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Enhancing Patient-Centered Care in Oncology through Telehealth: Advanced Data Analytics and Personalized Strategies in Breast Cancer Treatment

Deepak Singh[1], Suyash Bhogawar[2], Siddhartha Nuthakki[3], Nirmal Ranganathan[4]

[1]Product Manager, Telehealth Firm, CA, USA

[2]AI Architect, Rackspace Technology, CA, USA

[3]Senior Data Scientist, Fractal Analytics, TX, USA

[4]Principal AI Architect, Rackspace Technology, TX, USA

Abstract: ***Telehealth was a crucial tool for managing patients with breast cancer. It allowed for the continuity of care to include virtual consultations and appointments, psychological and emotional support, expert-guided physical activity from a distance, multidisciplinary collaboration, and even breast cancer detection. This study investigates the effectiveness of telehealth interventions in managing breast cancer care and recovery with the goal of improving patient outcomes and implementing tailored treatment alternatives. Its main point is how advanced data analytics fit into this procedure. Based on 12 research published in journals between 2013 and 2021, a thorough review of the literature is done to identify and characterize the essential aspects of agile methodologies that are relevant to coordination. In the context of breast cancer, telehealth can be utilized for remote monitoring; virtual consultations, and education, supporting a patient-centered approach that takes into account the unique needs and preferences of each patient. Modern data analytics can significantly improve targeted and personalized care for patients with breast cancer. By leveraging big data and machine learning algorithms, healthcare practitioners may analyze large patient data sets, identify patterns, and predict treatment outcomes. This data-driven strategy has the potential to improve overall efficacy, optimize treatment regimens, and provide a deeper understanding of patient characteristics. Due to its diverse character and abundance of molecular subtypes, breast cancer needs customized treatment regimens.***

Keywords: Patient-Centered Care, Telehealth, Breast Cancer, Data Analytics and Personalized Strategies

1. Introduction and Background

Telemedicine refers to a wide range of decentralized treatment strategies that bring clinicians to the patient, hence removing the need for transportation [1]. The use of home-based care visits, remote patient monitoring techniques, and phone or video telehealth visits are examples of telemedicine instruments [2, 3]. During the pandemic, the use of telemedicine- especially telehealth visits—accelerated throughout the major cancer centers and oncology units. This was necessary to guarantee the continuity of cancer care [4, 5]. Although there is still much to be learned about telehealth adoption as of this writing, this viewpoint highlights critical factors for maximizing telehealth as a fundamental component of the cancer care continuum and describes experiences to date at major institutions across diverse geographies [1, 6, and 7].

Taking care of breast cancer can be challenging, especially as it is the most prevalent cancer globally. In 2020, there were 2.26 million new cases of the disease recorded [8]. Numerous factors, such as the kind and stage of the tumor, affect the course of treatment, and effective care necessitates ongoing communication between patients and medical staff [9, 10]. Putting the patient's care closer to home could lead to better results. The usual symptoms of cancer patients, such as sadness, worry, emotional distress, and exhaustion, can be effectively managed with telephone interventions [11]. Information and communication technology (ICT) advancements have made telehealth a more widely recognized and improved option for managing breast cancer [3, 12].

Breast cancer is a prevalent illness that has many long-term survivors. It may be more advantageous for individuals with less symptoms or shorter survival durations than other cancers because it has a lower chance of recurrence. Different cancer types may require different targeted therapies because of variations in treatment and surveillance techniques. Additionally, there is a lack of evidence from US-based clinicians regarding their perspectives on TM utilization for breast cancer [16].

1.1 Rationale for Focusing on Telehealth in Breast Cancer Care

Telehealth has various potential applications, such as monitoring, diagnosing, treating, and preventing disease [3, 17]. It can enhance adherence, lessen chemo adverse effects, enhance post-treatment rehabilitation, and enhance mental functioning in the treatment of breast cancer [18]. During the COVID-19 pandemic, telehealth is essential to the care of patients with breast cancer. It made it possible for the continuity of care to incorporate remote expert-guided physical exercise, psychological and emotional support, virtual consultations and appointments, multidisciplinary collaboration, and even the detection of breast cancer [19, 20]. Although the user experiences are not properly described, the results show promise. A literature review can help gain a thorough grasp of a topic. supplying data

regarding the viability and acceptability of treatments. A literature review contributes to the establishment or improvement of more general rules and hypotheses. In order to improve patient-centered care in oncology through telehealth, this study's literature review attempted to assess and summarize research that were utilized to describe advanced data analytics and personalized strategies in breast cancer treatment. The COVID-19 pandemic has significantly increased the importance of telemedicine, and developing better technologies aimed at enhancing breast cancer management requires understanding the patient's perspective.

