DIGITAL TRANSFORMATIONS FOR HEALTH LAB

GOVERNING HEALTH FUTURES 2030

Evolution of Youth-friendly Digital Health System in India: An Analysis

Anyesha Mitra, January 2025

This report has been made possible by financial contribution from Fondation Botnar, Switzerland, to the Project IMG-22-005 “Digital Transformations of Health Lab (DTH-Lab). Their commitment to advancing global health is deeply appreciated, and this project would not have been possible without their contribution. DTH-Lab is hosted by Université de Genève (UNIGE), Switzerland. DTH-Lab is committed to ensuring and enabling Global Access. The knowledge and information gained from the Project will be promptly and broadly disseminated and its ‘Funded Developments’ will be made available and accessible free of costs. The Global Access Commitments will survive the term of the Project.

Suggested citation: Mitra, A. (2025). Evolution of Youth-friendly Digital Health System in India: An Analysis. Geneva: Digital Transformations for Health Lab.

Acknowledgements

- I would like to extend my heartfelt gratitude to all those who made this research report possible as part of my fellowship at the DTH Lab.
- First and foremost, I am deeply thankful to DTH-Lab for providing this unique opportunity to explore and contribute to the evolving field of digital health. The fellowship's structured guidance, resources, and mentorship have been invaluable in shaping the direction of my work.
- I express my sincere appreciation to my supervisor Louise Holly whose expertise, constructive feedback, and encouragement have played a pivotal role in refining this research. Special thanks are also due to the other colleagues at DTH-Lab and Koita Centre for Digital Health, Ashoka University for their unwavering support throughout the fellowship.
- Additionally, I am grateful to all the stakeholders who generously shared their insights during interviews, enriching the study with their on-ground perspectives and lived experiences.
- Finally, I would like to thank my peers in the fellowship cohort, whose thought-provoking discussions and collaborative spirit fostered a stimulating environment for learning and growth.
- This report is a culmination of collective effort, and I remain deeply indebted to everyone who contributed in one way or another.

Evolution of Youth-friendly Digital Health System in India: An Analysis

CONTENTS

ABBREVIATIONS

ABDM	Ayushman Bharat Digital Mission
AIIMS	All India Institute of Medical Sciences
BPL	Below Poverty Line
CHC	Community Health Centre
CME	Continuing Medical Education
CSC	Common Services Centre
CoWIN	Covid Vaccine Intelligence Network
DARPG	Department of Administrative Reforms and Public Grievances
DeITY	Department of Electronics and Information Technology
eSanjeevani OPD	eSanjeevani Online Outpatient Department
HER	Electronic Health Record
EMR	Electronic Medical Record
HPR	Healthcare Professionals Registry
HWC	Health and Wellness Centres
ICT	Information and Communication Technology
IMA	Indian Medical Association
ISRO	Indian Space Research Organization
MCI	Medical Council of India
MeITY	Ministry of Electronics and Information Technology
MoHFW	Ministry of Health and Family Welfare
NDHB	National Digital Health Blueprint
NeGP	National e-governance Plan
NHA	National Health Authority
NHDM	National Health Digital Mission
NITI Aayog	National Institution for Transforming India Aayog
OPD	Outpatient Department
ORS	Online Registration System
PHC	Primary Health Centre
PHR	Personal Health Record
RMP	Registered Medical Practitioners
VRC	Village Resource Centres

EXECUTIVE SUMMARY

This report, **"Evolution of Youth-Friendly Digital Health System in India: An Analysis"**, presents a comprehensive study on the development of digital health systems in India, with a particular focus on youth-friendly solutions. The research covers three distinct phases in the evolution of digital health: early beginnings and infrastructure building (late 1990s–2010), accelerated development with policy advancements (2011–2019), and rapid digital adoption during the COVID-19 pandemic (2020–present).

Phase 1: Early Beginnings (1990s–2010) saw the initiation of telemedicine projects by organizations like ISRO and Apollo Hospitals, with government support through policies like the National e-Governance Plan and the establishment of Common Services Centres (CSCs), though infrastructure and skilled workforce remained limited. **Phase 2: Policy and Technological Advancements (2011–2019)** introduced significant policy frameworks such as EHR/EMR standards, the National Health Stack, and the National Digital Health Blueprint, alongside the launch of telemedicine platforms, like eSanjeevani, to connect rural centres with urban specialists. **Phase 3: Rapid Digital Adoption (2020–present)** was driven by the COVID-19 pandemic, leading to the development of CoWIN, Aarogya Setu, and the Ayushman Bharat Digital Mission (ABDM), which focuses on interoperability through ABHA IDs, the Healthcare Professional Registry (HPR), and a Unified Health Interface (UHI) for integrated healthcare delivery.

As part of the **Youth Perspective Analysis,** the study found that despite the advancements, digital health initiatives primarily target the general population rather than addressing youth-specific health needs, such as mental health, sexual and reproductive health, and lifestyle diseases. Minimal involvement of youth in policy and programme design highlights a gap in ensuring these systems are youth-friendly.

