changes in MELD-Na scores, hospitalization rates, emergency department and urgent care utilization, Chronic Liver Disease Questionnaire domains, Liver Disease Undernutrition Screening Tool score, Liver Frailty Index score, and physical activity level were analyzed using a paired sample t-test.

Aim 3: To make recommendations for sustainability and scaling to a broader population of individuals awaiting organ transplantation within the organization and as a model protocol for other transplant centers.

- **Presentation of the project at USC.** The telemedicine project was presented at the USC Liver WIP Conference and to the Keck Medicine of USC's Quality Committee of the Hospital Governing Board. The project goals and progress were

provided to the audience. The project will also be presented at the USC Transplant Hepatology Core Lecture at the end of April.

- **Magnet Redesignation.** The telemedicine project, the mentorship from Dr. Annette Sy, and the leadership immersion will be included in the application for Magnet Redesignation.
- **Report to the OneLegacy Foundation.** After analyzing the baseline to end of protocol data, a final report will be prepared for the OneLegacy Foundation. This will discuss all findings from the quality improvement project, including the patients' clinical outcomes, quality of life based on the CLDQ, and patient satisfaction based on PSQ-18. A comparison will be made between data from the past two years and outcomes from the quality improvement project.
- **Presentation of outcomes at Keck Medicine of USC.** The benefits of telemedicine on system goals such as cost, no-show rates, patient satisfaction, ED/urgent care utilization, hospitalization, and re-admission rates will be presented to the project review/approving committee, GI and Transplant Department Physicians, Nurse Practitioners, Registered Dietitians, and other staff members. In addition, the outcomes will be presented to the hospital administration, including Keck Hospital of USC's Chief Executive Officer, Rod Hanners, MD, and Chief Nursing Officer, Annette Sy, RN. As a part of the presentations of outcomes, it will also be explained that data collection is continuing. Arrangements will be made for a subsequent report of outcomes, including any updating of recommendations. Telemedicine to optimize the delivery of care can drive improvement in clinical outcomes, patient retention,

key performance indicators, and metrics that lead to greater reimbursements and incentive payments.

Dissemination

Conference presentation. An abstract will be submitted for oral or poster presentation at the American Association for the Study of Liver Diseases' The Liver Meeting, the International Liver Transplantation Society's ILTS Annual Congress, and Sigma Theta Tau's International Nursing Research Congress. If selected, findings will be presented at national conferences. Other transplant centers can utilize the outcomes of this quality improvement project to improve patient care.

Publishing results. A manuscript will be submitted to the American Journal of Transplantation in early 2023.

Business Implications

Patients with NASH awaiting liver transplantation are at high risk of developing complications that lead to higher health care utilization and mortality rates. They have higher rates of poor health, barriers to care, and poor health-related quality of life. Improving clinical outcomes for liver transplant candidates with NASH remains a challenge nationally.

Telemedicine can reduce the quality gaps and overcome barriers to care. It offers various advantages, including enhancing access to care, improving clinical management, enhancing communication between patients and providers, increasing patient satisfaction, improving patient outcomes, and reducing health care costs. It also benefits the system by reducing costs, increasing patient retention, and improving key performance indicators and metrics.

The projected outcomes of this quality improvement initiative are:

1. Improvement in clinical outcomes

2. Increase in quality of care and patient satisfaction, and
3. Improvement in metrics and reduced health care costs leading to higher revenue.

Human Subjects

This DNP project was reviewed by the Yale Institutional Review Board (IRB) and affirmed that this was a quality improvement project. However, the University of Southern California (USC) IRB required an application and approval for the protection of human subjects under 45 CFR 45.111. The USC IRB also required that all participants sign a written consent. The project was approved by the IRB on January 4, 2022.

Timeline

See Appendix H for GANNT Chart – Telemedicine Timeline.

Immersion Plan

The American Association of Colleges of Nursing DNP Essentials (2006), leadership knowledge and skills learned at the Yale School of Nursing were put into practice during the leadership immersion. Dr. Annette Sy, Keck Medicine of USC's Chief Nurse Executive, was identified as the external expert and mentor for this DNP project.

After the defense and approval of the project at Yale, the telemedicine protocol was approved by the USC project committee. Through Dr. Sy's guidance and USC Transplant Institute's support, the DNP project implementation began immediately after IRB approval.

A monthly immersion log and project summary were submitted to Dr. Sy and the Yale School of Nursing faculty to provide a project update. Multiple meetings with the external mentor were held via Zoom to discuss project trajectory, identify issues surrounding the project development and implementation, and evaluate preliminary outcomes.

Chapter 4

Results

For this paper, only the ten patients that completed visits 1 and 2 were included in the analysis. The results compared the visit 1 and visit 2 outcomes. The JMP Statistical Software, a subsidiary of SAS Institute, was the tool utilized (JMP®, Version *Pro 16*. SAS Institute Inc., Cary, NC, 1989–2021).

Weight

Between visits 1 and 2, there was a total 21.319 kg weight loss. A left-tailed t-test was conducted to compare the weight loss between visits 1 and 2. The median weight decreased from 95.6 kg on visit 1 to 89.21 kg on visit 2. The observed mean difference was -2.1319, 95% CI [-4.4591, 0.19528]. Weight loss after the telemedicine protocol implementation was statistically significant (t-test -2.07234, $p = 0.0341$). The graph in Figure 1 shows the mean weights, the mean differences between weights, the mean difference depicted in a solid red line, and the upper and lower confidence interval (CI) for the mean difference depicted in red dashed lines. See Figure 1 for Weight Changes.

BMI

A left-tailed t-test was conducted to compare BMI differences between visits 1 and 2. The total decrease in BMI among the patients was 8.05 kg/m^2. The median BMI decreased from 36.44 kg/m^2 on visit 1 to 34.565 kg/m^2 on visit 2. The observed mean difference was –0.805, 95% CI [-1.6853, 0.07544]. After the telemedicine protocol implementation, the changes in BMI were statistically significant (t-test -2.06858, $p = 0.0343$). Figure 2 shows the mean BMI, the mean differences between BMIs, the mean difference depicted in a solid red line, and the upper

and lower confidence interval for the mean difference shown in red dashed lines. See Figure 2 for BMI Changes.

MELD-Na Score

The median MELD-Na score on the patients was 11 on visit 1 and 12 on visit 2. A paired t-test was used to analyze the MELD-Na score. There was no statistically significant finding (t-value = 0.309426, p-value = 0.7640) on the patient's MELD-Na score changes.

Hospitalization Rates

The average liver-related hospitalization (LRH) rate on visit 1 was 1.1 hospitalizations and zero on visit 2. Only one patient was hospitalized due to liver disease on visit 2. A paired t-test was conducted to compare the hospitalizations rates. After the telemedicine protocol implementation, the changes in LRH were statistically significant (t = -2.53546, p = 0.0319). Between visits 1 and 2, the observed mean difference was –1, 95% CI [-1.8922, -0.1078]. Figure 3 shows the mean LRH, the mean differences between LRH, the mean difference (solid red line), and the confidence interval for the mean difference (red dashed lines). See Figure 3 for Liver-Related Hospitalization Changes. The range of the differences is greater than half the range of the data, as depicted by the diamond shape on the figure.

For hospitalizations not due to liver disease, there were three hospitalizations on visit 1 and zero on visit 2. A paired t-test was done to compare the difference between the non-liver hospitalizations. The outcome was not statistically significant (t = -1.40556, p = 0.1934).

Emergency Department and Urgent Care Utilization

There was no liver-related ED utilization between visits 1 and 2. For ED visits not related to liver disease, there were four ED utilizations on visit 1 and zero on visit 2. The outcome was

statistically significant using a paired t-test (t = -2.44949, p = 0.0368). No patients went to an urgent care facility from visits 1 and 2.

Chronic Liver Disease Questionnaire

The Chronic Liver Disease Questionnaire has six domains: abdominal symptoms (AS), fatigue (FA), systemic symptoms (SS), activity (AC), emotional function (EF), and worry (WO). A paired t-test was conducted to analyze the CLDQ overall score and each domain. The overall median score was 4.74 on visit 1 and 4.665 on visit 2. The overall CLDQ score was not statistically significant (t = 0.079851, p = 0.9381). See Table 1 for Comparison of Visits 1 and 2 CLDQ Outcomes in Mean ± SD by Domain for the differences in each domain mean scores with standard deviation between visits 1 and 2.