1.2 Objectives

This study investigates the effectiveness of telehealth interventions in managing breast cancer care and recovery with the goal of improving patient outcomes and implementing tailored treatment alternatives. Its main point is how advanced data analytics fit into this procedure.

2. Method

The systematic review procedure for this investigation was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [21]. The article selection process was shown visually by the PRISMA flowchart. It provides a clear and well-organized explanation of the screening and selection procedures as well as the reasons behind each stage's article rejection. The systematic review was conducted with a methodical methodology and full adherence to the PRISMA standards [22]. The initial action was to look for relevant studies in the various databases.

2.1 Data Strategy

The MEDLINE, Cochrane Library, PubMed, and PMC databases were utilized in this study. The search terms "Telehealth" and "Breast Cancer" were used to locate relevant papers. These concepts were then combined with keywords using the Boolean operator "OR." The use of certain keywords, such as "Oncology," "Patient-Centered Care," "Personalized Strategies," and "Advanced Data Analytics," led to the development of Search Builders. Boolean operators (AND, OR) were carefully used to combine these terms to produce a highly specific and comprehensive search strategy.

2.2 Criteria (Inclusion and Exclusion)

Every study that was retrospective, RCT, cross-sectional, longitudinal, or interventional was taken into account. The English publication of the essay seemed suitable. A study prepared in a language other than English is evaluated based on its non-English title and abstract. If the text is deemed relevant to the desired study findings, an effort is made to translate it in its entirety. The publication year needs to be between the range of 2013 and 2021. A new study; rather, it combines data from reviews, conference abstracts, and other sources. English is not used in the language at all.

2.3 Screening of Articles

Once the relevant articles have been obtained from all the databases, remove the duplicates. After that, the abstracts, titles, and readings of the entire texts were used to evaluate the papers. Ultimately, 12 papers were selected for additional review and quality assessment.

2.4 Quality Appraisal Tools

In a systematic review, empirical examination and an assessment of the evidence's dependability are required. The CASP technique must be applied in order to evaluate the data's dependability as well as each study's inherent biases. The appropriate risk of bias score was created by accounting for the development of timelines, measurement mistakes, blinding, incomplete evaluations, selective the efficacy of, and other biases [23].

2.5 Data synthesis strategy

PRISMA guidelines were followed in the reporting of the results. The study's findings were summarized as a narrative report using themes found in the recovered data. The method employed to conduct the study includes a preliminary synthesis of the research findings from the research reviewed, an analysis of the connections between the studies, and a rating of the synthesis's strength.

3. Results and Discussion

The process of selecting studies resulted in the creation of 395 distinct publications. Figure 1 shows the systematic review, elimination, and article selection procedures. A total of thirty-two publications underwent full-text assessments, and fourteen were rejected based only on their abstracts or titles. After applying the exclusion criteria, 12 studies were located, and their quality was assessed. One study was omitted since it lacked identifying information. Part of the already-highlighted point is that the comprehensive synthesis of the key concerns fully met the predetermined goals of the current systematic review (Table 1).