A matrix was developed to assess existing government digital health solutions from a youth standpoint, focusing on parameters like equity, accessibility, affordability, privacy, and youth-driven development. Key solutions assessed included **eSanjeevani HWC & OPD**, **Tele-MANAS**, **Aarogya Setu**, **CoWIN**, **ABHA App, ORS and e-Raktkosh.**

India's digital health ecosystem has made significant progress, transitioning from isolated telemedicine projects to a more integrated, scalable digital-first system. However, to realize its potential as a truly inclusive platform, focused efforts are required to bridge the gaps in youth engagement and digital access. The recommendations in this report provide a pathway for future initiatives aimed at building a youth-friendly digital health system in India.

1. INTRODUCTION

India's journey towards creating digital health systems and its evolution started in the late 1990s with the increasing use of Internet services and improvement in information and communication technologies. The foundation of digital health initiatives in India was laid with pilot telemedicine initiatives to make healthcare accessible to remote locations in India. India's journey towards digital health systems can be categorized into 3 phases:

1. Early beginnings and infrastructure building (late 1990s to 2010)

In the first two decades, satellite-based telemedicine pilot projects by large hospital groups like Apollo Group were tested on a pilot basis. Thereafter, the government supported the scale-up and use of telemedicine services to provide health consultations and continue medical education initiatives. The focus in this phase was testing out new initiatives and models of Telemedicine services and improving them based on improvements in ICT. Thereafter, with the government's focus on promoting e-governance in the mid-2000s, the National e-Governance Plan further promoted the provision of various government services to the rural population in India, including health services through Common Service Centres, which was a one-stop shop for availing of government services online.

Further, during this phase, the government also focussed on digitizing various health information tracking systems like the Integrated Disease Surveillance Project (IDSP), Health Information Management System (HMIS), and Mother and Child Tracking System (MCTS).

2. Accelerated Development with Policy and Technological Advancements (2011-2019):

During this phase, the need for defining policies and regulations for Telemedicine initiatives and other digital health programmes was felt. This need arose from the ambiguity around the handling of data generated, exchanged, and stored as part of the telemedicine consultations; lack of clarity of roles and responsibilities among various actors involved in the telemedicine services and other health information tracking services; and lack of interoperability between various platforms. As a result, the Ministry of Health and Family Welfare notified the standards for Electronic Health Records and Electronic Medical Records in 2013, which was revised in 2016.

Further, MoHFW initiated the establishment of the National Medical College Network in 2013 with Open Tender Basis. The National Optical Fibre Network (2011) was initiated to provide high-speed bandwidth connectivity up to all 250,000 Gram Panchayat (executive committee of a village or group of villages) throughout India. As a Pilot Project of Teleconsultation, three sites (in primary health centres (PHCs) and community health centres (CHCs)) and one telemedicine centre in each block have been connected with one medical college in the states for telemedicine activities (Telemedicine Division, MoHFW, 2014).

The MoHFW drafted the strategy for a National Health Stack (NHS) in 2018 intending to create a nationally shared digital infrastructure usable by both centre and state across public and private sectors. The NHS was envisioned as a collection of cloud-based services where each service provides just one capability across multiple health services, accessible via simple open application programming interfaces (APIs). Lastly, the Ministry of Health and Family Welfare initiated efforts in the direction of a comprehensive, nationwide integrated e-health system under the National Digital Health Blueprint in 2019, for creating a common platform for the integration of existing applications in the health domain and data existing in silos, across public and private health facilities. This Blueprint paved the way for the setting up of the National Health Authority in 2019 which was entrusted with the role of designing strategy, building technological infrastructure, and implementing the national digital health ecosystem. Lastly, the National telemedicine service eSanjeevani was launched in India.

3. Rapid Digital Adoption and Consolidation (2020-Present)

Digital health initiatives received an accelerated focus after the creation of the Digital Health Blueprint which was further accelerated by the COVID-19 pandemic. Owing to the pandemic, the Medical Council of India, in partnership with NITI Aayog, formulated the Telemedicine Practice Guidelines in India. Other digital health solutions like CoWIN, and Aarogya Setu were launched during the pandemic, to cater to various services related to COVID-19 vaccine administration and provide access to essential health services on a single platform.

The National Digital Health Mission was also launched in 2020 (currently known as Ayushman Bharat Digital Mission) which aimed to implement the recommended strategies of the National Digital Health Blueprint. Currently, efforts are being made to consolidate the entire digital health infrastructure of India through ABDM and to enable access to digital health services across the continuum of care through one single platform.

Since the launch of the Ayushman Bharat Digital Mission (ABDM), digital health in India has experienced significant acceleration, leading to the development of various solutions to foster a digital-first approach to healthcare delivery. These digital health initiatives have been designed to streamline and enhance the accessibility of health services for citizens.

The upcoming section elaborates on each of these stages and the digital health initiatives/policies implemented in India. The landscape analysis also delves into the impact of these initiatives and identifies their strengths and weaknesses. Further, an assessment of the digital health initiatives currently provided by the Government of India directly to its citizens has been conducted from a youth stand point.