Abdominal Symptoms

The abdominal symptoms median score was 5.665 on visit 1 and 5 on visit 2. There was no statistical significance noted in the abdominal symptoms' domain (t = 0.689113, p = 0.5081).

Fatigue

The fatigue median score was 5 on visit 1 and 4.5 on visit 2. There was no statistical significance noted in the fatigue domain (t = 0.0475, p = 0.9632).

Systemic Symptoms

The systemic symptoms median score was 5.1 on visit 1 and 4.8 on visit 2. No statistical significance was noted in the systemic symptoms' domain (t = -0.19108, p = 0.8527).

Activity

The activity domain median score was 4.5 on visit 1 and 5.996 on visit 2. The change in the activity was statistically significant (t = 2.957929, p = 0.0160). The observed mean difference was 1.101, 95% CI [0.25898, 1.94302]. Figure 4 shows the mean CLDQ activity score, the mean

differences between the activity scores, the mean difference (solid red line), and the CI for the mean difference (red dashed lines). See Figure 4 Changes in the CLDQ Activity Domain.

Emotional Function

The median score for the emotional function was 5 on visit 1 and 5.37 on visit 2. There was no statistical significance noted ($t = 0.105927$, $p = 0.9180$).

Worry

The worry median score was 3.9 on visit 1 and 3.3 on visit 2. After the telemedicine protocol implementation, the changes in the worry domain were statistically significant ($t = -2.660532$, $p = 0.0260$). The observed mean difference was -0.76, 95% CI [-1.4062, -0.1138]. The graph in Figure 5 shows the mean CLDQ worry score, the mean differences between the worry scores, the mean difference depicted in a solid red line, and the confidence interval for the mean difference displayed in red dashed lines. See Figure 5 Changes in the CLDQ Worry Domain.

Liver Disease Undernutrition Screening Tool

There was no malnutrition finding between visits 1 and 2. There were no statistically significant changes noted in the patients' nutritional status.

Liver Frailty Index

The median LFI decreased from 4.35 (pre-frail) on visit 1 to 4.265 (pre-frail) on visit 2. The changes were analyzed using paired t-test. There was no statistically significance noted ($t = -1.6403$, $p = 0.1353$).

Physical Activity

The medial physical activity level of patients remained at moderate (level 2) between visits 1 and 2. Using a paired t-test, the result was analyzed, and no statistical significance was noted in the physical activity level of the patients.

Chapter 5

Discussion

The USC IRB approved the telemedicine protocol in January 2022. Due to the surges in the COVID-19 pandemic, the implementation of the project was delayed, affecting the project's timeline. The preliminary findings presented in this paper included the outcomes from ten patients that completed visits 1 and 2. See Figure 6 for Comparison of Visits 1 and 2 Outcomes.

The findings of this DNP project suggested that the use of telemedicine to deliver the standard of care improves patient outcomes. The analysis showed that the intervention effectively promoted weight loss, decreased hospitalizations and ED utilization, improved patient activity levels, and lessened the patients' worry. In addition, there were no changes that indicated worsening frailty, malnutrition, abdominal symptoms, fatigue, systemic symptoms, emotional function, and MELD-Na score.

The significant weight loss and BMI reduction correlated with the patients' reported increase in the physical activity domain of the CLDQ. This observed improvement was similar to other telemedicine studies (Barnett et al., 2020; Javanmardifard et al., 2017; Mazzotti et al., 2018). In contrast, the measured physical activity based on the RD assessment showed the patients' physical activity level remained moderate between visits 1 and 2.

The lack of improvement in physical activity can be due to the patients' frailty status and fatigue level. Between visits 1 and 2, the patients reported the same fatigue level on the CLDQ. This could have prevented the patients from increasing their activity level. In addition, the Liver Frailty Index assessment showed that, on average, the patients are pre-frail. The patients identified to be frail were referred for outpatient physical therapy evaluation and treatment.

Despite the frailty level decreasing from 4.35 to 4.265, there were no statistically significant findings to suggest an improvement in the paired t-test analysis.

One patient had refractory ascites and underwent weekly paracentesis. The patients' volume status could have contributed to the decrease in weight and BMI. However, the total weight loss of 21.319 kg among the ten participants is likely because the patients have maintained their physical activity level and adhered to the nutritional recommendations prescribed by the multi-disciplinary team.

All patients were instructed to follow a two-gram low salt, high protein diet. For patients with diabetes mellitus, a low carbohydrate diet was added to their nutritional prescription. The RD did not identify any patients in need of a nutritional supplement. The patients' nutritional status and abdominal symptoms did not change between visits 1 and 2. However, in similar studies done by Barnett et al. (2020) and Javanmardifard et al. (2017), there was a statistically significant increase in the patients' nutritional status. The difference between the studies and this project was the frequency of follow-ups with the patients. For this project, the RD followed the patients once a month, whereas the telemedicine studies by Barnett et al. and Javanmardifard et al. provided a weekly follow-up with patients.

There were no liver-related ED and urgent care visits. However, there was one liver-related hospitalization due to hepatic encephalopathy. This is a significant finding, decreasing the LRH rate from 1.1 to zero. In addition, there were no significant changes noted in the patients' MELD-Na score. This finding is likely due to the frequency of follow-ups with patients. A similar study by Su et al. (2018) suggested that telemedicine helped address liver-related issues and improved patient care, which led to higher survival rates.

A higher CLDQ score is linked with an improved health-related quality of life (Chawla et al., 2016; Younossi et al., 1999). The CLDQ worry domain analysis was statistically significant. However, the difference in the domain score was 0.6 between visit 1 and visit 2, indicating that the patients were slightly more worried on visit 2 than visit 1. Moreover, the emotional symptom domain increased from 5 on visit 1 to 5.37 on visit 2, indicating that the patients experienced an improvement in their emotional wellbeing on visit 2. On the contrary, the paired t-test analysis found no statistical significance between the scores. The overall CLDQ findings showed no significant improvements in the patients' quality of life. This can be due to the short interval between data collection.

Limitations

The first limitation of this DNP project is the small sample size. Due to the delay in implementation, only ten patients completed visits 1 and 2 by February 28, 2022. All analyses were performed using a paired t-test. The small sample size can make no difference between visits 1 and 2 variables and contribute to a type II error.

The second limitation is the short study duration. In the preliminary analysis of this DNP project, data from visits 1 and 2 were included. However, differences may show with a longer study duration. A shorter study duration may not yield reliable results.

The last limitation of this project is the generalizability. This project was conducted at one transplant center and limited the population to patients with NASH, affecting the project's external validity. NASH is not representative of the patients with CLD.

Conclusion

In summary, this DNP project revealed that using telemedicine to deliver the standard of care among patients with NASH can improve patient outcomes. The general findings that

emerged from this DNP project were: (1) telemedicine can promote weight loss and increase physical activity, and (2) telemedicine can decrease hospitalization rates and prevent ED/urgent care utilization. In addition, this project found no significant changes noted in the patients' MELD-Na score, HRQoL, frailty, and nutritional status.

The preliminary results of this DNP project raise several opportunities for further studies to evaluate the effects of telemedicine in managing patients with chronic liver disease. A larger study cohort and longer study duration will be necessary to determine if there is any true association between telemedicine and improvement in patient outcomes.