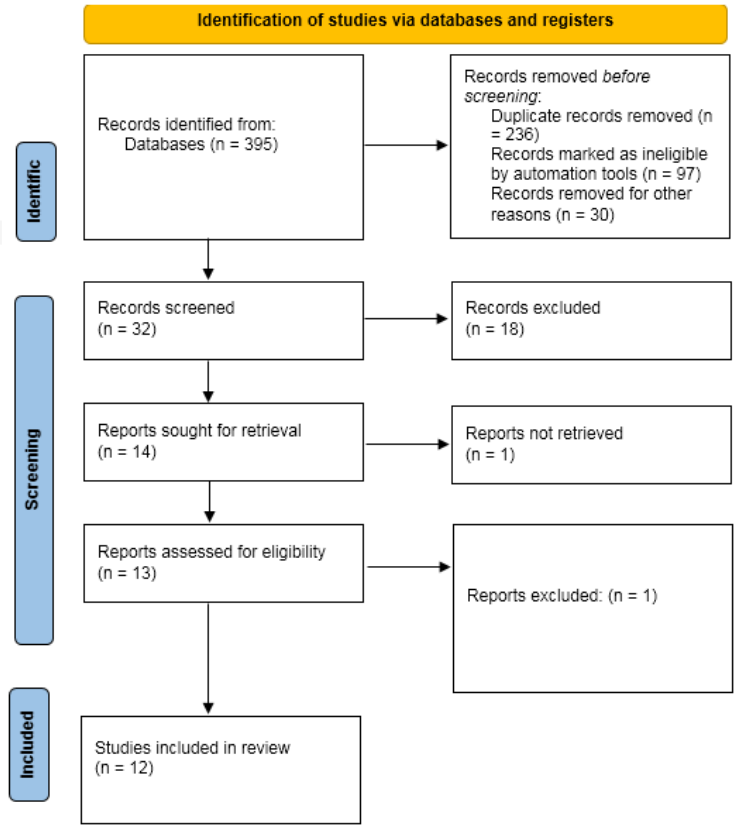

Figure 1: PRISMA Diagram

3.1 Telehealth in Breast Cancer Treatment

Telemedicine is a promising solution to mitigate the negative effects of cancer and its associated treatments on physical and mental health, for both healthcare providers and breast cancer survivors [2]. In order to lower the chance of recurrence, it also assists ladies in forming wholesome routines. Over the past few years, telehealth has been applied in the field of oncology, particularly with regard to breast cancer [7]. It has been demonstrated that using mHealth apps improves emotional functioning, self-efficacy, self-esteem, mood, and symptom interference [5, 24]. Especially for those living in remote and marginalized areas, the implementation of these telemammography systems during the COVID-19 pandemic ought to greatly enhance BCa screening and diagnosis [8, 13, 25, 26].

Table 1: Data Extracted

No.	Author and year	Aim	Design	Patient	Findings
1	Fjell et al. [3]	Using the interactive software Interaktor reduces the amount of symptoms that patients experience	RCT	Adults	experienced significantly lower physical symptom distress, emotional functioning was higher.
2	Johnson et al. [4]	the usefulness of telemedicine in the treatment of breast cancer.	cross-sectional study	Adult	patients express satisfaction and usability with telemedicine
3	Kim et al. [2]	enhancing drug compliance and	RCT	Adults	The treatment improved drug adherence, reduced chemotherapy side effects

		reducing physical side effects of chemotherapy.			
4	Stavrou et al. [6]	Perceptions of TM (telemedicine) regarding breast medical oncology care.	cross-sectional study	medical oncology clinicians	Breast clinicians TM as a valuable tool for improving outpatient breast cancer care.
5	Epstien et al. [7]	to improve communication between patients and oncologists.	RCT	medical oncologists and adult Patient	Communication training for oncologists with previsit coaching for patients significantly improved patient-centered communication.
6	Teicher [8]	The effect of transitioning from in-person to telehealth visits on patient satisfaction.	cross-sectional study	Adult	Satisfaction with receiving information with conducting survivorship visits via Telehealth.
7	Hirano et al. [10]	The blockchain network and health checkup function	RCT	Adult	Blockchain technology can securely manage medical data, providing an immutable and traceable audit trail in clinical trials.
8	Freeman et al. [5]	The use of an online health questionnaire with a remote follow-up component.	RCT	Adults	TD (and Live) reported less fatigue, cognitive dysfunction, sleep disturbance with WL
9	Lahoura et al. [11]	The cloud-based Electronic Life Management (ELM) technologies for disease diagnosis.	experimental	Adults	The cloud-based ELM was compared to advanced technologies for disease diagnosis performance.
10	Crefoord et al. [12]	The study investigates the use of the Interaktor app among patients	Mixed Methods	Adults	Patient engagement in providing continuous and convenient communication.

		with breast or prostate cancer during their treatment.			
11	Maguire et al. [9]	The impact of remote monitoring of adjuvant chemotherapy.	RCT	Adults	ASyMS for remote symptom monitoring in cancer care has been proven to significantly reduce.
12	Borosund et al. [1]	12-month trial with six months of follow-up data.	RCT	Adults	Significant reduction in symptoms of distress, anxiety, and depression.