2. METHODOLOGY

2.1. Landscape Analysis of Evolution of Digital First Health Systems in India

The evolution of digital health in India has been studied through a landscape analysis of various initiatives. A mixed-method approach has been used for this analysis which comprises an exhaustive literature review and key informant interviews (KIIs) with some key officials within the government, civil society, and medical industry who have been instrumental in shaping the digital health ecosystem in India. The period considered for this study is from the late 1990s to the present, since the early digital health interventions started evolving during this time. The literature included in the study comprises peer-reviewed journal articles, government policy documents and reports, news articles, and editorials published in reputable journals, which were sourced through an open Google search using relevant keywords and databases like Google Scholar and PubMed.

For the KIIs, five interviews were conducted and the objective was to triangulate the findings from the literature review to identify strengths, and weaknesses of various digital health initiatives, and identify the way forward. These interviews were conducted with former and current officials from the Ministry of Health and Family Welfare and National Health Authority. In addition, it was conducted with civil society participants from organizations like PATH and Koita Foundation, who are working extensively with the Government of India on digital health.

2.2. Assessment of Digital Health Solutions from Youth's perspective

This research focused on mapping digital health solutions provided directly by the Government of India to its citizens. While the primary objective was to map and assess the digital health solutions available for youth, the solutions were evaluated from the perspective of their suitability for younger populations, given the absence of youth-specific digital health initiatives in India. The existing digital health solutions were systematically mapped according to their core functions, aligning with the scope of services currently provided by the Government of India. The World Health Organization's (WHO) classification of digital interventions, services and applications in health , as per their services and application types nomenclature, was used for this mapping. (World Health Organization, 2023) This classification represented the types of software, information and communications technology (ICT) systems and services or communication channels that delivered or executed the digital health intervention(s) and health content. The five nomenclatures comprised of the following:

- **Point of Service:** Systems that facilitate the provision and delivery of healthcare services to persons at the point of care. They include software capabilities that enable healthcare

providers to access, record and update individuals' health information as well as interactively communicate with them.

- **Health System/Provider administration:** Systems that facilitate the administrative and clinical management aspects of health systems. They provide software capabilities or services to healthcare that may be leveraged by other applications across the digital health enterprise.
- **Registries and Directories:** Systems that serve as a central authority for maintaining specific sets of data. They provide software capabilities or services that are canonical/master lists, which are enforced by specific governance mechanisms.
- **Data Management Services:** Systems that serve as a repository containing data that has been validated. They provide capabilities to store, process, retrieve and analyse data held within such systems.
- **Surveillance and Response:** Systems that support the continuous, systematic collection, analysis and interpretation of data for use in health contexts. They provide software capabilities that utilize protocols to generate information.

Post Mapping, a matrix for assessing digital health solutions, was developed using important parameters to ensure that the digital health solutions are youth-friendly. The parameters were adapted from DTH Lab's Global Blueprint on Digital First Health Systems, (Digital Transformations for Health Lab, 2024), WHO's research tool to measure the youth friendliness of primary care services, (World Health Organization, 2002) (Haller et al., 2012) and the United Nations' (UN) Digital Inclusion Checklist. (United Nations, n.d.) A glossary was developed for each parameter, based on the above-mentioned sources. Further, a thematic coding of platform-related documents, other publicly available literature related to the solutions, and insights from qualitative interviews with the youth will be conducted to assess the solutions against each parameter. Table 1 provides a detailed overview of the parameters and their definitions, that will be used for conducting thematic coding.

2.3. Limitations of the Study

- Since health is a state subject in India, there are various digital health initiatives/solutions undertaken by the state governments. As this doesn't fall within the scope of this study, this study provides a limited overview of the digital first health systems and solutions provided by the government.
- Considering India's limited Internet bandwidth and low digital literacy, a few solutions are also provided to the citizens by frontline health workers. While this might not fit the classical definition of a digital-first health system, it is the adapted version in the Indian context, especially in the rural settings. Hence, to get a complete picture of the digital first health systems in India, it is advisable to include these solutions in the study as well. However, they have been excluded due to the logistical and budgetary considerations of the study.
- The sample for youth included is the study is limited and not truly representative and might provide a restricted overview of the suitability of the digital health systems to priorities of the youth.

Table 1: Assessment of G2C Digital Health Solutions as per a Youth-friendliness Framework

Parameters	Glossary
Youth-driven development of digital health	Involvement of youth in designing, implementation or monitoring of the Digital Health Solution
Equitable	-Considers neutral, inclusive language and design that avoids discrimination based on gender, religion, caste, or age -By design doesn't leave out people that are already at a disadvantage, e.g. gender divide, digital literacy, rural-urban divide.
Maintains confidentiality and privacy	**Transparent Data Policies:** Provides clear information on how user data is collected, stored, and used, written in accessible language without complex legal terms. **User Consent:** Ensures that users can give informed consent before their data is collected or shared. **Customizable Privacy Settings:** Allows users to adjust privacy settings based on their preferences, empowering them to control their personal information.
Accessibility	Users have access to language support, regular high intensity of Internet, digital equipment and supportive cultural norms to access the digital health solutions.
Availability	The suitability of the solution as per the availability of physical enabling infrastructure required for users to connect to the Internet. For users this means, for example, having a smartphone or a computer and availability of the minimum required Internet bandwidth to be able to access the digital health solution.
Affordability	In addition to the affordability of devices, the cost of data also needs to be affordable compared to disposable income of users, in particular those who are underserved, or groups that face barriers to inclusion/connectivity.