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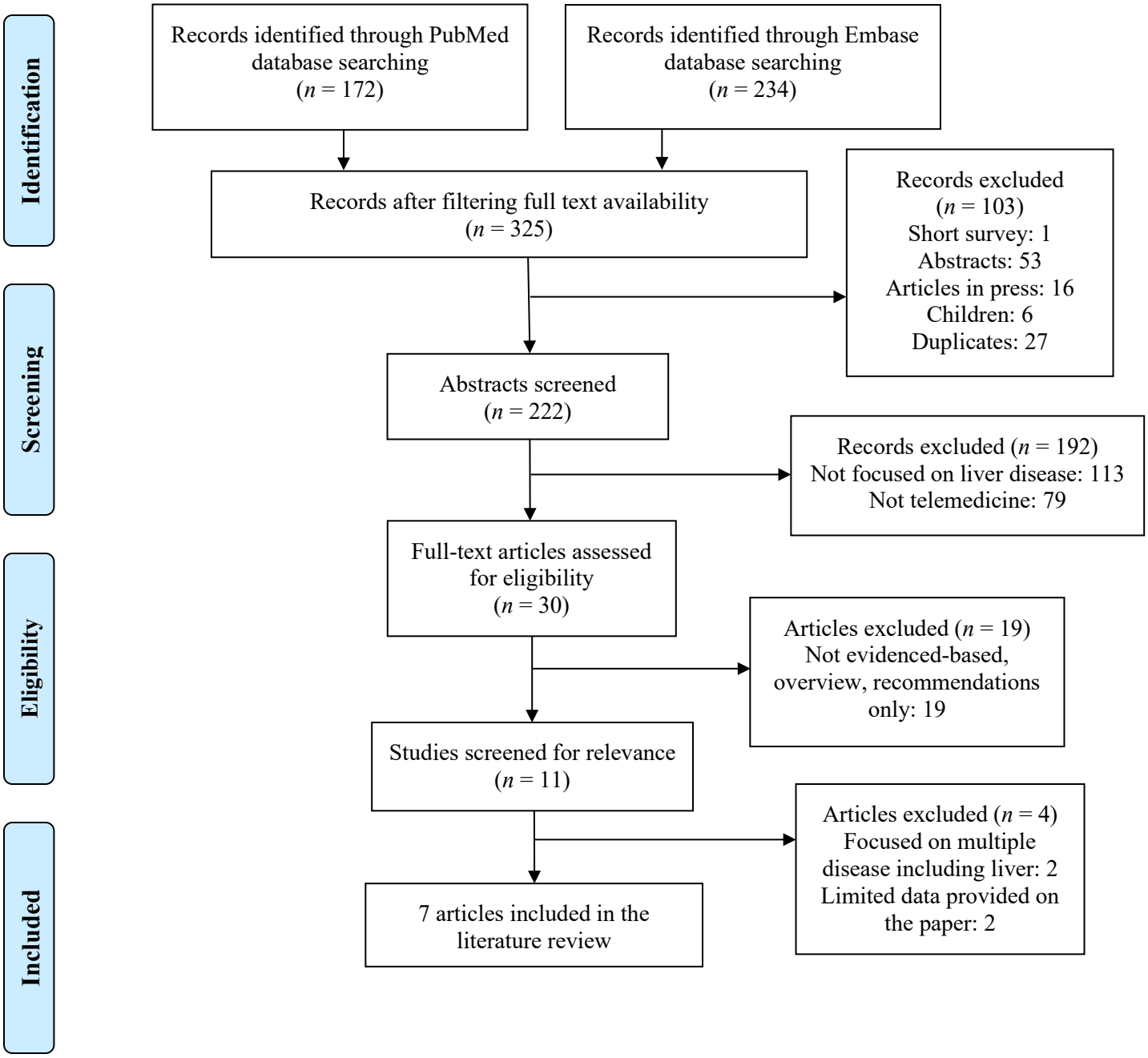
Appendices

Appendix A

Adapted PRISMA Flow Diagram



Appendix A Flow diagram to show number of studies remaining at each stage of literature review. *Source:* From Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & the PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLOS Medicine, 6*(7), e1000097. https://www.doi.org/10.1371/journal.pmed.1000097.

Appendix B

Evidence Table

Title, authors, date, journal	Purpose	Level of Evidence	Sample	Design	Results	Strengths	Weaknesses	Contribution: Science and/or Practice
Liver Transplant Recipients' Experiences and Perspectives of a Telehealth-Delivered Lifestyle Programme: A Qualitative Study Amandine Barnett, Katrina L. Campbell, Hannah L. Mayr, Shelley E. Keating, Graeme A. Macdonald, and Ingrid J. Hickman 2020	To assess the feasibility of a 12-week telehealth lifestyle program To assess the experiences of liver transplant recipients with telehealth	2b*	19 patients were included in the study, between 25-68 years old. 63% were males. Median time since liver transplant was 4.4 years. Exclusion criteria: food allergy or dietary restriction that would	Qualitative study Focus groups and one on one interviews were conducted on the participants The program is a 12-week telehealth intervention which included weekly group contact alternating education on diet and physical activity recommendat	Median attendance was 10 sessions. Telehealth was a well-accepted experience by many participants (n=8). The overall experience was that lifestyle interventions sessions were as good or better than traditional face-to-face appointments. Telehealth was advantageous due to less	Use of focus groups and interviews for data collection It included data triangulation and use of multi-disciplinary team to develop schedule and interpret results Telehealth lessened the burden of the participants to travel.	Small sample size There was a probably of bias from the exclusion of participants without video enabled devices and non-English speakers	Telehealth is feasible for lifestyle modification programs, especially for liver transplant recipients.

Journal of Telemedicine and Telecare			affect the MedDiet eating pattern, physical disability where increase in physical activity would be inappropriate, deemed unsafe by the providers to participate, and non-English speaker or unable to read/write in English.	ions, totaling of 14 telehealth appointments (6 dietetic and 8 exercise sessions provided by dietitians and exercise physiologists. Experiences, perspectives and feasibility were assessed at the end of the 12-week telehealth intervention.	burden on travel or to make appointments. Modification of nutritional habits was a positive experience for the participants (n=13). There was an increase in the amount of self-directed physical activity and awareness of exercise capabilities and desire to engage in healthy behaviors.			

*Oxford Centre for Evidence-Based Medicine: Levels of Evidence (2009)
1a: SR (with homogeneity*) of RCTs, 1b Individual RCT (with narrow Confidence Interval), 1c: All or none, 2a: SR (with homogeneity) of cohort studies, 2b: Individual cohort study, 2c: "Outcomes" Research; Ecological studies, 3a: SR (with homogeneity) of case-control studies, 3b: Individual Case-Control Study, 4: Case-series (and poor quality cohort and case-control studies), 5: Expert opinion without explicit critical appraisal, or based on physiology, bench research or "first principles"

Title, authors, date, journal	Purpose	Level of Evidence	Sample	Design	Results	Strengths	Weaknesses	Contribution: Science and/or Practice
The Effect of Telenursing on Self-efficacy in Patients with Non-Alcoholic Fatty Liver Disease: A Randomized Controlled Clinical Trial Sorur Javanmardifard, Fariba Ghodsbin, Mohammad Javan Kaviani, and Iran Jahanbin 2017 *Gastroenterology and Hepatology From Bed to Bench*	To determine the impact of telenursing on nutritional behavior and physical activity self-efficacy	1b*	60 participants were included in the study. 30 were assigned to the intervention group and 30 to the control group. 26.7% (*n*=8) were females and 73.3% (*n*=22) were males in the intervention group. 20.7% (*n*=6) were	Randomized controlled trial. Sherer and Maddux's nutritional behavior self-efficacy questionnaire and Pender's physical activity self-efficacy questionnaire were obtained as baseline information. A nutritionist consulted with all the participants. Each got a written dietary advice and were instructed to	The reported mean score of both nutritional and physical behavior self-efficacy increased in both groups after the intervention ($p<0.001$). The nutritional mode was statistically significant ($p<0.001$) for the intervention group but not for the control group ($p>0.05$).	The study concluded that telenursing could improve the patient's self-efficacy in adherence to nutritional regimen and physical activity and health behaviors associated with non-alcoholic fatty liver disease by increasing awareness.	Small sample size. Short length of study. The study did not address its limitations.	Findings of this study can be applied in practice to improve outcomes for patients with non-alcoholic fatty liver disease.

			females and 79.3% (*n*=23) were males in the control group. Mean age was 40.3 and 38.3 years in the interventi on and control groups.	perform at least 30 min of moderate physical activity 4-5 times per week. A training booklet was provided. The intervention group had telephone follow-ups for 12 weeks in which adherence to diet and physical activity were assessed. The control group did not receive any interventions.				

