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# A Comprehensive Review On Digital Health Technologies In Pharmaceuticals: A Transformation For Patient Healthcare With Innovation And Precision

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**Keywords**

Digital Health Technology, Medication Adherence, Telemedicine, Personalized Medicine, Remote Patient Monitoring, Healthcare Innovation.

**Abstract**

Digital Health Technologies (DHTs) have revolutionized the healthcare industry by incorporating such tools as wearables, mobile applications, telemedicine, and electronic health records to improve patient care. The technologies increase accessibility, efficiency, and personalized treatment, particularly in medication adherence, chronic disease management, and clinical trials. To illustrate, mHealth apps and wearables have led to a 20-30% increase in medication adherence, and remote patient monitoring (RPM) has decreased hospital readmissions by as much as 38%. The COVID-19 pandemic has accelerated the adoption of telehealth, and it has offered continuity of care in the face of disruption around the world. DHTs can also enable personalized medicine through the use of AI and genomic technologies that enable more personalized treatment that has fewer side effects and better outcomes. However, concerns such as data confidentiality, regulatory adherence, and integration with existing systems remain significant. The mean healthcare data breach cost in 2023 was 9.23 million, which highlights the importance of such frameworks as HIPAA and GDPR. New technologies, including AI, blockchain, and advanced wearables, are likely to introduce further changes, including an effective drug development procedure, improved patient engagement, and secure data storage. The regulations should be revised to strike a balance between innovation and patient safety and interdisciplinary collaboration is the key to overcome technical and ethical challenges. DHTs are transforming healthcare delivery, and they present possibilities of patient-centered, data-driven care. The stakeholders should collaborate to address the challenges and achieve equitable access, which will eventually promote global health equity.

## 1 Introduction

Digital Health Technologies (DHTs) encompass a broad variety of approaches and services that rely on digital information and communication technology to optimize health results. This encompasses wearable, electronic health records (EHRs), telemedicine, Mobile Health (mHealth) apps, and health information technology (HIT) systems. These technologies have been developed to enhance patient

involvements and augment the efficacy of healthcare delivery as well as allow real-time monitoring and managing of health problems [1].

The last two decades brought a significant change in the involvement of DHTs in the pharmaceutical industry. Initially, digital health was all about administrative task such as electronic prescription and basic record-keeping [2,3]. Nevertheless, due to technological advancement and better internet access, its use has expanded to complex data analytics, remote monitoring, and patient interaction applications [4].

One critical milestone that occurred in this history was the advent of smartphones and wearable technology at the early stage of 2010s that provided the opportunity to monitor and capture data related to health in real-time [5]. Moreover, the COVID-19 pandemic accelerated the role implementation of digital health solutions and the use of telehealth services that maintained the treatment continuity in case of an emergency on a population scale [6]. DHTs have become critical to the drug adherence programs, clinical experimentation, and personalized care plans, transforming the entire approach to the creation, promotion, and consumption of drugs in a radical way [7].

DHTs are vital to the provision of healthcare in a modern world and they enhance accessibility, efficiency and patient-centered care. They facilitate direct involvement of patients in the management of their health by availing of instructional materials and self-monitoring materials [8]. Such technologies improve communication, functioning, and clinical decisions of healthcare providers [9].

DHTs are also useful in eliminating disparity in healthcare access since they make healthcare available remotely to underserved populations. With big data analytics, an organization will be able to pull useful insight out of large databases to the end of improving patient outcomes and treatment decisions [10].

**Goals of the DHTs for improve Patient Care**

Evaluate the situation with DHTs within the area of pharmaceutics and focus on the main breakthroughs and applications for improve patient care showing in figure 1.

1. Examine the advantages and setbacks of the use of such technologies in healthcare facilities.
2. Comment on the implications to further research and development, at least as regards to patient involvement and personalized therapy.
3. Offer suggestions of how the stakeholders, such as lawmakers, drug manufacturers, and healthcare providers, need to use DHTs to better treat patients and accelerate the provision of healthcare [11].

