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A Comparative Analysis of e-Sanjeevani and an AI-Driven Telemedicine Chatbot Framework

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Abstract: Telemedicine has become a cornerstone of modern healthcare delivery, particularly in resource-constrained and geographically diverse regions. India's national telemedicine platform, e-Sanjeevani, exemplifies population-scale digital health deployment by enabling widespread access to remote medical consultations. However, teleconsultation systems remain limited in their ability to provide automated clinical interpretation and prescription safety support. In parallel, advances in artificial intelligence (AI) have enabled clinical decision support systems that enhance diagnostic reasoning and reduce medication-related errors. This paper presents a comparative systems-level analysis of e-Sanjeevani and a multimodal AI-based clinical decision support platform. The study examines their architectures, methodologies, and functional objectives, highlighting their complementary strengths. The results indicate that integrating AI-driven clinical intelligence with national telemedicine infrastructure can significantly enhance clinical safety, decision accuracy, and healthcare quality.

Keywords: Telemedicine, Clinical Decision Support Systems, Artificial Intelligence, e-Sanjeevani, Prescription Safety.

1 INTRODUCTION

Telemedicine is the delivery of healthcare services through digital communication technologies. This enables remote consultations, diagnosis, and treatment. Internationally, it has been implemented through national health services, insurance-based teleconsultation models or private digital health platforms. In countries like India, challenges such as uneven distribution of healthcare resources and limited access in rural areas bring attention to the need for scalable digital solutions. Platforms such as e-Sanjeevani and AI-based systems like the proposed model present two different approaches to digital healthcare services. e-Sanjeevani focuses on expanding access to medical consultations through a government-led telemedicine service. However, it offers limited support for complex clinical interpretation and prescription safety [1].

Proposed telemedical model AI supports clinical decision-making through symptom analysis and prescription verification. Thus, bridging this gap. e-Sanjeevani primarily serves patients, doctors, and public healthcare workers by enabling remote consultations through a government-led telemedicine platform. This paper presents a comparative study of these two systems by analyzing their concepts, methodologies and key features. Telemedicine as a means of medical aid has seen rapid adoption nationwide. This is done as an effort to improve accessibility, efficiency and Continuity of care by various implementation models such Government health systems, Insurance-supported services and Private platforms [2]-[4]. Studies report post-COVID findings on telemedicine as high patient satisfaction and effective for routine care. Some challenges identified by the study were infrastructure limitations, clinician training and handling complex cases remotely.

Telemedicine in India focuses on addressing the rural and urban gap in healthcare. Reports state many Government-supported platforms were studied, of which e-Sanjeevani was highlighted. E-sanjeevani attracted a lot of attention due to its OPD model, which provides direct patient-to-doctor consultations and a Hub-and-spoke / AB-HWC model for assisted consultations. The benefits include improved access to healthcare and reduced travel burden. Studies highlight the growing use of AI in healthcare. decision-making as a support for clinicians and not as their replacement. Its purposes include symptom analysis, risk identification and prescription error detection. It also offers prescription-related focus such as drug interactions and dosage inconsistencies. A main advantage of AI based systems is its multimodal systems approach, taking text, voice and image as inputs. This system reported improved analytical performance. Some of the current limitations include experimental or pilot stage implementation along with limited real-world deployment.

1.1. Statistical Data

E-sanjeevani is a telemedicine platform launched in the year 2019 as part of the Ayushman Bharat Digital Mission. During its initial phases, the platform provided approximately 5 million teleconsultations, along with a budget of ₹63,000 crore granted by the Ministry of Health and Family Welfare (MoHFW). Due to the pandemic in 2020, telemedicine saw a catalytic increase in their global adoption. E-Sanjeevani OPD was launched in April 2020, enabling outpatient consultations during nationwide lockdowns.