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Title, authors, date, journal	Purpose	Level of Evidence	Sample	Design	Results	Strengths	Weaknesses	Contribution: Science and/or Practice
Telehealth-Based Evaluation Identifies Patients Who Are Not Candidates for Liver Transplantation Venkata Rajesh Konjeti, Douglas Heuman, Jasmohan S. Bajaj, HoChong Gilles, Michael Fuchs, Phillips Tarkington, and Binu V. John 2019 *Clinical Gastroenterology and Hepatology*	To compare transplant evaluation outcomes between referrals triaged through SCAN-ECHO with direct referrals	2a*	190 patients were referred for transplant. 91 were referred through the SCAN-ECHO program (47.8%). Majority were male and Caucasian in both groups. Mean age for both SCAN-ECHO and non-SCAN-ECHO	Patients referred for liver transplant evaluation were either referred to SCAN-ECHO for a preliminary analysis of candidacy before completing a full work-up or direct referrals for full-evaluation. The study included all liver transplant referrals between August 2012 and September 2016 at a	Patients referred through SCAN-ECHO were likely to be candidates for transplantation during the initial referral. Telehealth-based triage reduced unnecessary transplant evaluations by 60%. This program promoted identification of noncandidates effectively, minimized unnecessary testing, travel, and reduced cost.	Good sample size Collected data and clinical characteristics of patients referred for liver transplantation Compared the characteristics of the SCAN-ECHO group and non-SCAN-ECHO group including the indication for transplant, rejection rates, and reasons for non-	The study was limited to a single VA facility, which focused on a unique population Generalizability of the findings may be constrained due to the limitations above.	Findings of this study suggests that telehealth is useful in identifying noncandidates for transplantation without the need for additional testing. It can improve access, reduce cost and minimize unnecessary testing.

			group was 60.	single VA center.	Rejection at time of transplant referral was higher among non-SCAN-ECHO group (41.4%) compared to the SCAN-ECHO group ($p<0.0001$). Rejection after completing evaluation work-up was higher among non-SCAN-ECHO group (55.6%) compared to the SCAN-ECHO group (23.1%) ($p<0.0001$). Fewer patients in the SCAN-ECHO group were denied for transplant	transplant candidacy		

					due to psychosocial issues, comorbidities, and progression of HCC.			

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Title, authors, date, journal	Purpose	Level of Evidence	Sample	Design	Results	Strengths	Weaknesses	Contribution: Science and/or Practice
Patient Satisfaction and Healthcare Utilization Using Telemedicine in Liver Transplant Recipients Long B. Le, Harman K. Rahal, Matthew R. Viramontes, Katherine G. Meneses, Tien S. Dong, and Sammy Saab 2019 *Digestive Diseases and Sciences*	To assess the impact of telemedicine in overcoming barriers to care while sustaining strong patient-physician relationships	2a*	21 post-liver transplant patients were included in the telemedicine study. Three patients were used as controls for the study. Mean age was 51 years for the telemedicine group and 52 years for the control group (p=0.89).	Retrospective study Patients were divided to telemedicine group and traditional in-office follow-up group. Patient Satisfaction Questionnaire-18 (PSQ-18), Telemedicine Satisfaction Questionnaire (TSQ), and Health Utilization Questionnaire (HUQ) were used to assess patient satisfaction and	The PSQ-18 score did not differ significantly between the groups (p=0.89). The lowest mean score for both groups was the dissatisfaction with the expenditures involving medical care (p=0.03). Accessibility of the visit also had a low score (p=0.89). The highest was the interpersonal manner and friendliness of the physician perceived (p=0.32).	Control patients were used to match each telemedicine patients to ensure adequate responses for 1:1 matching, to maximize the effects of any selection bias.	Small sample size The study found no significant difference in general patient satisfaction between groups. The selection process could have contributed to selection bias. Patients were selected by convenience using clinical profile, insurance coverage, and	Findings of this study suggests that telemedicine contributes to reduced cost and less time off work to make the follow-up appointment.

				healthcare utilization. Each telemedicine patient who responded with the questionnaire were matched to a post-liver transplant control patient.	The TSQ indicated that patients in the telemedicine group had moderate to high level of satisfaction with telemedicine services. 85% of the questions had a 4 or higher score. The HUQ mean score was higher among the telemedicine group. The highest satisfaction was the saved travel time and decrease expenditure associated with in-person appointments.		familiarity and comfort level with computers. Patients were matched by clinical diagnosis and age range. The use of survey contributed to a degree of response bias.	

					Patient outcomes did not differ in both groups.			

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Title, authors, date, journal	Purpose	Level of Evidence	Sample	Design	Results	Strengths	Weaknesses	Contribution: Science and/or Practice
Telemedicine Improves Access to Hepatology Consultation with High Patient Satisfaction Ezequiel Mauro, Sebastian Marciano, Maria C. Torres, Juan D. Roca, Abel L. Novillo, and Adrian Gadano 2020 *Journal of Clinical and Experimental Hepatology*	To evaluate the impact of telemedicine in resolving consultations To assess patient satisfaction by using telemedicine	2b*	200 patients (n=200) were included to participate on the telemedicine consultations. Median age of patients was 54. 56% were males.	This study provided telemedicine consultations to patients using non-hepatologist health care providers. Patient satisfaction was assessed using the Patient Satisfaction Questionnaire Short Form (PSQ-18) and Telemedicine Satisfaction Questionnaire (TSQ).	73% (n=145) consultations were resolved through telemedicine. 55 patients required face-to-face consultation. A total of 188 patients answered the questionnaires. PSQ-18 results showed a high degree of satisfaction except for financing of the consultation. On the other hand, 70% of the questions had the highest possible score. TSQ showed a high degree of general	Outcomes of the study supports the implementation of telemedicine to provide early consultations or increase access to specialized consultations.	Limitation included possible selection bias. The providers that provided telemedicine were the participating physicians. Lack of control group Lack of final diagnosis evaluation or confirmation made by the non-hepatologist providers	Findings of this study suggests that telemedicine consultations resulted in high level of patient satisfaction. This study supports the implementation of telemedicine to provide early consultations or increase access to specialized consultations.

					satisfaction with telemedicine. Most common diagnosis associated with the resolved consultations were non-alcoholic fatty liver disease, viral hepatitis, and benign liver lesions. HCC and cirrhosis were the common reasons for face-to-face consultations.			

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Title, authors, date, journal	Purpose	Level of Evidence	Sample	Design	Results	Strengths	Weaknesses	Contribution: Science and/or Practice
An Internet-based Approach for Lifestyle Changes in Patients with NAFLD: Two-year Effects on Weight Loss and Surrogate Markers Arianna Mazzotti, Maria Tuchese Caletti, Lucia Brodosi, Silvia Di Domizio, Maria Luisa Forchielli, Salvatore Petta, Elisabetta Bugianesi, Giampaolo Bianchi, and Giulio Marchesini 2018	To determine the efficacy of a web-based educational interventio n targeting lifestyle changes to promote health eating habits, habitual physical activity, and weight loss in patients with non-alcoholic fatty liver disease	2a*	716 patients were included in the study. Participan ts underwent either a web-based interventi on or a group-based interventi on. 438 participate d in a three-month group lifestyle modificati on program.	Cohort observational study The group lifestyle modification program consisted of healthy diet counseling, 120-minute weekly sessions with physicians and dietitians, and the last session with a psychologist that discussed behavioral strategies for stimulus control and weight loss maintenance.	Attrition rate was higher in females ($p<0.001$) and in the group-based intervention group ($p<0.001$) and decreased progressively in the web-based group. The calorie intake decreased in the two cohorts ($p=0.006$). Physical activity increased from baseline in both groups ($p=0.183$). BMI decreased progressively in both groups	Large sample size High attrition rate Used motivational interviewing The goal of >10% weight loss was achieved and maintained at two years. Weight loss was accompanied by reduction in liver enzymes.	High number of cases were lost to follow-up. Limitations included using the standard of care for the control group. This may have demonstrate d superiority of treatment approaches.	Findings of this study suggests that web-based education can be beneficial in patients with non-alcoholic fatty liver disease. This study proves that an internet-based cognitive and educational program is useful for patients with non-alcoholic fatty liver disease and can promote lifestyle changes.

Journal of Hepatology			278 participated in a web-based program. Mean age is 52 years old. 67% were males. 33% have DM type 2.	The web-based program consisted of the group program but divided in four sessions.	(p=0.063), average of 3.4% in the web-based intervention at 6 months, 4.9% at 12 months, 5.5% at 24 months (p<0.001). About 20-28% lost weight >5% at different time points. All liver enzymes decreased significantly in both groups at 6 (p<0.001), 12 (p<0.001), and 24 months (p=0.002).			