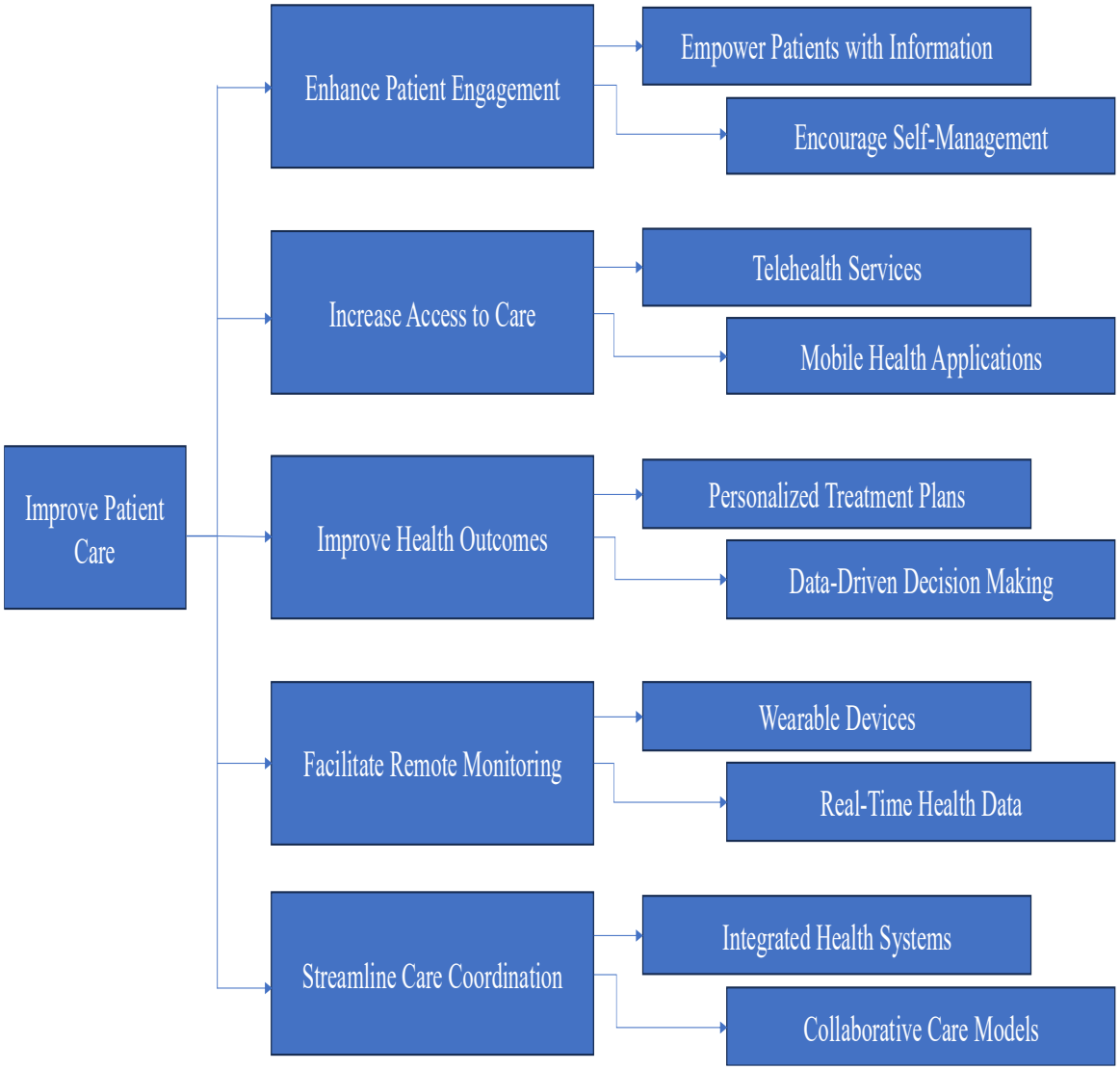


**Figure 1** Digital Health Strategies for Improved Patient Care

## 2 Types of Digital Health Technologies (DHTs)

The various DHTs are discussed in summary overview of DHTs presented in Table 1 and Various approaches of DHTs used in patient care in figure 2.

### 2.1 Mobile Health (mHealth)

Mobile Health (mHealth) is the utilization of mobile devices, including smartphones, tablets, etc. to promote the public health and clinical practice. It consists of different applications and services, which include:

- **Mobile Apps:** Health monitoring apps, medication reminder apps and chronic disease management apps (e.g., MySugr apps to manage diabetes, Medisafe to manage medication adherence) [12].
- **Wearable Devices:** Medicalized technologies that monitor the health indicators of the heart rate, physical activity, and sleep pattern (e.g., Fitbit, Apple Watch) [13].