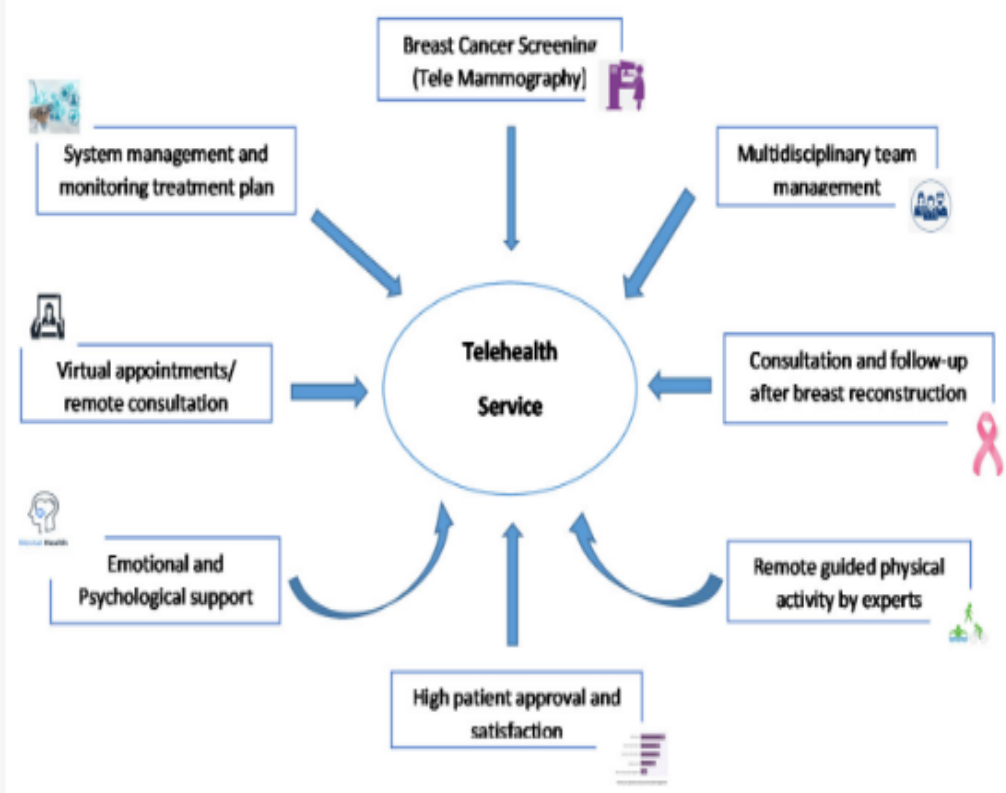

Figure 2: Telehealth to manage breast cancer patients [13]

Health literacy is increased and education is provided via mHealth apps [5, 6]. They assist women with coping mechanisms and enhance drug adherence [7, 8]. The sense of physical incentives, psychological elements like motivation, social functions like group practice, and business goals like scheduling ahead for physical activity have all benefited from mHealth apps [9]. In a randomized, controlled research, Lahoura et al. assessed patient-reported outcomes for virtual consultations and discovered no distinction between standard and video-assisted consultations in terms of patient satisfaction and health [31]. Telephone calls are used in telehealth formats to link patients remotely in various settings through the use of electronic devices known as peripherals, including as blood pressure monitors, digital thermometers, glucose monitors, and pulse oximetry devices. Asynchronous or synchronous use of digital photos and movies is also possible in remote monitoring [32]. Real-time synchronous telehealth makes use of technologies like video conferencing, which allows a patient and physician to communicate through a two-way audiovisual link. Health care practitioners have direct patient communication in addition to imparting medical information with a subsequent disease diagnosis, treatment plan, and drug delivery [4, 27, and 28].