3. TRANSITION OF THE DIGITAL HEALTH ECOSYSTEM IN INDIA

Digital health in India has evolved significantly since the early 2000s, with telemedicine being one of the earliest initiatives. However, its adoption and mainstream use accelerated post-COVID. According to the former Additional Secretary from the Ministry of Health and Family Welfare, the government's strategy has shifted towards building an interoperable ecosystem with initiatives like the National Digital Health Blueprint (2019) and the India Health Stack (2018). The current strategy under ABDM focuses on interoperability rather than integration, ensuring that different digital health solutions can communicate seamlessly.

The evolution and change in strategy from the 2000s to the present times will be covered in the upcoming sections.

3.1. Early beginnings and infrastructure building (late 1990s to 2010)

During this period, the focus was on connecting rural healthcare facilities with speciality hospitals through telemedicine services to bridge the gap in access to healthcare due to the shortage of health facilities and health personnel in remote areas. With the improvement in ICT and Internet services, telemedicine services and networks were expanded and improved. With the onset of Internet technologies and advancements in digital infrastructures, several initiatives were also undertaken to digitize health information tracking systems. The following section lists various initiatives undertaken by the Government of India in this regard.

3.1.1. Telemedicine Services in India: Pilot to Scale

The initial telemedicine services in India were in the form of a pilot where the Indian Space Research Organization (ISRO), in collaboration with Apollo Group of Hospitals (a private group of healthcare institutions), linked the Apollo Hospital in Chennai with the Apollo Rural Hospital at a village in Andhra Pradesh using Satcom based Telemedicine Technology in 2001.(Indian Space Research Organization, 2005) Later, in 2002, ISRO's Karnataka Telemedicine project linked the Narayana Hrudayalaya Bangalore, a super speciality hospital with two district hospitals in south interior Karnataka. (Indian Space Research Organization, 2005)

Based on these successful experiences, the first telemedicine network was set up, involving three institutions of excellence and connecting rural health centres across the country. By 2004, the telemedicine network was expanded to include 22 speciality hospitals connected with 78 district hospitals and rural healthcare centres. This also included remote and hard-to-reach areas in distant and difficult terrains like Jammu and Kashmir; Lakshadweep; and Andaman and Nicobar Islands. (Indian Space Research Organization, 2005) Telemedicine technology was adopted for teleconsultation, telediagnosis, and tele treatment. This was enabled through a system that consisted of customized hardware and software for both

patients' and specialist doctors', which was linked with diagnostic equipment used by the patients. The patient, with their duty doctor, consulted the specialist and obtained a line of treatment based on the diagnosis identified from the medical information shared by the patient and their doctor.

In addition to this, telemedicine technology was used to facilitate continuing medical education and training for doctors and paramedics in regional colleges and hospitals from a higher-level hospital or institution. It also enabled monitoring of intensive or emergency care for defence forces or during disaster management. Mobile telemedicine units were also introduced in some areas where the equipment was mounted on a bus or van to establish a mobile telemedicine centre anywhere it was needed. The mobile telemedicine service was applied mostly in the field of ophthalmology and for running health promotion and prevention programmes. (Indian Space Research Organization, 2005)

Subsequently, in 2004, ISRO also initiated pilot projects for integrating telemedicine services with the Resource Information database, as well as tele-education facilities at the Village Resource Centres/Community Centres (VRC), to reach out to more rural areas of the country. As of 2014, 456 VRCs were set up by ISRO on a pilot scale, in association with selected nongovernmental organizations (NGOs), trusts, and state government departments. (Ministry of Science and Technology, 2014) The VRCs had the provision of disseminating health promotion initiatives and some telemedicine services for consultation.

Challenges in Telemedicine Facilities

Karanth et al. (2005) conducted an elaborate assessment of the telemedicine services initiated by ISRO, particularly in hard-to-reach areas of Jammu and Kashmir and Lakshadweep. (G K Karanth & Dr. H Sudarshan, 2005) The study identified challenges with the functioning of remote telemedicine centres and identified a lack of policies for regulating the handling of telemedicine services.

There was no systematic procedure/protocol for telemedicine for recording data on consultations and advice received, which made follow-ups, tracking of medical conditions, and monitoring and evaluation of the initiative difficult. There was a lack of training amongst medical professionals to operate the telemedicine system at the hub and spoke facilities coupled with the unavailability of technical support to operate the system. This often led to dependencies on the few professionals who could operate the system, which caused delays in consultations.