*Oxford Centre for Evidence-Based Medicine: Levels of Evidence (2009)
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Title, authors, date, journal	Purpose	Level of Evidence	Sample	Design	Results	Strengths	Weaknesses	Contribution: Science and/or Practice
Virtual Consultations Through the Veterans Administration SCAN-ECHO Project Improves Survival for Veterans with Liver Disease Grace L. Su, Lisa Glass, Elliott B. Tapper, Tony Van, Akbar K. Waljee, and Anne E. Sales 2018 *Hepatology*	To assess the impact of virtual consultations (SCAN-ECHO) on all-cause mortality among patients with liver disease	2b*	Regional cohort of patients within the VA system (VISN 11) 520 patients who had SCAN-ECHO visit were included. 62,237 were included in the no visit cohort. These patients did not have a traditional in-person hepatology	Patients included were not randomized. The design attempted to match patient characteristics between control and cases	The SCAN-ECHO group had more studies and procedures (variceal screen was 25% vs 15%). The SCAN-ECHO group had significantly improved survival and were at decreased risk of death (p=0.003) compared to the no visit group. The SCAN-ECHO group had similar survival as those with traditional in-person visits.	Applied propensity matching using broad demographic and clinical characteristics to adjust for effect estimates The SCAN-ECHO consultations improved screening procedures and enhanced survival benefit for patients with cirrhosis. The study showed that the benefits of the SCAN-ECHO	Limitations included the possibility of not accounting all patient differences or eliminating confounding. The study was limited to VA, which focused on a unique population Generalizability of the findings may be constrained due to the limitations above.	Findings of this study suggest that virtual consultations helped address issues of patients with liver disease. In addition, the program improved process measures such as screening for cancer and varices.

			consultation. Seven were excluded due to only having an abnormal imaging ICD-9 code. A total of 513 were included (n=513). Cohort included patients with ICD-9 code that matched a liver disease		The SCAN-ECHO group had no effect on alcohol use compared the no visit group (p>0.05). The SCAN-ECHO group had a higher rate of liver cancer (25% versus 15%) compared to the no visit group. The SCAN-ECHO group contributed to improvements in care quality and higher survival rates than patients with no visit.	showed after a year.		

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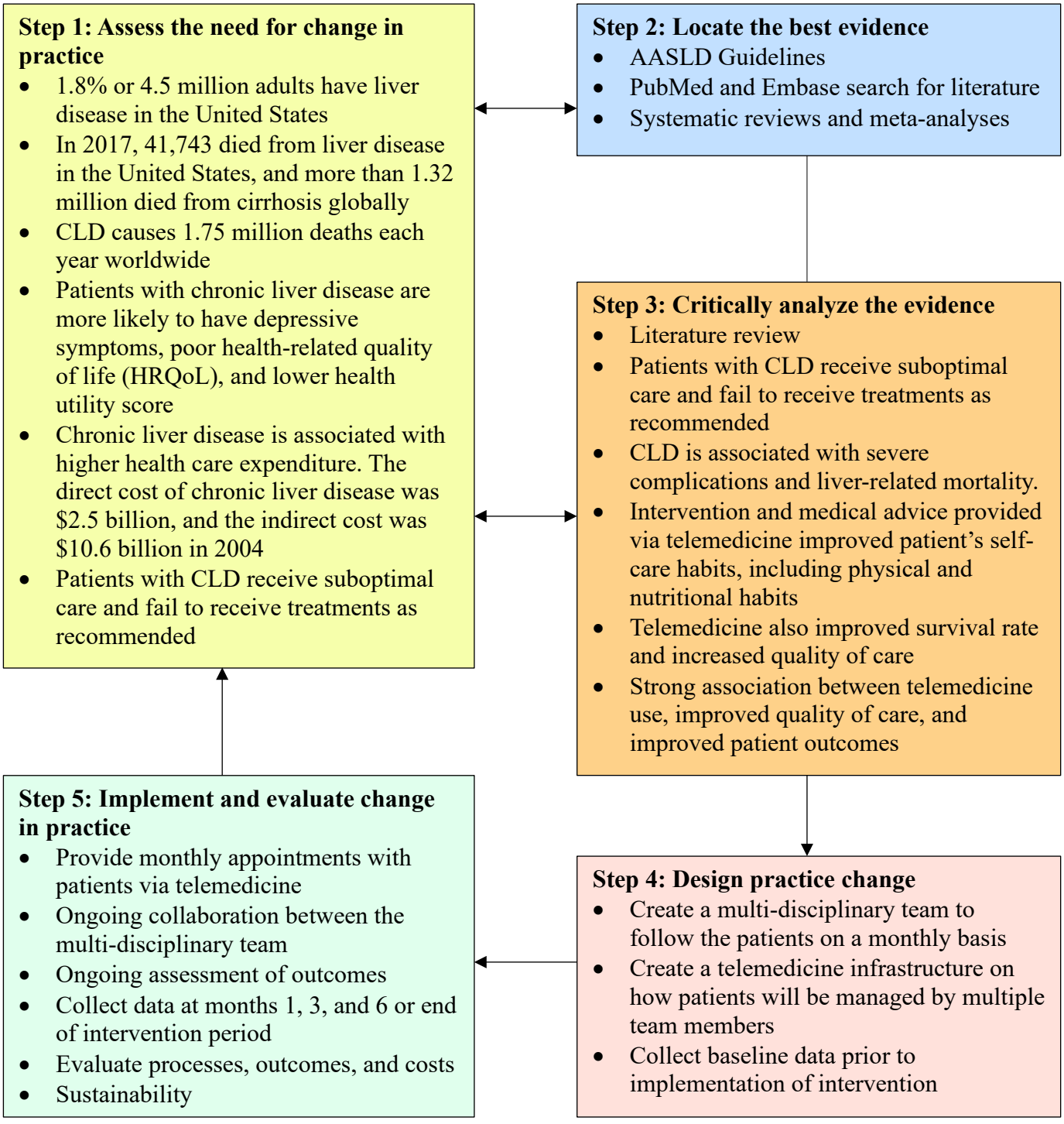
Appendix C

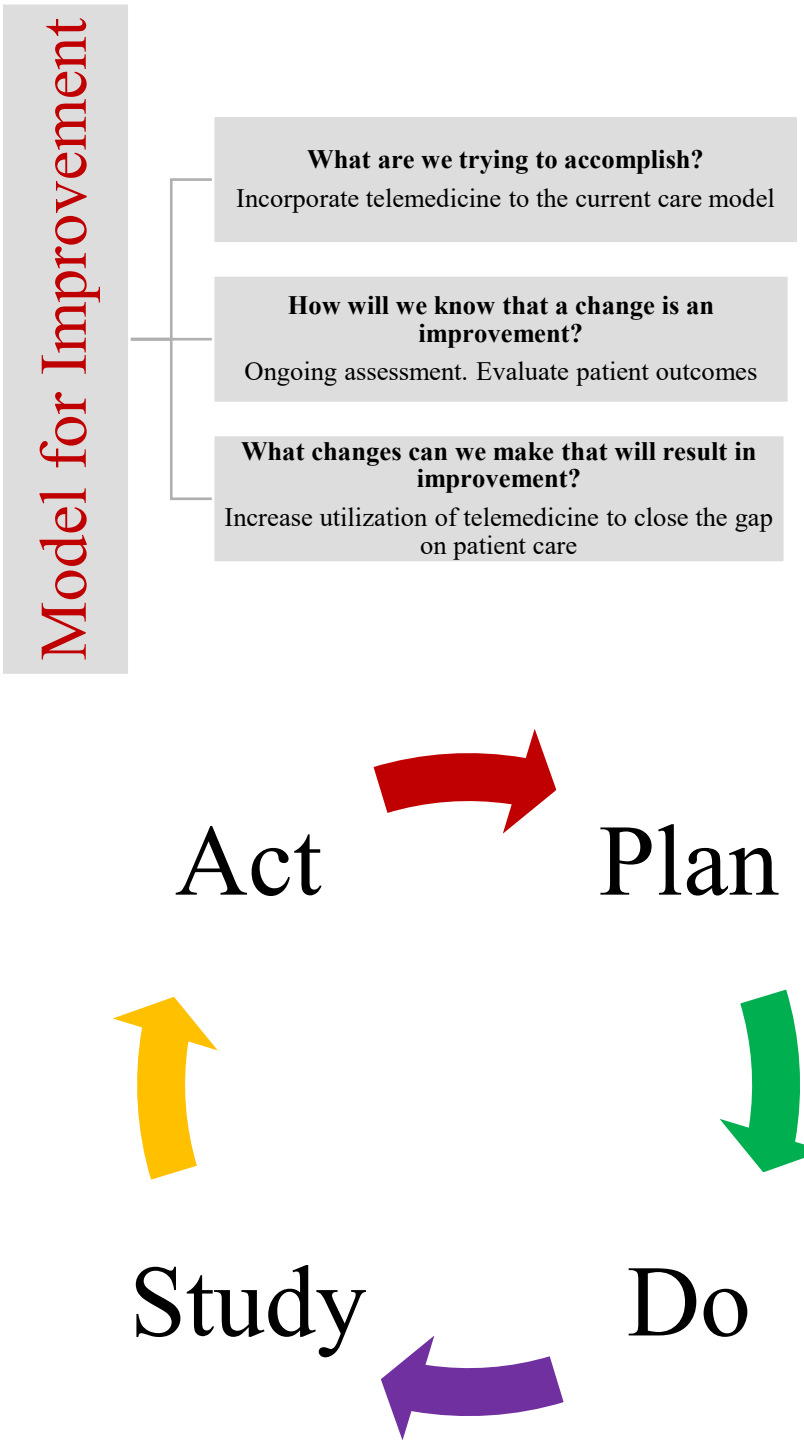
Project Model



Appendix C A model of evidence-based practice change to show the steps and schematic of the DNP project. *Source:* Larrabee, J. H. (2009). *Nurse to nurse: Practice*. McGraw-Hill.