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By September 2021, total consultations had increased to nearly 12 million. The platform then went on to grow exponentially reaching 340–360 million patient consultations in 2025 since launch. Simultaneously, its budget increased from ₹63,000 crore in 2019 to ₹87,657 crore in 2025.The global telemedicine market was valued at approximately USD 41–50 billion in 2019. It grew to over USD 90 billion by 2022 and is projected to reach approximately USD 111 billion by 2025.Long-term forecasts indicate continued high growth, with the market expected to expand to approximately USD 380–400 billion by 2030 and further to nearly USD 532 billion by 2034, representing a compound annual growth rate (CAGR) of approximately 18–22% over the forecast period [5].

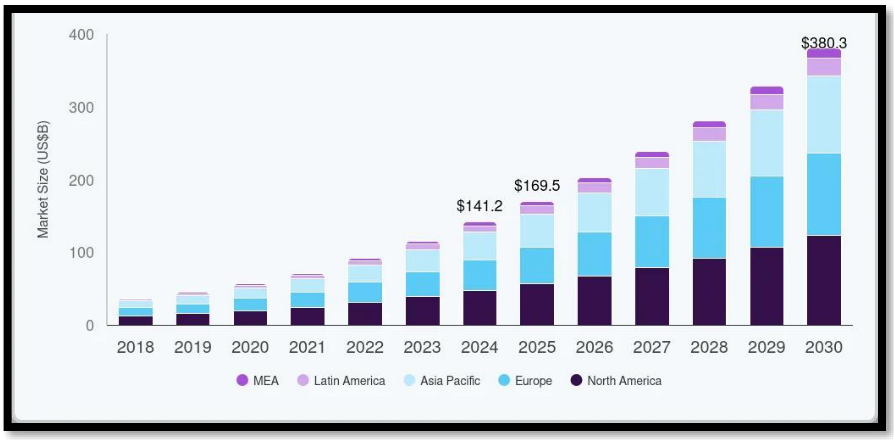

Fig. 1. Statistical analyses of Telemedicine market

Table 1. Tabular representation of statistical data of telemedicine in India and across the globe

Parameter	Global Telemedicine	India Telemedicine	e-Sanjeevani (India)
Launch / Major Adoption Phase	Major surge from 2020 onwards (COVID-19 pandemic)	National adoption scaled from 2019–2020	Launched 2019
Market Size (Baseline)	USD 41–50 billion (2019)	~USD 0.5–1 billion (2019)	Government-funded (non-commercial)
Market Size (Recent)	USD 90+ billion (2022)	USD 3.1–4 billion (2024)	~340–360 million consultations (2025)
Projected Market Size	USD 380–400 billion (2030) USD 532 billion (2034)	USD 10–19.9 billion (2030)	Continued nationwide expansion
Growth Rate (CAGR)	~18–22%	~20–25%	Rapid scale-up driven by public adoption
Investment / Budget Support	Private & public investment peaked at USD 55–60 billion (2021)	Healthtech funding peaked at USD 4–5 billion (2021)	MoHFW budget increased from ₹63,000 crore (2019) to ₹87,657 crore (2025)

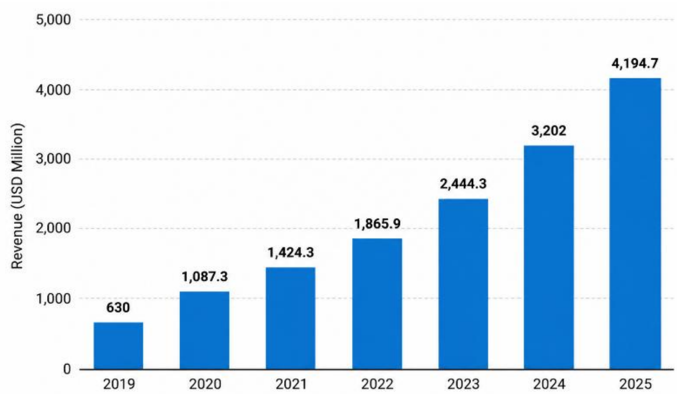

Fig. 2. Year-wise revenue of Telemedicine market in India

2 Related Work

Recent studies report high patient satisfaction and effective routine care delivery through telemedicine platforms, while identifying limitations in handling complex clinical cases. Parallel research in AI-CDSS highlights improvements in symptom interpretation, risk assessment, and medication error reduction [6]. However, large-scale integration of AI-CDSS into national telemedicine infrastructures remains limited, revealing a significant research gap. Based on the reviewed literature, a comparative analysis was conducted to identify key inferences and research gaps across telemedicine platforms and AI-based clinical decision support systems. In order to have a detailed comparison between these 2 entities, various papers, journals and an exclusive table is designed as shown in table 2.