**Role in Medication Adherence and Chronic Disease Management:**

- **Medication Adherence:** mHealth technology is able to remind about taking medicines, monitor the efficacy and supply educational materials, which will also greatly enhance adherence levels. Analysis indicates that mHealth interventions have the potential to enhance compliance by 20-30 percentages [14].
- **Chronic Disease Management:** The mHealth instruments help to monitor patients with chronic conditions continuously and make adjustments to the plans and make interventions when needed. As an example, it is possible to find apps on diabetes management by which a patient can record a blood sugar level and receive individual feedback [15].

### 2.2 Telehealth and Telemedicine

- **Telehealth:** The generic term that brings together all the remote healthcare services; which involve remote patient monitoring, health education and telemedicine [16].
- **Telemedicine:** A subcategory of telehealth particularly used to name the mode of clinical service delivery through the help of telecommunications technology, e.g. video consultation [16].

**Impact on Access to Healthcare and Pharmaceutical Services:**

- **Access to Healthcare:** Telehealth broadens access to healthcare services particularly to the patients in underserved communities and those living in remote regions. One of the studies developed by the American Journal of Managed Care stated that telehealth visits grew by more than 154% during the COVID-19 pandemic [17].
- **Pharmaceutical Services:** Telemedicine offers consultations and prescriptions and the patients get medications without visiting clinics. This has specifically been useful in the management of chronic issues and mental health as frequent consultations are important [18].

### 2.3 Electronic Health Records (EHRs)

Participation in Data Management and Patient Information Storage: EHRs are the electronic equivalent of the paper charts of patients and present their entire health data, such as their medical history, medication, allergies, and test results. They enable:

- **Efficient Data Management:** EHRs facilitate data entry and access thus helping to make health care more efficient. In one of the studies, it was demonstrated that EHRs can save 20 percent of the time spent on documentation [19].
- **Enhanced Patient Safety:** EHRs offer warnings about drug interactions, drug allergies, and helps in safe prescribing [20].

**Importance in Pharmacovigilance and Clinical Decision Support:**

- **Pharmacovigilance:** EHRs help to manage drug safety as such events can be recorded, and promptly reported to regulation authorities [21].
- **Clinical Decision Support:** Clinical guidelines and alerts can be integrated in EHR systems and help the healthcare providers make wise decisions in the treatment of patients [21].

### 2.4 Health Information Technology (HIT)

Health Information Technology (HIT) is a number of technologies applied to deal with the information regarding health issues. HIT systems in pharmacies are HIT:

- **Pharmacy Management Systems:** Medication dispensing, inventory management and billing software [22].

- **Electronic Prescribing (e-Prescribing):** One that enables healthcare providers to pass prescriptions electronically to pharmacies, thus, minimises error at the same time enhancing performance [22].

**Integration of HIT with Pharmacy Practice:**

- **Workflow Optimization:** HIT is used to improve the workflows of pharmacies by automating their routine work, therefore enabling the pharmacist to pay more attention to the patients [23].
- **Data Sharing:** The combination of HIT systems with EHRs allows sharing the information about patients with no hindrance, which enhances the care coordination between the healthcare providers [23].