There wasn't any clarity in execution and budgetary accountability for the equipment which often caused delays in repairing glitches in the system, leading to their breakdown. ISRO was responsible for overseeing the establishment of the facilities and the vendor supplying the hardware and software was responsible for maintenance and technical support for the first year after installation. However, the challenges with technical support issues occurred after the first year as there was no budget or personnel earmarked for the maintenance of these facilities. The facilities also reported issues with incompatibility of software between different referral and nodal facilities due to the purchase of software from different vendors which often caused issues with the exchange of medical reports and establishing connectivity for the teleconsultation. In addition, there weren't any designated personnel for delivering telemedicine services, hence it was viewed as an additional workload for the already overburdened health personnel. This led to a lack of motivation to provide consultations. From

the beneficiaries' perspective, their consent wasn't sought for availing of telemedicine services and often the patient wasn't present during the consultation, instead, the decision to avail of a telemedicine consultation was made by the consulting doctor. Lastly, infrastructure-related challenges like slow bandwidth and electricity supply also led to the remote facility doctor sharing the reports or data of the patient before the consultation. These factors also limited the triaging opportunity for diagnosis.

3.1.2. Policy initiatives

In 2005, MoHFW set up the first Indian Task Force for Telemedicine to propose solutions for challenges identified in the telemedicine services in India and to recommend protocols and policies to standardize and regulate telemedicine services. (Chellaiyan et al., 2019) The Department of Information Technology also constituted a Technical Working Group to define the Standards for Telemedicine Systems in India. (Tripathy Shri Braja Kishore, 2006) In 2006, the National e-Governance Plan (NeGP) was initiated by the Department of Electronics and Information Technology (currently an independent Ministry of Electronics and Information Technology) and the Department of Administrative Reforms and Public Grievances under the Ministry of Personnel, Public Grievances, and Pensions, which aimed to improve the delivery of public services and simplify the process of accessing them through electronic media, which also included health-related initiatives. (Ministry of Electronics and Information Technology, Government of India, n.d.)

Indian Task Force for Telemedicine

Several subcommittees were set up within the National Task Force to work on various areas related to telemedicine and create a national policy document. The task force's terms of reference were outlined to focus on areas such as interoperability of platforms, standards for the management of health data, the development of a national telemedicine grid, identifying relevant stakeholders and projects for evaluation, preparing pilot initiatives, establishing a national cancer telemedicine network, and drafting a national policy on telemedicine and telemedical education. (Chellaiyan et al., 2019)This taskforce kickstarted the process for the creation of various standards and guidelines for digital health including telemedicine, in the years to come.

To begin with, the National Rural Telemedicine Network was established in 2009. Through this initiative, the MoHFW aimed to expand the telemedicine services initiated by ISRO and DeITY and integrate them under the National Rural Health Mission (NRHM). (Ministry of Health and Family Welfare, 2013) The objective was to interconnect sub-centres, PHCs, CHCs and district hospitals with the larger state-level or national-level hospitals and create low-cost rural telemedicine infrastructure.(National Coordinator, National Medical College Network (NMCN) Project, n.d.)

Further, to facilitate cancer care, all the regional cancer centres, along with four peripheral hospitals at the district level, were networked under the OncoNET project. Tele-ophthalmology projects were deployed in most of the states, empowering vision centres to link with expert eye centres. (Ministry of Health and Family Welfare, 2013)

Technical Working Group for Standards for Telemedicine Systems in India

The Department of Information Technology (DIT) formed a committee of experts to propose steps for standardizing digital information to support the implementation of telemedicine systems. A Technical Working Group for Telemedicine Standardization, operating under this committee, developed a document titled Recommended Guidelines & Standards for the Practice of Telemedicine in India. (Tripathy Shri Braja Kishore, 2006) This document outlined standards and specifications for telemedicine systems, software, communication networks, security and privacy protocols, data exchange standards to ensure interoperability across various telemedicine platforms, clinical devices, and telemedicine process guidelines. It also recommended system requirements for different categories and levels of telemedicine systems.

Additionally, the DIT initiated a study to draft a document called Proposed Framework for Information Technology Infrastructure for Health (ITIH) in India. (Tripathy Shri Braja Kishore, 2006) This study provided recommendations on standards for health information exchange between stakeholders, addressing data elements, health identifiers, clinical terminology, minimum data sets, billing formats for health insurance, and messaging standards. It also discussed health informatics education and the legal framework required to protect the privacy and confidentiality of health data.

National e-Governance Plan

The NeGP was approved by MeITY in 2006, for the government to focus on creating the digital infrastructure in the country to ensure that government services were accessible to the rural population in India, down to the remotest villages. Under this plan, the objective was to facilitate large-scale digitization of records across various government services and enhance access to the government services closer to the beneficiaries through digital means.

Under the plan, the government approved 31 projects across various areas, including health, to be implemented as a mission mode project. Under this plan, the focus was on enhancing and expanding the network infrastructure for providing high-speed Internet across various government departments at all levels and providing access to the citizens to some of the government services online, closer to their homes.