Table 2. Tabular representation of literature review of telemedicine and AI-CDSS

Work	Key Inference	Identified Research Gap
Adoption and Utilization of India's e-Sanjeevani National Telemedicine Service [1]	Demonstrates that e-Sanjeevani significantly improves healthcare access, especially in rural areas, through OPD and AB-HWC models.	Lack of automated clinical decision support for diagnosis and prescription safety.
Telemedicine Services in India: A Scoping Review of Two Decades [2]	Highlights large-scale adoption of telemedicine platforms and reduced burden on public hospitals.	Limited intelligence-driven assistance during remote consultations.
Effectiveness of Telehealth Versus In-Person Care [3]	Finds telemedicine effective for routine consultations and follow-ups with high patient satisfaction.	Insufficient support for complex or ambiguous clinical cases.
Exploring the Impact of Telemedicine on Healthcare Accessibility [4]	Confirms telemedicine's role in reducing geographic and economic barriers to care.	Does not address diagnostic accuracy or medication safety challenges.
Barriers and Facilitators to Telehealth Adoption in India [5]	Identifies infrastructure, training, and workflow challenges in telemedicine implementation.	No integration of intelligent clinical decision-support tools.
Post-Pandemic Utilization of Telehealth Services [6]	Shows sustained telehealth adoption beyond COVID-19 across multiple countries.	Focuses on access and utilization rather than clinical decision quality.
Telemedicine for Chronic Disease Management [7]	Demonstrates effectiveness in managing chronic conditions remotely.	Limited real-time decision support for clinicians.
Multimodal AI Systems for Clinical Decision Support [8]	Shows improved diagnostic accuracy by combining text, voice, and image inputs.	Limited deployment in real-world telemedicine platforms.
AI-Based Prescription Verification Systems [9]	Demonstrates effectiveness in identifying drug interactions and dosage errors.	Not integrated into large-scale public healthcare systems.
Explainable AI in Clinical Decision Support [10]	Highlights importance of explainability for clinician trust and adoption.	Few systems combine explainability with multimodal clinical inputs.
Interpretable Machine Learning for Clinician–AI Collaboration [11]	Shows improved clinician acceptance with interpretable AI models.	Lack of integration with live clinical workflows.
AI-Driven Symptom Assessment Tools [12]	Demonstrates potential for AI to assist in early symptom interpretation and triage.	Limited validation in clinical and telemedicine settings.
AI in Reducing Medication Errors [13]	Confirms AI's role in reducing prescription-related errors.	Requires tighter integration with clinician-led platforms.
Clinical Decision Support Systems in Healthcare: A Review [14]	Establishes CDSS effectiveness in improving clinical outcomes.	Limited multimodal input handling and real-world scalability.

2.1. Research Gap

Research reported telemedicine strengths as accessibility and scalability, its limitations as lack of automated analysis and limited prescription safety support. On the other hand, AI system strengths are strong analytical capability and decision support, limited to integration with large-scale platforms. The research gaps mentioned above bring to attention the need for a combining telemedicine with AI solutions.

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3 SYSTEM OVERVIEW OF E-SANJEEVANI TELEMEDICINE APPLICATIONS

E-Sanjeevani is a cloud-based telemedicine platform implemented as a National Telemedicine Service by the Ministry of Health and Family Welfare (MoHFW), Government of India. It enables patients to access healthcare services remotely via smartphones or web browsers. This significantly improves access for those underservedor rural areas.The eSanjeevani platform operates through two models: eSanjeevani OPD and eSanjeevani AB-HWC. E-Sanjeevani OPD is a direct-to-patient telemedicine service targeting individuals with internet-enabled devices. E-Sanjeevani AB-HWC is an assisted provider-to-provider model and functions through a hub-and-spoke system. This model is tailored for rural and underserved populations with limited digital access or health literacy.