Appendix D

Adapted PDSA Model for Improvement



Appendix D The model for improvement: PDSA. *Source:* Hickey, J. V., & Brosnan. (2017). *Evaluation of health care quality for DNPs (2nd ed.)*. Springer.

Appendix E

The Chronic Liver Disease Questionnaire (CLDQ)

Younossi et al. (1999)

Response options:

1 All of the time

2 Most of the time

3 A good bit of the time

4 Some of the time

5 A little of the time

6 Hardly any of the time

7 None of the time

Questions:

1. How much of the time during the last two weeks have you been troubled by a feeling of abdominal bloating?
2. How much of the time have you been tired or fatigued during the last two weeks?
3. How much of the time during the last two weeks have you experienced bodily pain?
4. How often during the last two weeks have you felt sleepy during the day?

   How much of the time during the last two weeks have you experienced abdominal pain?
5. How much of the time during the last two weeks has shortness of breath been a problem for you in your daily activities?
6. How much of the time during the last two weeks have you not been able to eat as much as you would like?

7. How much of the time in the last two weeks have you been bothered by having decreased strength?
8. How often during the last two weeks have you had trouble lifting or carrying heavy objects?
9. How often during the last two weeks have you felt anxious?
10. How often during the last two weeks have you felt a decreased level of energy?
11. How much of the time during the last two weeks have you felt unhappy?
12. How often during the last two weeks have you felt drowsy?
13. How much of the time during the last two weeks have you been bothered by a limitation of your diet?
14. How often during the last two weeks have you been irritable?
15. How much of the time during the last two weeks have you had difficulty sleeping at night?
16. How much of the time during the last two weeks have you been troubled by a feeling of abdominal discomfort?
17. How much of the time during the last two weeks have you been worried about the impact your liver disease has on your family?
18. How much of the time during the last two weeks have you had mood swings?
19. How much of the time during the last two weeks have you been unable to fall asleep at night?
20. How often during the last two weeks have you had muscle cramps?
21. How much of the time during the last two weeks have you been worried that your symptoms will develop into major problems?
22. How much of the time during the last two weeks have you had a dry mouth?
23. How much of the time during the last two weeks have you felt depressed?

24. How much of the time during the last two weeks have you been worried about your condition getting worse?
25. How much of the time during the last two weeks have you had problems concentrating?
26. How much of the time have you been troubled by itching during the last two weeks?
27. How much of the time during the last two weeks have you been worried about never feeling any better?
28. How much of the time during the last two weeks have you been concerned about the availability of a liver if you need a liver transplant?

Appendix F

Liver Disease Undernutrition Screening Tool

Casas Deza et al. (2021)

Liver Disease Undernutrition Screening Tool

Please answer all 6 questions to the best of your ability

Patient Questions	Column A	Column B	Column C
1) How have you been eating lately?	□ Normal or Fine □ I've been trying to eat less than normal.	□ I've been eating "less than normal" for **a month or less.** □ I don't know	□ I've been eating "less than normal" for **more than one month**.
2) Have you lost any weight in the last year?	□ No □ Yes, but I have been trying to lose weight.	□ Yes, I have lost **some weight.** □ I don't know	□ Yes, I have lost **a lot of weight.**
3) Have you noticed any loss of body fat or thinning of your **arms or ribs**?	□ No	□ Yes, a little □ I don't know	□ Yes, a lot
4) Have you noticed any muscle loss in your **temples, legs, clavicle, or shoulders?**	□ No	□ Yes, a little □ I don't know	□ Yes, a lot
5) Do you have any fluid or swelling in your **abdomen or legs?**	□ No, I have **no fluid** in my abdomen or legs.	□ I have **some fluid** in my legs or abdomen. □ I don't know	□ I have **a lot of fluid** in my legs or abdomen.
6) Are you able to participate in your usual activities? (Ex: walking, climbing stairs, carrying groceries)	□ Yes, I can participate in all my usual activities.	□ No, **occasionally** I am **too tired, weak, or feel too bad** to participate in my usual activities. □ I don't know	□ No, **often** I am **too tired, weak, or feel so bad** that **I cannot** participate in my usual activities.

If you have checked
5 or more boxes in column A

No undernutrition has been identified.

If you have checked
2 or more boxes in column B or C

Undernutrition identified
Refer for nutrition evaluation.

Appendix G

Short-Form Patient Satisfaction Questionnaire (PSQ-18)

Marshall & Hays (1994)

SHORT-FORM PATIENT SATISFACTION QUESTIONNAIRE (PSQ-18)

These next questions are about how you feel about the medical care you receive.

On the following pages are some things people say about medical care. Please read each one carefully, keeping in mind the medical care you are receiving now. (If you have not received care recently, think about what you would expect if you needed care today.) We are interested in your feelings, good and bad, about the medical care you have received.

How strongly do you AGREE or DISAGREE with each of the following statements?

(Circle One Number on Each Line)

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. Doctors are good about explaining the reason for medical tests	1	2	3	4	5
2. I think my doctor's office has everything needed to provide complete medical care	1	2	3	4	5
3. The medical care I have been receiving is just about perfect	1	2	3	4	5
4. Sometimes doctors make me wonder if their diagnosis is correct	1	2	3	4	5
5. I feel confident that I can get the medical care I need without being set back financially	1	2	3	4	5
6. When I go for medical care, they are careful to check everything when treating and examining me	1	2	3	4	5
7. I have to pay for more of my medical care than I can afford	1	2	3	4	5
8. I have easy access to the medical specialists I need	1	2	3	4	5

How strongly do you AGREE or DISAGREE with each of the following statements?

(Circle One Number on Each Line)

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
9. Where I get medical care, people have to wait too long for emergency treatment	1	2	3	4	5
10. Doctors act too businesslike and impersonal toward me	1	2	3	4	5
11. My doctors treat me in a very friendly and courteous manner	1	2	3	4	5
12. Those who provide my medical care sometimes hurry too much when they treat me	1	2	3	4	5
13. Doctors sometimes ignore what I tell them	1	2	3	4	5
14. I have some doubts about the ability of the doctors who treat me	1	2	3	4	5
15. Doctors usually spend plenty of time with me	1	2	3	4	5
16. I find it hard to get an appointment for medical care right away	1	2	3	4	5
17. I am dissatisfied with some things about the medical care I receive	1	2	3	4	5
18. I am able to get medical care whenever I need it	1	2	3	4	5