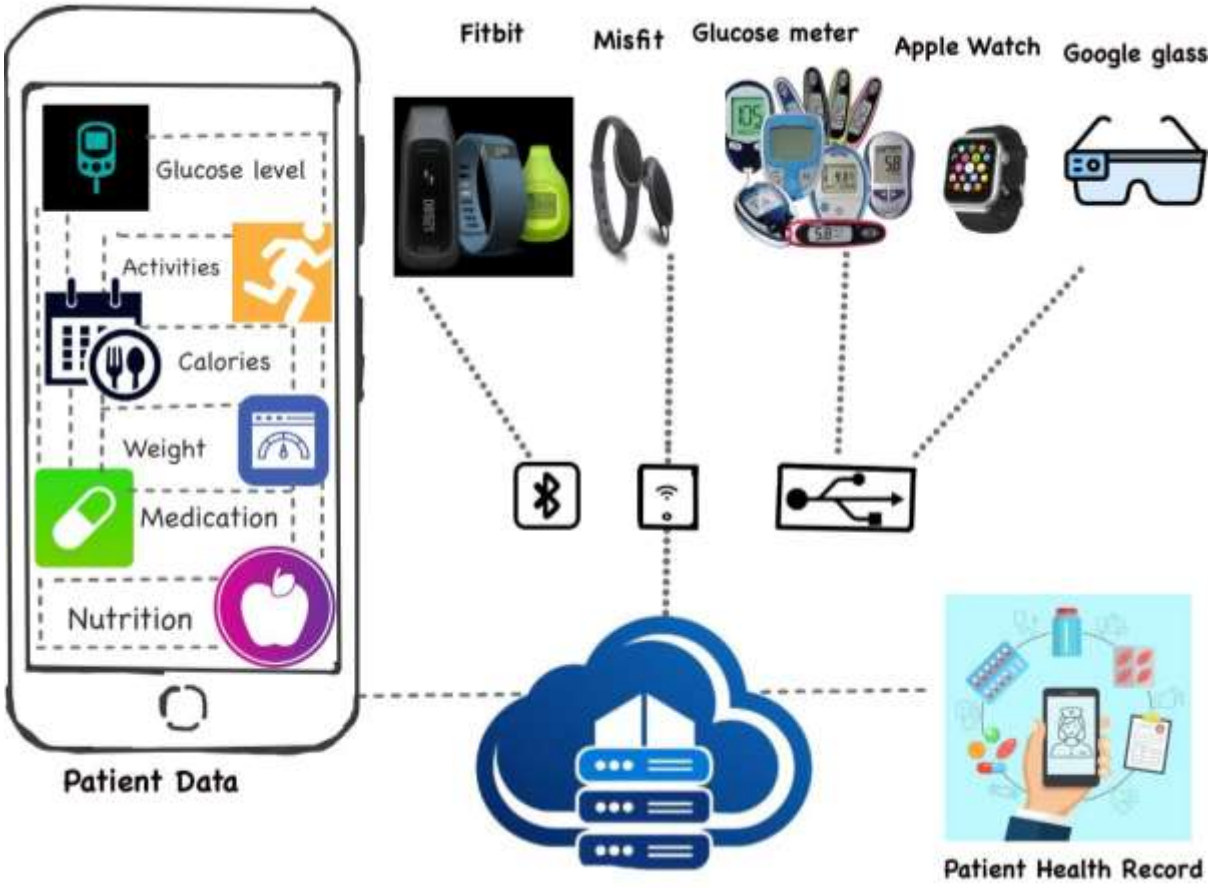


**Figure 2** Various approaches of DHTs used in patient care

**Table 1** Summary overview of various DHTs

| Digital Health Technology (DHTs) | Definition | Examples | Role/Impact |
|---|---|---|---|
| **Mobile Health (mHealth)** | Use of mobile devices for health support | Mobile apps (e.g., MySugr), Wearables (e.g., Fitbit) | Improves medication adherence, chronic disease management |
| **Telehealth/Telemedicine** | Remote healthcare services | Video consultations, Remote monitoring | Expands access to care, facilitates |

| Digital Health Technology (DHTs) | Definition | Examples | Role/Impact |
|---|---|---|---|
| | | | pharmaceutical services |
| **Electronic Health Records (EHRs)** | Digital patient health records | Comprehensive health information systems | Enhances data management, supports pharmacovigilance |
| **Health Information Technology (HIT)** | Technologies for health information management | Pharmacy management systems, e-Prescribing | Optimizes pharmacy workflows, improves data sharing |

## 3 Applications of DHTs in Pharmaceuticals

### 3.1 Medication Adherence

Taking medications as prescribed or medication adherence is critical to treatment yet it regularly fails because of the expense, memory lapse, or a complicated plan. Better compliance has the capacity to reduce hospitalizations and expenses. Some of the solutions involve the use of simplification of dosing, training, and digital adjustments such as reminders. WHO: 50% of patients of chronic diseases have difficulties with a long-term assiduity.

**Technologies that Promote Adherence**

- **Reminders**: Patients are assisted in using medications at the right time with the following of mobile applications and SMS reminders. To take an example, there is the app like Medisafe which reminds patients about taking the medications [24].
- **Tracking Apps**: These programs enable patients to record the use of their medications, dosage and side effects. Such apps as Mytherapy have medication recording and health tracking features [25].

**Evidence of Improved Adherence Rates**

- The results of a systematic review were that the adherence increased by about 10-30 per cent in electronic reminder [74].
- A research proved that patients who used medication tracking applications exhibited 25 per cent improvement in compliance in contrast to those that did not employ such technologies [26].

### 3.2 Remote Patient Monitoring (RPM) in Digital Health

RPM enables post-op and chronic disease acute care using wearables, sensors, and applications on patient-monitored data (e.g., heart rate, glucose). Advantages: patients receive less treatment and hospital visits; it is cheaper and it gives the power back to the patient. These are issues of data overload, access disparities and hurdles of regulations. The future trends concentrate on AI analytics and 5G. In a 2024 study, RPM reduced readmission rates associated with heart failure by 38 %.