One of the notable initiatives under this plan, launched in 2006, was establishing Common Services Centres (CSCs) which served as access points for the delivery of Government-to-Citizen (G2C) e-services within the reach of the citizen, by creating the physical service delivery of ICT Infrastructure. (Digital India, n.d.) The scheme aimed for the establishment of one lakh (100,000) ICT-enabled front-end service delivery outlets, equitably spread across rural India in the ratio of one CSC per six villages. The CSCs provided local villagers with telemedicine services, information on various health services, awareness about health conditions, and assistance in applying for various health schemes. Later on, in 2015, CSC 2.0 was launched, making available select diagnostic services and generic medicines at CSCs. It was planned to establish at least 2.5 lakh (250,000) CSCs covering all Gram Panchayats of the country over four years, which included strengthening and integrating the existing one lakh (100,000) CSCs and making operational an additional 1.5 lakh (150,000) CSCs at Gram Panchayat. (Ministry of Electronics and Information Technology, n.d.) As of December 2024, 5.84 lakh CSCs were functional in India and 4.63 lakh out of those were functional in rural areas. (Dr. Prashant Yadaorao Padole, 2024) While this initiative did boost access to digital

G2C services, evaluations of the CSCs revealed certain challenges with their functioning as well. An assessment by the Accountability Initiative, Centre for Policy Research highlighted the long-term sustainability and accountability issues in running the CSCs. (Mridusmita Bordoloi, 2018) Further, a study by the Indian School of Business (commissioned by the Digital India initiative for CSC 2.0) revealed several challenges at the providers' and beneficiaries' end. (ISB Research Team, 2018) There was a lack of awareness amongst citizens about CSCs and their offerings which hindered the utilization of services offered by the VLEs and could imperil the growth and sustainability of the venture. There were also technological and networking challenges observed due to a lack of infrastructure which delayed the services, thereby impacting its utilization.

Further, the government also initiated the Mother and Child Tracking System (MCTS) in 2009, which is a web-enabled system to monitor and ensure the delivery of a full spectrum of services to all pregnant women and children. The MCTS was developed by the National Informatics Centre (NIC) in collaboration with the National Rural Health Mission (NRHM) and the Health and Family Welfare Department. One of the major challenges was poor data quality due to the absence of clear processes and guidelines governing data processes, and the lack of systematic monitoring and supervision frameworks for MCTS implementation. (Gera et al., 2015)

3.1.3. Digitization of surveillance and health programmes monitoring

MoHFW launched the Integrated Disease Surveillance Project (IDSP) with World Bank assistance in November 2004. The MoHFW also launched the Health Management Information System under NHM in 2008.

Integrated Disease Surveillance Project

The IT network connected 776 sites in state and district headquarters and premier institutes with the help of the National Informatics Centre (NIC) and Indian Space Research Organization (ISRO) for data entry, training, video conferencing, and outbreak discussion.

Under the project, weekly disease surveillance data on epidemic-prone diseases were collected from reporting units such as sub-centres, primary health centres, community health centres, and hospitals, including government and private sector hospitals and medical colleges. State or District surveillance units analysed the weekly data for disease trends. Whenever there was a rising trend of illnesses, the rapid response teams investigated them to diagnose and control the outbreak. The process of reporting was digitized on a single platform in 2008. (Ministry of Health and Family Welfare, n.d.-b)

A media scanning and verification cell was established under IDSP in July 2008 which detected and shared media alerts with the concerned states/districts for verification and response. A 24-7 call centre was established in 2008 to receive disease alerts on a toll-free telephone number. The information received was provided to the state and districts' Surveillance Units for investigation and response. (Ministry of Health and Family Welfare, n.d.-b) District laboratories were strengthened for the diagnosis of epidemic-prone diseases. Comprehensive guidelines for the involvement of the private sector and medical colleges were also developed.

In December 2016, IDSP, under the oversight of the National Centre for Disease Control, Government of India, conducted the disease re-prioritization workshop and subsequently identified 33 priority health conditions for surveillance. In addition, the workshop also called for an ICT Master Plan and Minimum Data Set for health conditions under surveillance to strengthen early outbreak detection and public health response. In May 2017, IDSP conducted a workshop to develop the minimum data set for diseases and health conditions under IDSP. (Tanu et al., 2023)

At the request of MoHFW/GoI, WHO Country Office supported the development and design of the Integrated Health Information Platform (IHIP), (Ministry of Health and Family Welfare, n.d.) which is a web-enabled, near-real-time electronic information system that is embedded with all applicable Government of India's e-Governance standards, Information Technology (IT), data & metadata standards to provide the state-of-the-art single operating picture with geospatial information for managing disease outbreaks and related resources. The revamped website was rolled out between 2021-2022 in a phased manner. (Ministry of Health and Family Welfare, 2021a)

Health Management Information System (HMIS)

The HMIS was launched under the National Health Mission in 2008 which was a Government-to-Government (G2G) web-based Monitoring Information System that was put in place by the Ministry of Health & Family Welfare (MoHFW) in partnership with the National Informatics Centre (NIC), to monitor the National Health Mission and other health programmes and provide key inputs for policy formulation and appropriate programme interventions. (Ministry of Health and Family Welfare, n.d.) All health facilities (across all states/union territories) upload facility-wise service delivery data every month, training data quarterly, and infrastructure-related data on an annual basis on the HMIS web portal.