3.1. Architecture of e-Sanjeevani App

The architecture of the e-Sanjeevini App is shown in Fig. 1.

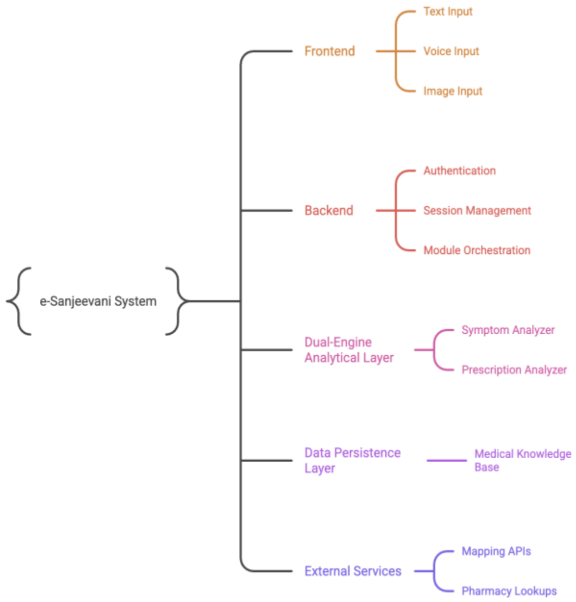

Fig. 1. Visual representation of e-Sanjeevani work flow and methodology

E-Sanjeevani has a 2-model approach - eSanjeevaniOPD and eSanjeevani AB-HWC. The first provides a patient-to-doctor and the latter, provider-to-provider [9].

- E-SanjeevaniOPD: Upon registration in the portal/ app, users join a virtual queue, receive video consultations from a registered doctor, and obtain an e-prescription which can be stored/linked to digital health records.
- E-Sanjeevani AB-HWC: uses a hub-and-spoke model utilising community health officers at HWCs who collect basic vitals / history and connect with doctors at hub centres.

e-Sanjeevani is integrated with Ayushman Bharat Digital Mission (ABDM) / ABHA for linking patient health records with state health infrastructure for service delivery. The platform is deployed at a national scale by the government, with thousands of hubs and millions of consultations.

3.2. Key Features

Some of the key features of the existing telemedicine app are as follows.

- Remote video consultations - enables remote clinical consultations
- E-prescriptions - generates e prescriptions from registered medical practitioners.
- Dual telemedicine models - OPD and AB-HWC
- Support for follow-ups and specialty consultations - The platform supports follow-ups, specialty consultations and can integrate health records through digital health accounts like ABHA.
- Nationwide accessibility - It enables patients to access healthcare services remotely via smartphones or web browsers

4 SYSTEM OVERVIEW OF PROPOSED TELE-MEDICAL MODEL

The proposed model is a multimodal diagnostic platform designed to increase the accuracy of clinical interpretation and reduce diagnostic and medication related errors.

This is achieved through incorporating a dual engine architecture to facilitate simultaneous symptom analysis and prescription verification. The frontend captures the inputs in the form of text, voice and images, and displays the final analysis and recommendations. In contrast, the backend is responsible for the core logic of the system by including user authentication, session management, data flow orchestration between modules, and communication between layers [11]. The dual-engine architecture contains a symptom analyzer and prescription analyzer which perform symptom analysis and prescription verification. Medical knowledge is stored and integrated with APIs in the data Persistence and external Services layers.