3.2 Advanced Data Analytics in Oncology

After utilizing the internet to install the program on the device, the responder uses the researcher's account to log in to the system. The software creates a secret hash key upon a

participant's initial login, which is kept on their device until the study is finished [2, 5]. To stop impersonation through hacked accounts or brute force attacks, the account is locked when a participant signs in for the first time (Figure 3). On the other hand, vulnerabilities may exist prior to blockchain network database registration [11]. The information may be altered, and there is a chance of impersonation, which would reduce its dependability. By locking the user profile upon the initial login, the system is intended to stop impersonation [10]. In order to guarantee app-only access during clinical trials, the relay server verifies the authentication key in the client application [9]. By creating an internet protocol domain constraint to safeguard the blockchain network—which houses medical data—the technology is extremely secure [7]. The software utilizes user data and the client hashchain, which are registered on the blockchain network, to communicate with the network during clinical study. The app transmits the private hash key to the blockchain network at the conclusion of the trial [5, 10, 13, and 17].

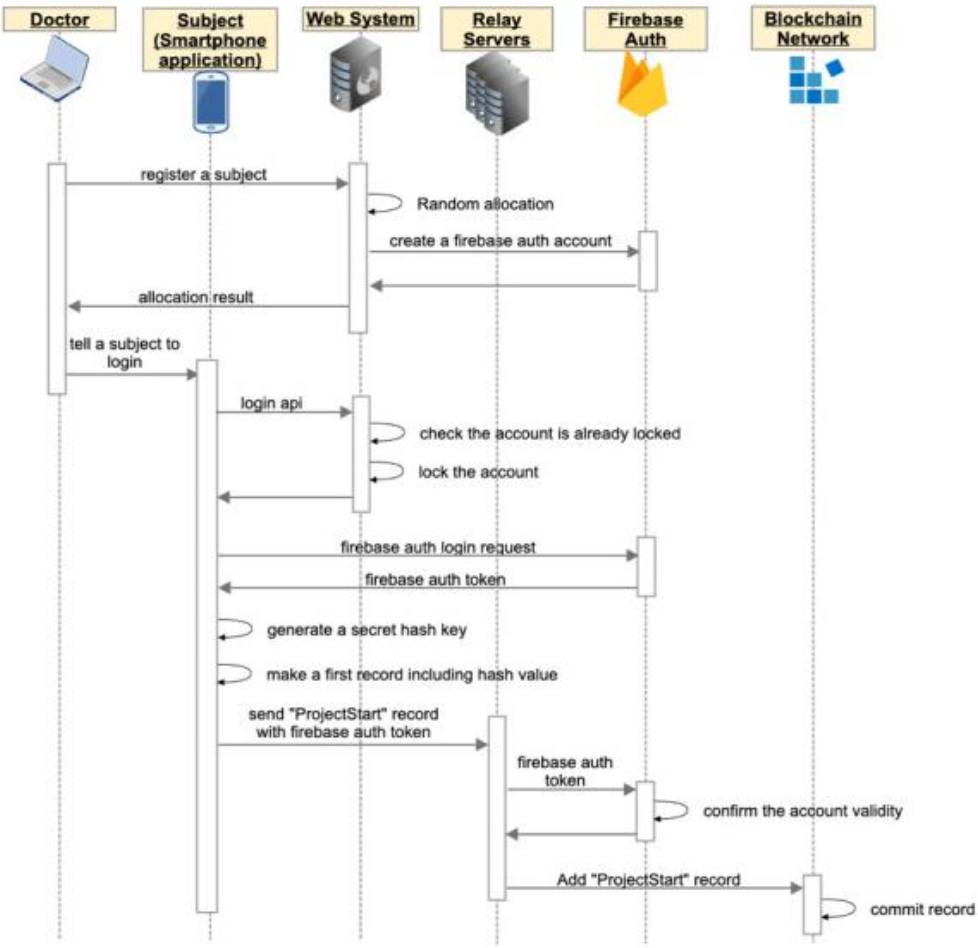

Figure 3: Data Integrity [13]

Some resources in the impacted area of Arizona experienced impaired EC2 instances due to Data Integrity during the Amazon Web Services Disruption Event. A data center outage caused one of the blockchain network nodes to go down [12]. Because the blockchain network was set up to span various AWS AZs and consisted of three organizations, each with two validating peers, redundancy was maintained during the event to ensure consistent system functioning [3]. Furthermore, the impacted node was immediately restored in a healthy data center through the deployment of a regular health check function utilizing Amazon EC2 Auto Scaling Service. Protocol was used to validate the data, and traceability was protected. The integrity of the clinical trial data was maintained by our system despite a significant disruption to cloud server services [1, 8, and 26].