**Use of Wearables and Sensors**

- Wearable gadgets (including smartwatches and fitness trackers) and sensors check the vital body parameters like heart rate, blood pressure, and glucose level. Smart technologies such as Apple Watch and Fitbit have embedded functions of health monitoring [27].
- Diabetes management through information fed in real time into continuous glucose monitors (CGMs), such as Dexcom, enables timely change of medication [27].

**Impact on Chronic Disease Management and Medication Adjustments**

- A research conducted by Bodenheimer and Berry-Millett (2009) indicated that remote monitoring may help reduce the number of hospitalizations in chronic conditions by 25 percent [28].
- In the Telemonitoring in Heart Failure Study (2017), those patients who used remote monitoring experienced a 40 percent reduction in the number of readmissions [29].

### 3.3 Personalized Medicine in Digital Health (DHTs)

Personalized Medicine, where DHTs AI diagnostics, wearables, and genomic tools drive precision medicine treatments on a personal genetic and lifestyle basis, has a benefit: increasing precision, lowering side effects, and improving outcomes. The setbacks are data privacy limitation, cost obstacle, and interoperability of systems. The eventual high-customization (e.g. CRISPR, organ-on-a-chip) lies in the future. The development of AI-stimulated cancer treatment increased the survival quotient by 22%.

**Role of Digital Health in Tailoring Treatments**

- Digital health techs assist in gathering patient data and therefore healthcare providers could adjust the treatment depending on the response of the patients. To illustrate, health records may be combined with genomic data to make drug therapy personal [30].
- PROs apps enable clinicians to modify the treatment plans in real-time, depending on the feedback provided by the patients.

**Case Studies Demonstrating Successful Personalized Approaches**

- The All of Us Research Program seeks to collect health information of different groups of people to design treatments taking into consideration their genetic, environmental, and lifestyle environments.
- In one of the studies conducted by Schwaederle et al. (2017), molecular profiling and targeted therapies enhanced patient outcome in 70 percent of the cases with Oncology research [31].

### 3.4 DHTs Transform Clinical Trials

DHTs (wearables, AI, decentralized platforms) make the trials faster - reduce the timelines by 30 percent and increase diversity by 40 percent. Field device data increases objectivity and apps lead to a better involvement of patients. The regulatory challenges notwithstanding, federated learning and AI-based enrollment have scalability. Savings: ~ 20M dollars per Phase III trial.

**Use of Digital Tools in Patient Recruitment and Data Collection**

- Digital tools will access more individuals and diverse populations to participate in clinical trials recruited via social media, on-line registries, and health applications.
- Data collected on EDC systems facilitate data collection in order to reduce errors and allow better data integrity [32].

**Impact on Trial Efficiency and Patient Engagement**

- According to a study conducted by Lopert et al. (2020), digital ways of recruitment can save a third to half of the time it normally takes to recruit [33].
- Mobile apps have also proven to improve patient engagement and retention rates of the trial, with increased rates of 20-percent compared to the results when methods were traditional [34].

## 4 Benefits of DHTs

The various health benefits of DHTs are discussed and showing figure 3.

### 4.1 Improved Patient Outcomes

The use of DHTs has emerged to be one of the most important ways of increasing patient outcomes.

**Evidence Linking DHTs to Better Health Outcomes**

- **Remote Monitoring**: It has been observed that remote patient monitoring (RPM) may cause fewer hospital readmissions and management of chronic disease. Indicatively, a meta-analysis revealed the power of RPM to decrease hospital returns of up to 30%, in the case of patients with heart failures [35].
- **Medication Adherence**: Digital apps that remind and track the person have been found to improve adherence. An example of systematic review published reports that mHealth interventions enhanced medication adherence by an average 25 percent [36].

**Case Studies Illustrating Successful Implementations**

- **Case Study 1**: A six-month post-survey of a mHealth application used in diabetes management showed a 40% reduction in the level of HbA1c of the users, which indicates a great increase in glycaemic control [37].
- **Case Study 2**: A 3-month remote consultation program in management of hypertension indicated a 20 mmHg decrease in the systolic blood pressure of the participants participating in the program [38].

### 4.2 Enhanced Communication

Digital solutions help patients and healthcare agents communicate better with their health outcomes improved and they are also explained in table 2.