4.1. Architecture of proposed tele-medical model

Frontend (user input collection and UI), Backend (authentication, session management, module orchestration), Dual-Engine analytical layer (Symptom Analyzer + Prescription Analyzer), Data Persistence layer (medical knowledge base), and External Services (APIs for mapping/pharmacy lookups). The frontend accepts text, voice, and image inputs. Voice is converted to text (speech-to-text), images (e.g., prescription scans) go through image preprocessing and OCR before being passed to analyzers. Symptom analyzer works on symptom interpretation, severity indicators and guideline-based recommendations. Prescription analyzer focuses on OCR, structured drug extraction, drug–drug interaction checks, and dosage anomaly detection. Symptom Analyzer uses NLP and multimodal fusion to provide severity indicators and actionable guidance. Prescription analyzer uses OCR to generate a verified, digitized prescription list and safety summary (interactions/alerts). The prototype uses a serverless cloud backend (Firebase)

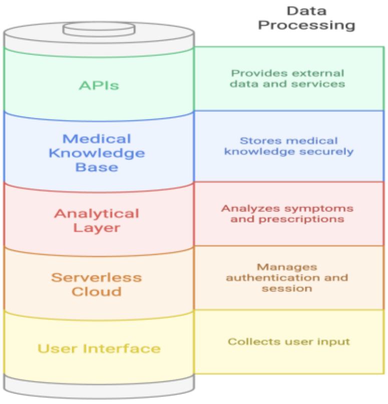

Fig. 2. Visual representation of the proposed model work flow and methodology

4.2. Key Features

The multimodal input feature allows the user to input diverse data forms, such as text, voice and images. The AI symptom analyser feature analyses user symptoms and issues warnings based on the severity and critical symptoms identified. Additionally, it provides further guidance and instructions to the user. The find the doctor feature generates an interactive map with clearly marked pins for nearby clinics and hospitals that house specialists in the recommended field along with a scrollable list that provides details for each provider. The multilingual Translation feature provides on-demand translation of displayed analysis along with a speaker option to read out the information in user selected language. The prescription analysis, details, and summary feature generate digitized prescription list, expandable drug information cards and automated safety check summaries The find nearby pharmacies feature generates an interactive pharmacy map with detailed pharmacy Information and one tap action buttons.

5 Comparison Scope and Analysis

E-Sanjeevani is a communication-centric system while the proposed model is an analysis-centric system. One uses workflow logic while the other uses algorithmic reasoning. One stores consultation data, while the other processes and interprets clinical data. E-Sanjeevani is primarily communication-centric and service-oriented, focusing on large-scale teleconsultation delivery. The proposed tele-medical model is analysis-centric, emphasizing clinical intelligence and safety. While e-Sanjeevani excels in accessibility and scalability, the proposed model enhances accuracy, explainability, and prescription safety.

The systems are complementary and exhibit strong integration potential. e-Sanjeevani focuses on teleconsultation service delivery and is designed for population-scale access. The proposed model focus on clinical decision support and is designed for analytical assistance. e-Sanjeevani has a centralized storage of consultation records with prescriptions stored as digital documents. This includes limited analytical use of stored data. The proposed model is an AI-based clinical decision support system that inputs multimodal patient data (text, voice, images) to provide symptom analysis and prescription safety checks. On the other hand, e-Sanjeevani, is a government-operated telemedicine platform that provides large-scale remote consultation services through OPD and AB-HWC models. While e-Sanjeevani focuses on service delivery and access, the other focuses on analysis and safety.

Table 3. Comparison with respect to features of the tele-medical models

Feature	Proposed model	e-Sanjeevani
Modality	Text, voice, medical images (multimodal)	Text/video/audio
AI Support	LLMs, CNNs, STT, OCR, NLP	Basic/rule-based
Symptom Analysis	AI-driven diagnosis & severity prediction	Doctor-driven video consult
Prescription Validation	Automated OCR + drug checks	Doctor entered; no AI check
Drug Interaction Checks	Automated, real-time	Manual, doctor dependent
Multilingual & Speech	Yes (text & speech)	Multilingual (limited speech)
Recommendations	Location-aware, real-time	State/clinic registry
Emergency Protocols	Automated alerts	Doctor escalation
Patient Engagement	90% intuitive usage	Large-scale, literacy-dependent
Specialty Services	Custom AI models possible	Tele-radiology, psychiatry, surgery
Regulatory Compliance	Needs validation & clearance	ABDM-compliant, government-backed
Connectivity Needs	Data-intensive for images/voice	Designed for variable environments
Free Service	Not specified	Yes (fully free for public)
Scalability	Cloud/serverless, scalable	National deployment
Challenges	Validation, data privacy, workflow integration	Infrastructure, training, connectivity