3.3 Personalized Strategies in Breast Cancer Treatment

Individuals with CIPN have a higher risk of bone fractures because they are more likely to fall [9]. Despite having a negative impact on the patients' ability to move around, a study indicated peripheral neuropathy had no effect on the corresponding dose quantity in the adjuvant chemotherapy treatment [10]. This implies that the cancer treatment strategy would not be impacted by CIPN experiences among breast cancer patients [3, 7]. It is necessary to develop solutions that aid in improving the effectiveness of cancer treatment in order to shorten the duration of the procedure [2, 29]. However, as was previously said, there are differences amongst patients in how well they respond to cancer treatment. It has been proposed that a patient's age and cancer stage may have an impact on how well they respond to treatment [5, 11]. For instance, because pharmacokinetics change with age and lead to worse drug clearance, older individuals are more susceptible to the

harmful effects of chemotherapeutic medicines [4]. Similarly, individuals with more advanced disease also showed a low complete response rate to treatment [8, 9, and 33]. To ensure that cancer therapy is safe and effective for every patient, the best drug combination and dose must be chosen for each individual patient. This continues to be a significant issue for oncologists and medical professionals. Here are several potential tactics that might be employed to improve the efficacy of cancer therapy by optimizing the drug selection and dosage [6, 13, and 30].

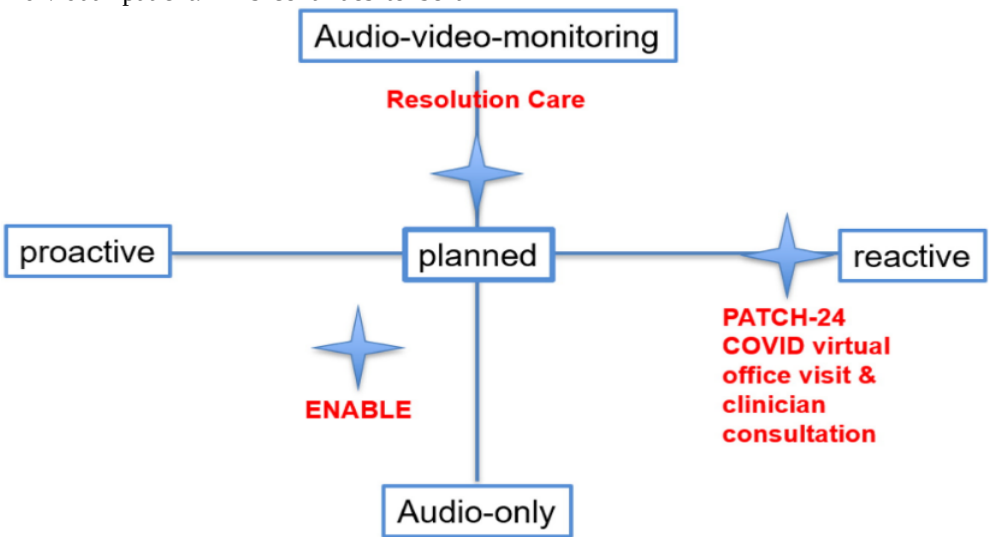

Figure 4: Spectrum of Telehealth [13]

Cancer survivors can get telehealth care in their native tongue in a situation where family members or other housemates can offer consolation and support [4]. Language does not in and of itself prevent the use of telehealth; however, it does necessitate ahead planning in order to schedule and manage translation services, assist the patient and translator in navigating the range of electronic platforms accessible, and arrange for follow-up [1, 14, 31].