**Role of Digital Platforms**

- **Patient Portals**: Through these platforms, patients have access to their medical records, can communicate with their providers as well as book appointments, which creates a better experience to patients. Investigations indicate that patients utilizing portals express a lot more satisfaction and involvement in their treatment [39].
- **Telemedicine**: Telehealth visits have enhanced the access to care particularly among patients in the rural communities. In a research study, it was established that 85 percent of all telehealth users participating in the study felt closer to their healthcare providers than during traditional care using in-person visits [40].

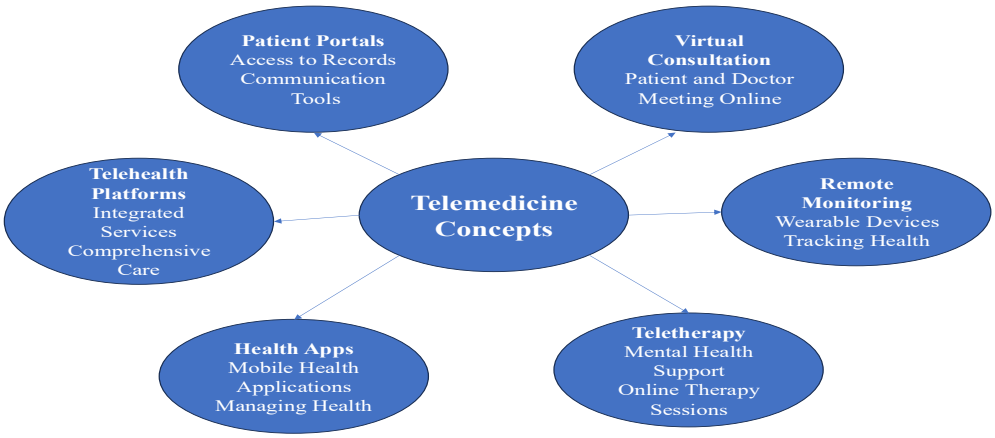


**Figure 3** Various Digital platform in DHTs

**Impact on Patient Education and Engagement**

- **Educational Resources**: Digital health-related technologies will usually give patients educational resources based on their needs and the condition, which improves their health management and knowledge in health matters. As an example, the group of patients who accessed digital platforms reported that their health literacy went up by 30% [41].
- **Engagement Tools**: These interactive tools like chatbots and virtual health coaches can improve patient engagement resulting in improved health. According to one research, patients taking such tools had a 50 percent better chance of adhering to treatment guidelines [42].

### 4.3 Data Analytics and Decision Support

DHTs enable a better development and management of drugs in terms of big data analytics integration.

**Use of Big Data Analytics**

- **Predictive Analytics**: Healthcare providers can analyze huge data sets inside and discover tendencies and forecast patient results. As an example, predictive models can be built, which forecast hospitalization, which allows taking proactive actions [43].
- **Clinical Decision Support Systems (CDSS)**: CDSS also apply data analytics to help healthcare providers make evidence-based guidance to enhance clinical decisions. One research concluded that replacing errors with CDSS decreased medication errors by 40 percent [44].

**Examples of Decision Support Systems in Pharmacy Practice**

- **Pharmacy Management Systems**: These systems are coupled with the data of patients, medication history and clinical guidelines in order to assist pharmacists in the management of medications. As an example, a pharmacy management system used in a community pharmacy had decreased adverse drug events by 25 per cent [45].
- **AI-Powered Decision Tools**: Pharmacists use AI-based tools that help them detect possible adverse drug reactions and simplify the therapy usage. This high estimation was proven by a recent assessment of these tools, which revealed a 35 percent enhancement of medication review precision [46].

**Table 2** Benefits of DHTs

| Benefit Category | Evidence/Impact | References |
|---|---|---|
| Improved Patient Outcomes | RPM reduces readmissions by 30% | 35 |
| | Mobile health interventions improve adherence by 25% | 36 |
| Enhanced Communication | 85% of telehealth users feel more connected | 40 |
| | 30% increase in health literacy through digital tools | 41 |
| Data Analytics and Decision Support | CDSS reduces medication errors by 40% | 44 |

| Benefit Category | Evidence/Impact | References |
|---|---|---|
| | Predictive models enable proactive interventions | 43 |

## 5 Challenges and Limitations

### 5.1 Data Privacy and Security

**Concerns Regarding Patient Data Protection**

Largely, the fact that DHTs are becoming more prevalent among patients prompts quite a bit of concerns regarding patient data privacy and safety. As with any type of sensitive information, health information is being collected, stored and transmitted via several different platforms, the possibility of information breach and unauthorised access is an eminent issue. Identity theft, financial fraud, and loss of patient confidence in healthcare systems, are the possible outcomes of the specified breaches.