6 DISCUSSION

Integrating AI-CDSS capabilities into national telemedicine platforms could enable predictive risk assessment, automated follow-up recommendations, and real-time clinical decision support. Such integration would improve both accessibility and quality of care in public health systems.Both systems under consideration share a common goal of improving healthcare delivery through the use of digital platforms, yet they differ significantly in their design objectives and operational focus. E-Sanjeevani is primarily a service-oriented and communication-centric telemedicine platform that emphasizes remote healthcare access through direct clinician–patient interactions, where clinical decisions are largely human-driven.

In contrast, the proposed model is analysis-oriented and data-driven, focusing on AI-assisted decision support by extracting insights from clinical data to support healthcare professionals. Despite these differences, both systems rely on digital technologies to enable remote healthcare support, maintain a strong dependence on clinician involvement, and ultimately aim to enhance patient outcomes. The comparison highlights important trade-offs between scale and intelligence, where e-Sanjeevani prioritizes widespread accessibility, while the proposed model emphasizes analytical accuracy. Similarly, accessibility versus accuracy, levels of automation, clinical safety support, and integration feasibility emerge as key differentiating factors. While e-Sanjeevani excels in scalable and accessible service delivery, the proposed model offers advanced automation and intelligent decision support, suggesting that a complementary integration of both approaches could further strengthen digital healthcare ecosystems.

7 FUTURE SCOPE

The future scope of this work lies in the enhancement of telemedicine platforms through the integration of advanced intelligent features that move beyond basic consultation services. Feature additions such as predictive risk assessment can enable early identification of potential health complications, while automated follow-up recommendations can ensure continuity of care and improved patient adherence to treatment plans. Intelligent prescription monitoring can further enhance clinical safety by identifying anomalies, contraindications, or non-compliance in real time.

Moreover, the integration of AI-based clinical decision support systems (AI-CDSS) into telemedicine platforms can facilitate multimodal clinical analysis by combining patient history, clinical notes, imaging, and physiological data to support informed decision-making. Real-time decision support for doctors, coupled with scalable AI deployment in public healthcare systems, can significantly improve the efficiency and quality of care delivery. Such intelligent assistance has the potential to enhance accessibility, particularly in resource-constrained and remote settings, thereby strengthening the overall effectiveness and reach of digital healthcare services.

8 CONCLUSION

E-Sanjeevani, implemented as a national telemedicine service by the Ministry of Health and Family Welfare, focuses on improving access to healthcare through remote consultations, especially for rural and underserved populations. It enables patients to consult registered medical practitioners without the need for physical travel.The proposed model, on the other hand, is designed as an AI-enabled clinical decision support system that assists in symptom analysis and prescription verification using multimodal inputs.

While e-Sanjeevani emphasizes large-scale healthcare accessibility and service delivery, the proposed model focuses on enhancing clinical accuracy and safety through an AI based system. This study provides a comparative evaluation of a national-scale telemedicine platform and an AI-driven clinical decision support system from a biomedical engineering perspective. E-Sanjeevani demonstrates the feasibility and impact of large-scale telemedicine deployment by improving healthcare accessibility, particularly for rural and underserved populations. The proposed model addresses critical gaps in clinical intelligence by providing multimodal symptom analysis and prescription safety verification. The findings reveal that these systems are complementary rather than competitive. Integrating AI-assisted decision support into national telemedicine workflows can improve diagnostic accuracy, reduce medication errors, and support clinician decision-making while preserving human in the loop control. Such an integrated framework represents a scalable and ethically aligned pathway for intelligent digital healthcare systems.

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This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ETHICS STATEMENT

This study did not involve human or animal subjects and, therefore, did not require ethical approval.

STATEMENT OF CONFLICT OF INTERESTS

The authors declare that they have no conflicts of interest related to this study.

LICENSING

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