Appendix H

GANNT Chart – Telemedicine Timeline

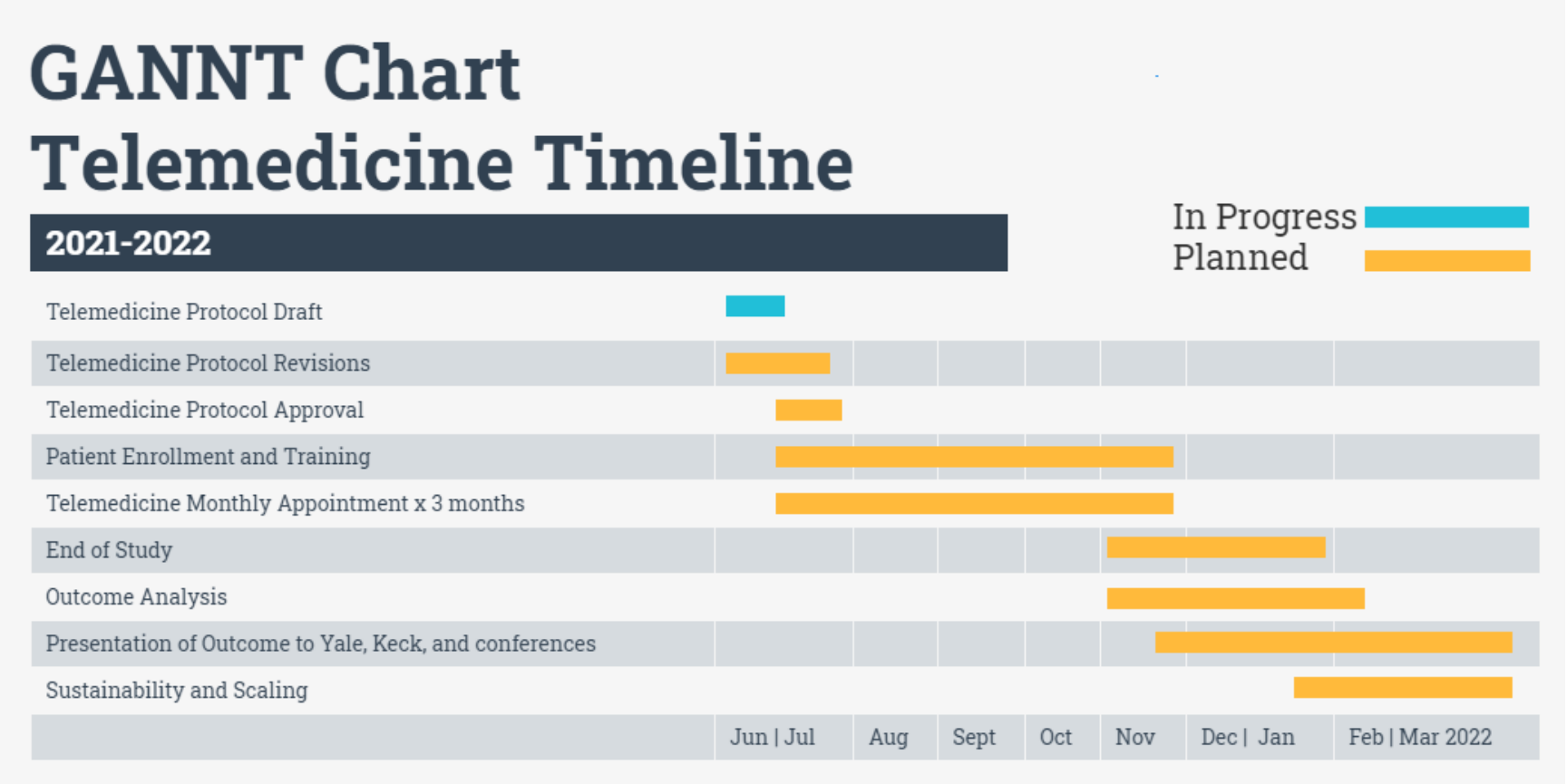


Figure 1

Weight Changes

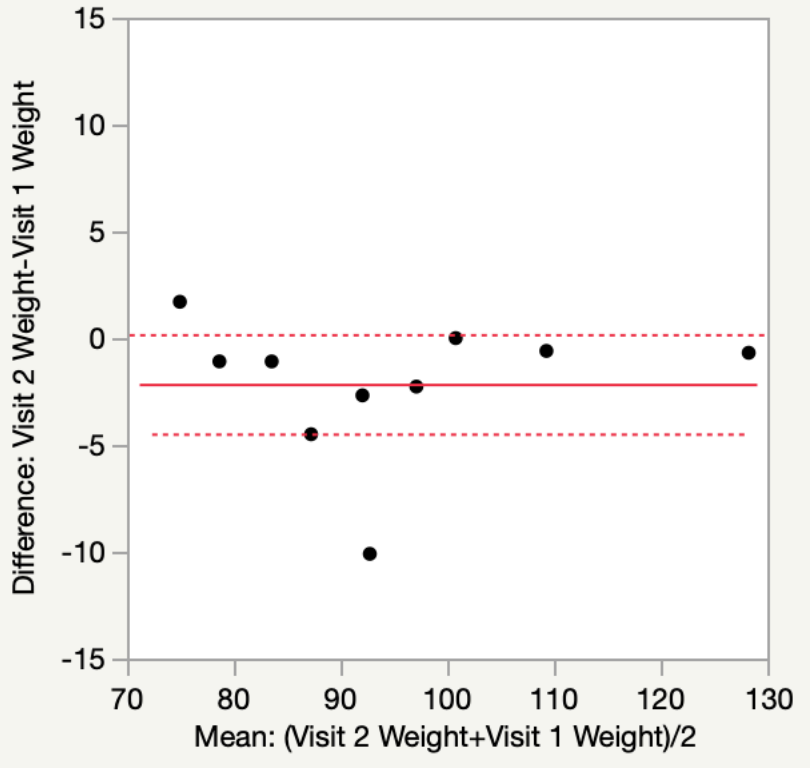


Figure 2

BMI Changes

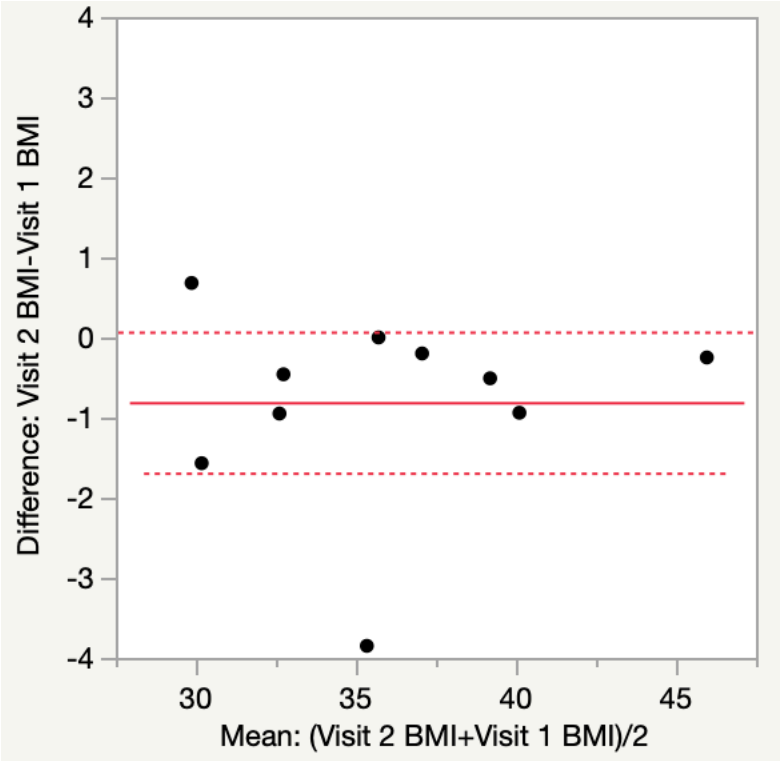


Figure 3

Liver-Related Hospitalization Changes

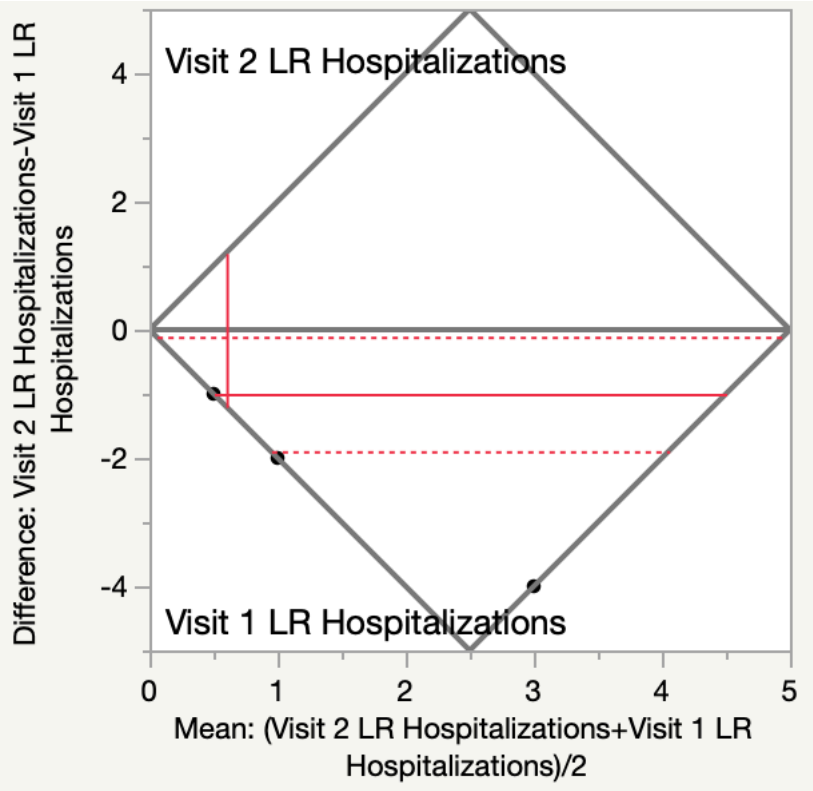


Figure 4

Changes in the CLDQ Activity Domain

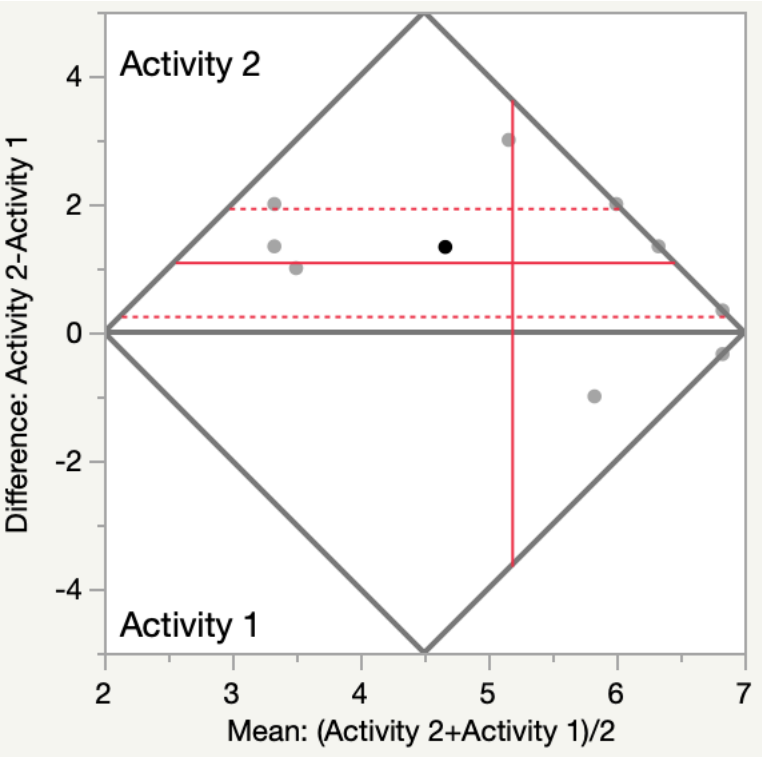


Figure 5

Changes in the CLDQ Worry Domain