- **Statistics**: IBM also reported that the mean cost of data breach in healthcare industry was roughly 9.23 million in the year 2023 making it the costliest industry in terms of data breach [47].

**Regulatory Frameworks Governing Digital Health Data**

Digital health has several regulatory frameworks to safeguard the data of patients. Among the main regulations we can consider the following:

- **Health Insurance Portability and Accountability Act (HIPAA)** in the United States, that contains standards of the security of health information [48].
- **General Data Protection Regulation (GDPR)** of the European Union that gives detailed instructions regarding data protection and privacy of an individual [49].

The rules require strict data management procedures, consent, and breaches reporting, which may be tricky to adhere to by digital health technology vendors.5.2 Technology Adoption Barriers

**Factors Influencing Adoption**

The integration of DHTs among the providers and patients is based on several factors presented in table 3.

**Table 3** Various factors which influenced the DHTs among the providers and patients

| Factor | Description |
|---|---|
| **Cost** | High initial investment and ongoing maintenance costs. |
| **Usability** | Complexity of technology can hinder user engagement. |
| **Training** | Lack of adequate training for healthcare providers and patients. |
| **Resistance to Change** | Cultural resistance within healthcare settings. |
| **Regulatory Concerns** | Fear of non-compliance with regulations. |

**Strategies to Overcome Barriers**

In an effort to ease on the adoption of DHTs, a number of approaches may be adapted as follows:

- **Education and Training:** Offering multidisciplinary training to health care professionals and patients on usability issues and confidence on the use of digital tools [50].
- **Cost-Effectiveness:** It is necessary to prove that these DHTs have cost savings and better patient outcomes that are significant on a long-term basis [51].
- **User-Centric Design:** Creation of interactable and user-oriented interfaces accommodating the needs of different users [52].
- **Stakeholder engagement:** Engaging the healthcare providers, patients, and policymakers in the process of planning and applying digital health solutions in order to achieve buy-in and acceptance [53].

### 5.2 Integration with Existing Healthcare Systems

**Challenges in Integration**

Combining DHTs with the conventional healthcare systems suffers a number of challenges:

- **Interoperability:** Data sharing and communications between systems may not be possible because of the differences between the technological platforms on various health-related digital applications [54].
- **Legacy Systems:** A lot of healthcare organizations are still using the outdated systems that cannot be compatible with the modern technologies of digital health [55].
- **Data Fragmentation:** The data about patients mostly lies on different platforms and to gain a good perspective about the health of the patient it is hard to have the information gathered [56].

**Recommendations for Seamless Integration**

To have a smooth combination, the recommendations are as follows:

- **Embrace Interoperable Standards:** Promote the use of universal data standards and protocols (e.g., HL7, FHIR) to enable data sharing [54].
- **Invest in New Systems:** Healthcare organizations should focus on the modernization of ancient systems to facilitate their integration with digital tools in healthcare [55].
- **Make Collaborative Ecosystems:** Stimulate the collaboration of technology developers, healthcare providers, and regulatory organizations in order to support similar integration policies [57].

## 6 Future Directions

### 6.1 Emerging Technologies

**Overview of Upcoming Digital Health Innovations**

Digital health is advancing at a great rate and there are a number of technologies that will change the pharmaceutical environment:

- **Artificial Intelligence (AI):** AI algorithms are being implemented that analysed huge masses of health data, forecast patient outcomes and individual treatment plans. As an example, AI could be used to simplify drug discovery by estimating the useful formula of drugs [58].
- **Block chain:** It is an effective way of realising secure and transparent transactions in healthcare data management. It is capable of increasing traceability within drug supply chains, decreasing counterfeit drug materials and increasing patient safety [59].

- **Telemedicine Platforms:** Telemedicine Industry discoveries such as virtual reality, or augmented reality are transforming remote consultations and educating patients [60].
- **Wearable Devices:** Developed wearables, such as those with biosensors, have the potential of measuring vital signs and medication taking and managing care proactively [61].