A study by Harvard School of Public Health evaluated the HMIS system and identified certain challenges with the system. (Ranganayakulu Bodavala, 2012) The number of institutions dealing with the collection, storage, and transmission of Health and Family Welfare information was large, resulting in duplication and gaps in data collection. The exhaustive information collected was hardly used at any level. A significant number of human hours were invested in data reporting due to outdated systems. The information collected from the PHCs was never fed back to them after processing. It was just supplied to the top tiers of the administrative hierarchy. This genuinely affects the willingness of the PHC to correct the process or activity.

Due to old technology (hardware and software), interoperability issues, non-availability of web API, programmatic need, and lack of decision support system, revamping of HMIS was initiated in 2019 and HMIS 2.0 was launched in 2020. As of 31 August 2021, there were 726 districts and around 2.17 lakh (217,000) health facilities mapped in the HMIS Portal including 341 Medical Colleges and around 75,000 Health and Wellness Centres reporting through HMIS. HMIS captures over 300 data items monthly under Service Delivery which include indicators related to programs focussing on Reproductive, Maternal and Child Health, Immunization, Family Planning, Vector borne disease, Tuberculosis, Morbidity and Mortality, OPD, IPD Services, Surgeries etc. (Dheeraj Kumar Ojha, 2003) Further, it covers over 400 data items under Infrastructures and Human Resources every month which include includes Human

Resources, Equipment, Cleanliness, Building, Availability of Medical Services. (Dheeraj Kumar Ojha, 2003)

The new revamped version ensures that data is extensively validated at different levels before it is used for performance. Accuracy was defined as the extent to which data are correct, reliable, and certified. Data validation checks were inbuilt to ensure accuracy while reducing the manual effort required from health workers. (Dheeraj Kumar Ojha, 2003) However, the data on the revamped portal is not available on the HMIS portal like before, which doesn't allow for any public scrutiny of the availability or quality of the data reported.

3.2. Accelerated Development with Policy & Technological Advancements (2011-2019)

As mentioned in the introduction section, this phase was comprised of significant boosts in ICT and Internet services which supported the expansion of telemedicine and other digital health efforts. Further, the challenges identified by the Taskforce on Telemedicine, and their recommendations, paved the way for new policies and standards that focussed beyond telemedicine and laid the foundation for the expansion of the digital health ecosystem in India.

3.2.1. EHR/EMR Standards 2013 and 2016

The Centre for Development of Advanced Computing (CDAC) was established as the National Resource Centre for EHR Standards in 2012. In 2013, the expert committee set up by MoHFW drafted the EHR/EMR standards, intending to enable access to fully integrated health records in an electronic format, to any health service provider/practitioner, any diagnostic centre, or any pharmacy. The document contained recommendations for developing a uniform EHR creation and maintenance system by healthcare providers. After that, the standards were revised based on stakeholder feedback and emerging needs in 2016.

These guidelines addressed all aspects of data and information which make up any healthcare record system and provided implementation strategies specific to the item in context. (Ministry of Health & Family Welfare, 2016) It offered detailed recommendations on the interoperability and standards, clinical informatics standards, data ownership, privacy and security aspects, and various coding systems.

To facilitate the adoption of EHR/EMR standards, various government initiatives were undertaken. National E-health Authority of India (NeHA) was proposed to be set up in 2015 under the Ministry of Health & Family Welfare (MoH&FW) to establish the e-health ecosystem in India. One of the objectives of the NeHA was "to lay down data management, privacy and security policies, guidelines, and health records of patients per statutory provisions". (Manisha Wadhwa, 2020)

The Ministry of Health & Family Welfare (MoH&FW) drafted the Act for the Establishment of Digital Health Information in Healthcare Security (DISHA) for the promotion or adoption of e-health standards; to standardize and regulate the processes related to the collection, storing, transmission, and use of digital health data; and to ensure reliability, data privacy, confidentiality and security of digital health data and related matters. As part of the act, the

National Institution for Transforming India (NITI Aayog) also launched the National Health Stack, a scheme to create digital health records for all citizens by 2022. Further, it proposed establishing a national legislative body through the act, called National Digital Health Authority. (Pankaj Musyuni, 2022) In 2019, the MoHFW submitted DISHA to be subsumed under the Personal Data Protection Bill, 2019, which was revised as Data Protection Bill 2021 and eventually passed as the Digital Personal Data Protection Act in 2023. (Dipika Jain, 2023) Further, a health-specific data protection framework was passed in India, i.e., the Health Data Management Policy, 2022 (HDMP, 2022).