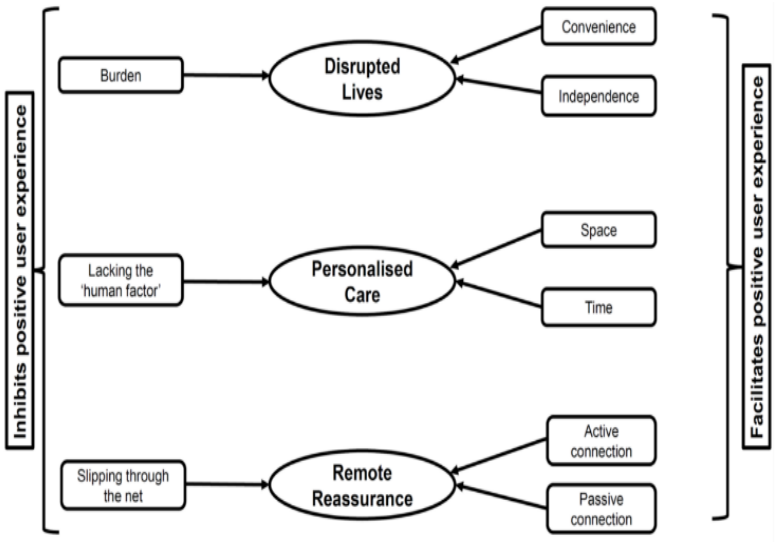

Figure 5: Cancer survivor engagement with telehealth [14]

3.4 Challenges and Future Directions

Cancer treatments can cause difficult symptoms, yet the majority of patients are treated as outpatients [1, 2]. Improved patient outcomes can result from health care workers detecting and evaluating the potential hazards associated with cancer treatment based on patients' judgments of the frequency and severity of their symptoms as well as their worries [3, 4]. Research has demonstrated that implementing mobile technology interventions to assist cancer patients with symptom monitoring and self-care can enhance communication between patients and clinicians, enhance symptom management and self-care skills, lessen symptom burden, and boost survival [4-6]. Although there are more applications available to help cancer patients manage their symptoms, very few of them offer evidence-based material or have undergone extensive testing [7, 8]. Furthermore, only a small number have interactive elements, like peer and health care professional communication and self-care assistance for prompt clinical management [7, 9, and 36]. Understanding how digital interventions work and how to improve them through usage and user experience assessments is essential [5, 6].

Research indicates that cancer patients who are receiving treatment at home take advantage of and value the chance to

notify medical staff about their symptoms [6, 8, and 29]. In the context of cancer care, the use of mobile technology for health (mHealth) to promote self-management has been associated with favorable outcomes regarding both physical and psychological symptoms [3, 10]. Two daily symptom evaluations, personalized counsel, and access to instructional webpages were all part of an early system for remote symptom management during cancer treatment [5, 35]. The study [20] discovered that patients varied significantly in the number of reports they made and that all patients visited the webpages. In addition, a few minor technological issues were reported, and patients reported improvements in the way they could communicate with medical staff and felt satisfied with the care they received [12, 34]. Since then, systems for managing symptoms remotely while receiving cancer treatment have shown high acceptance [30] and long-term viability [3, 31]. The majority have been web-based and have required patients to evaluate their symptoms using a tablet or home computer [4, 6].

4. Conclusion

Treatment for breast cancer is being revolutionized by the use of telehealth, sophisticated data analytics, and customized approaches. Healthcare professionals may enhance treatment outcomes, elevate patient experiences, and propel individualized cancer care forward by putting the patient at the center of their care and utilizing technology and data. In oncology care delivery, telehealth has shown to be an invaluable resource, giving patients easy access to doctors, lessening the need for travel, and improving overall healthcare delivery efficiency. Telehealth can be used for remote monitoring, virtual consultations, and education in the context of breast cancer, promoting a patient-centered approach that gives special consideration to each patient's requirements and preferences. Targeted and individualized care can be greatly enhanced by the use of modern data analytics in breast cancer treatment. Healthcare professionals may examine massive patient data sets, spot trends, and forecast treatment outcomes by utilizing big data and machine learning algorithms. With the help of this data-driven approach, patient profiles may be better understood, treatment regimens can be optimized, and overall efficacy can be raised. Because of its heterogeneous nature and wide range of molecular subtypes, breast cancer requires individualized treatment plans. Regular communication between patients and healthcare providers is made easier by telehealth, which also makes it possible to gather data in real time about symptoms, treatment outcomes, and patient experiences. The ability to customize interventions based on individual responses is improved by this continuous feedback loop, which maximizes the trade-off between reducing side effects and increasing therapeutic efficacy.

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