**Potential Impact on the Pharmaceutical Industry**

Convergence of such technologies may result in:

- **Faster better:** AI has the potential to accelerate and cut down the cost of developing a new drug through clinical trial design optimization and the determination of an appropriate target patient population [62].
- **Improved Patient Engagement:** Wearable and mHealth applications can support enhanced patient engagement, where their use can result in increased patient adherence and better results [63].
- **Improved Operating Process:** Block chain has the potential to facilitate oversimplification of supply chains, with assurance that drugs are original and minimize losses paid through fraud [59].

### 6.2 Policy and Regulatory Considerations

**Need for Updated Regulations**

At the same time, as regulations often fall behind new DHTs, more of them should be provided on the federal level. The main areas that should be addressed encompass:

- **Data Privacy:** The data privacy laws that exist might not be sufficient to safeguard the patient information in a digital landscape. The DHTs also pose specific challenges that newer frameworks would have to deal with [64].
- **Approval Processes:** There are regulatory bodies, which must settle on clear processes related to approving the AI algorithms as well as the digital health apps, without overregulating developments [65].

**Recommendations for Policymakers**

Develop Clear Guidelines: Devise explicit laws that govern data privacy, data security, and the process of DHTs approval [66].

- **Embrace Collaboration:** Stimulate togetherness among technology developers, healthcare administrators, and policy-making authorities to establish criteria capable of safeguarding, but simultaneously initiating innovation [67].
- **Promote Education:** Educate medical workers on how to utilize DHTs and the effects of new regulations [68].

### 6.3 Research Opportunities

**Areas for Future Research**

There are some topics that can be developed:

- **Impact Assessment:** Studies regarding whether DHTs positively influence the outcome of patients and healthcare expenditures are vital in ensuring proper implementation of DHTs [69].
- **Integration Studies:** Studies on how DHTs can be embedded into the workflow and healthcare systems will provide the best practices [70].
- **Longitudinal Studies:** Long term researches to determine effects of digital health on treatment of chronic diseases and patient compliance are needed [71].

**Importance of Interdisciplinary Collaboration**

- **Cross-Disciplinary Research:** The interaction between technologists, healthcare providers, and policy makers may result in innovation and creative ways of solving difficult problems in healthcare [72].
- **Shared Understanding:** IDTs might allow using interdisciplinary teams to increase development and delivery of digital health technology [73].

## 7 Conclusion

DHTs have become an essential part of the current healthcare system fundamentally transforming pharmaceutical processes both in drug development and treatment of patients. DHTs overcome the determinant issues of medication adherence, clinical trials, and personalized medicine integration through the use of the wearables, AI, telemedicine, and block chain tools. There is evidence that shows that they have a physical effect on the population: remote monitoring leads to a 30-percent reduction in hospital readmissions, mHealth apps can increase medication adherence by 25-percent, and decentralized clinical trials can reduce timelines by 30-percent and increase the diversity of participants. Such developments are not only resulting in better outcomes in patients, but also are saving expenses, as much as 20 million dollars per Phase III trial.

Nevertheless, there are some obstacles on the way to the use of DHTs. Data security considerations, compliance requirements, interoperability with legacy systems, and other challenges come as huge setbacks. As an example, in 2023, healthcare data breaches reach an average of $9.23 million showing the importance of having comprehensive standards such as HIPAA and GDPR. It is also hard to adopt because of resistance to change and excessive cost of implementation. Stakeholders should advance interoperable standards (e.g. HL7/FHIR), fund user-centered design, and develop interdisciplinary cooperation of technologists, clinicians, and policymakers, to address these challenges.

In the future, the industry is expected to be disrupted further due to new technologies such as AI-powered drug discovery efforts, block chain encrypted supply chains, and trials enabled by metaverse technologies. Decision-makers have to adjust the regulations to the balance act between innovation, and patient protection, and scientists are to rely on the longitudinal study to prove the long-term effectiveness. Most importantly, the success of the DHTs will depend on the equal access to them all classes of the population so that the underprivileged population also would enjoy the benefits of the remote care and the digital tools.

DHTs are an initiative that will change the paradigm to patient-centered, data-driven health. They have the potential of increasing efficiencies, lower costs and democratizing access which is unprecedented. However, it takes some careful efforts to close the ethical, technical and regulatory gaps to realize such a potential. It is possible to claim that, by being innovative without losing patience trust, the pharmaceutical industry can use DHTs to initiate the era of precision medicine and global health equity. The road is long, and we require the multi-disciplinary input of numerous individuals in order to make advances, and the reward is still very much worth the effort.

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**Conflict of Interest**

The writers attest that there is no conflict of interests between their interests in the article’s content.

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