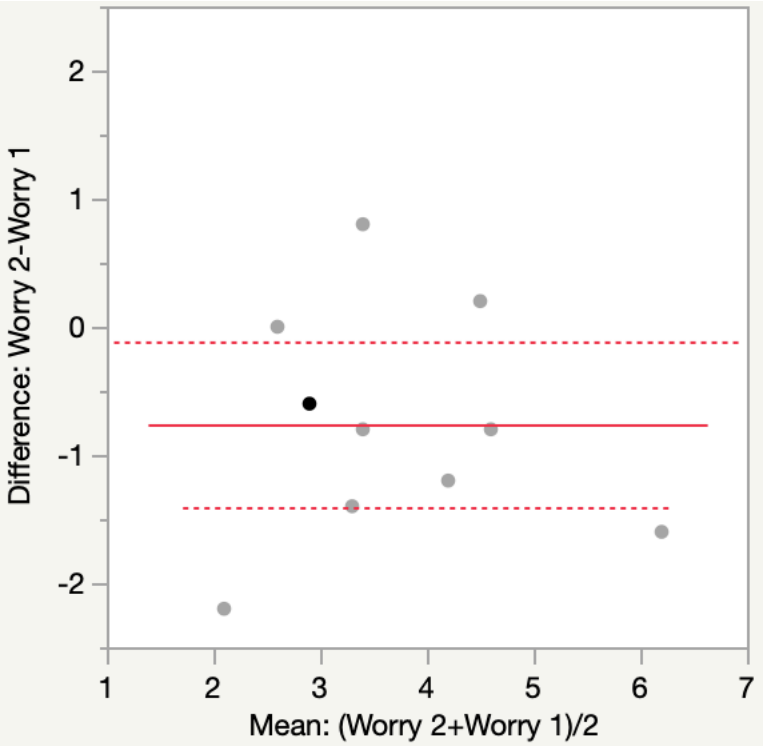


Figure 6

Comparison of Visits 1 and 2 Outcomes

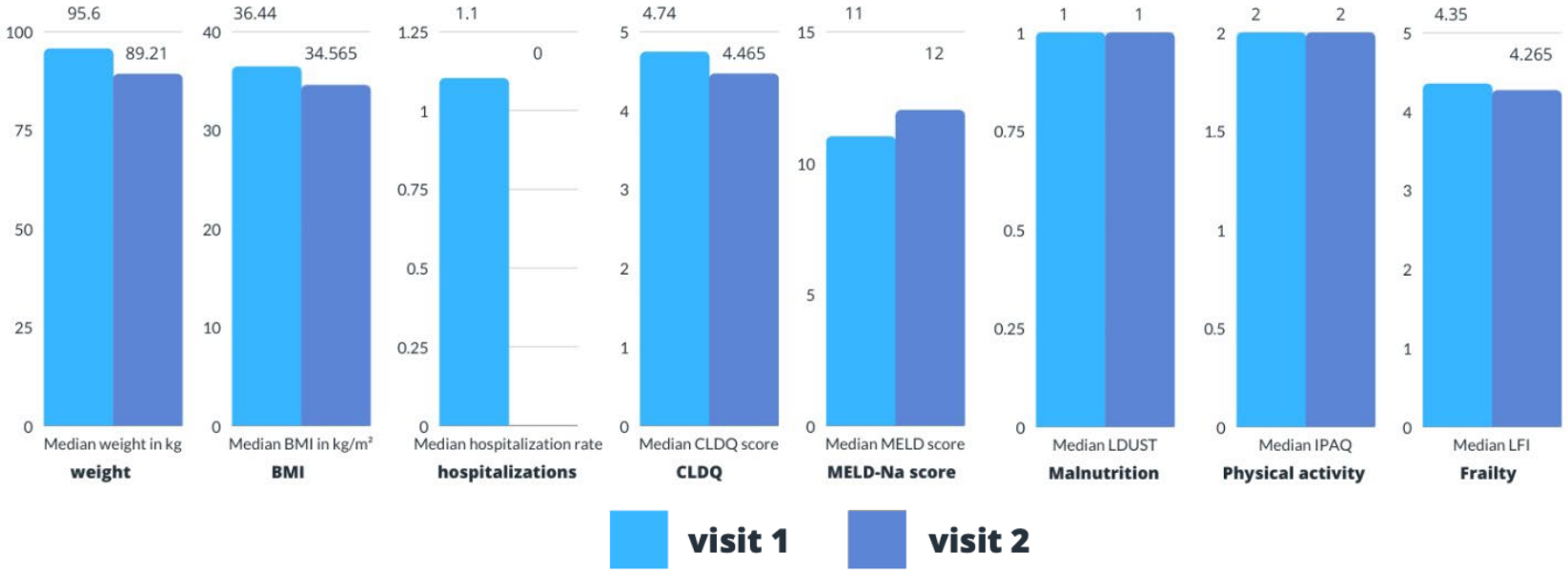


Table 1

Comparison of CLDQ Outcomes in Mean ± SD by Domain

Domain	Visit 1 Mean ± SD	Visit 2 Mean ± SD
AS	4.99 ± 1.51	5.36 ± 1.33
FA	4.78 ± 0.95	4.8 ± 1.14
SS	4.98 ± 1.07	4.9 ± 1.38
AC	4.63 ± 1.73	5.73 ± 1.28
EF	5.23 ± 1.06	5.27 ± 0.98
WO	4.1 ± 1.29	3.34 ± 1.25
Total	4.82 ± 0.88	4.84 ± 0.87