Critiques of the Regulatory Framework for Health Data

According to Naithani 2023, this act reduced the level of protection for health data as compared to the Data Protection Bill 2021. The Digital Personal Data Protection (DPDP) Act, 2023 does not define health data and does not categorise data as sensitive personal data. The DPDP allows data processing when data is voluntarily provided. When the scope of data processing is unclear and lacks purpose limitations, individuals' privacy can be compromised. (Paarth Naithani, 2023) Health data may be used for secondary purposes, such as commercial activities, beyond its original intent of providing health services. This misuse can result in harm, including discriminatory treatment, privacy violations, and loss of control over personal health information. Although the level of protection under the draft HDMP, 2022 was greater than under the DPDP, it raised the question of which standards should take precedence. (Paarth Naithani, 2023)

3.2.2. National Health Stack and National Digital Health Blueprint (NITI Aayog, 2018)

In 2018-2019, the government of India launched the Ayushman Bharat Scheme to deliver comprehensive primary healthcare to the citizens through Health and Wellness Centres (PHCs and service centres were strengthened to HWCs) and provide insurance coverage of `500,000` per family through the Pradhan Mantri Rashtriya Swasthya Suraksha Mission. To strengthen the supply side of the system for delivering the health schemes effectively, the government considered the development of a robust National Digital Health infrastructure so that the innumerable health schemes implemented by different states can be congregated into a single umbrella scheme over time. This meant creating an environment where all people could obtain health services anywhere in the country, whether in private or government hospitals, without suffering financial hardship or high indirect costs.

This objective led to the conception of a National Health Stack. NITI Aayog drafted the strategy for the NHS which later served as the basis for the National Digital Health Blueprint. The National Health Stack is comprised of five key components:

- ***National Health Electronic Registry*** which would act as a single source of all data related to health, also known as an electronic national health registry. This would include data for various health-sector stakeholders, healthcare providers (hospitals, clinics, labs, etc), beneficiaries, doctors, insurers, and frontline health workers. All registries will have open APIs for publishing and consent-based access by authorized entities.
- ***Digital Health IDs*** would be provided to every stakeholder group participating in the health ecosystem. A federated identification system would be implemented which would allow for identification through this unique identification (ID) instead of using any other additional national IDs.

- ***An electronic coverage and claims platform*** that will comprise a policy engine, a claims engine, and a fraud management service. The policy engine would allow defining and storing of insurance policies for individuals and families in a machine-readable format and provide APIs to consume and update these policies. The claims engine would manage the way claims flow in health insurance schemes and ensure ease of filing and settling claims. The fraud detection services would leverage multiple engines and use big data analytics and machine intelligence. These engines would be interlinked through APIs to allow easy flow of data and services.
- ***Federated Personal Health Records (PHR) Framework*** would enable the management and aggregation of user health data, as well as the consent-based flow of such data across different stakeholders who require access to deliver value-added services to the user. The PHR would be maintained in a secure and private environment, with the individual determining rights of access. This will be made possible through Health Data Fiduciaries (trustees) that would facilitate consent-driven interaction between entities that generate the health data and entities that want to consume the PHR to deliver better services to the individual.
- ***National Health Analytics Framework*** will enable the creation of anonymized and aggregated datasets that assist in the creation of dashboards, reports, and other types of statistics. These aggregated datasets will present the overall direction of health of the country/state/district leading to data-driven decisions and targeted policymaking in the health sector.

National Digital Health Blueprint (NDHB) (Ministry of Health & Family Welfare, 2019)

NDHB was released by the MoHFW in 2019. It provided a detailed strategy for the application and implementation of the NHS, along with a broader, more comprehensive vision of a digitally integrated healthcare ecosystem for all citizens. Its objective is to ensure that various aspects of the NHS are fully connected and prevent the accumulation of detached silos.

The key features of this blueprint include a unified architecture, a set of architectural elements, a five-layered structure of architectural institutional blocks, a Unique Health ID (UHID), privacy and consent control, national portability, electronic health records, appropriate principles and guidelines, and health analytics. (Rahul Dev, 2020) These features and implementation guidelines have been drafted after drawing lessons from best practices across the world.

3.2.3. eSanjeevani

The MoHFW launched the National Telemedicine Service in India in 2019 under the Ayushman Bharat Mission. It was delivered via two variants of 'eSanjeevani AB-HWC', a doctor-to-doctor telemedicine platform, and 'eSanjeevani Online Outpatient Department (OPD) – Stay Home OPD', a doctor-to-patient telemedicine system. The AB-HWC version was launched in 2019 as a doctor-to-doctor hub-and-spoke model implemented in Health and Wellness Centres (HWCs) across India, as part of the Ministry of Health's efforts to enhance telemedicine.

This facility is hosted on a cloud-based platform that provides assisted teleconsultations for patients who visit Health and Wellness Centres (HWCs), where community health officers in Health & Wellness Centres facilitate the teleconsultation for the patients who are connected

to the doctors and specialists in hubs established in secondary/tertiary level health facilities or medical colleges. It also allows various healthcare facilities to act as a spoke and seek consultation centres with access to specialists from a higher-level facility, acting as a hub. (Nirupam Bajpai & Manisha Wadhwa, 2021) The Figure below depicts a representation of the hub and spoke model for Ayushman-HWCs, an assisted telemedicine service model.

This enables real-time virtual consultations for patients through the doctor at the HWC. After each consultation, the platform generates an e-prescription, which can be used to obtain medication. Key features of the system include teleconsultation, video conferencing, comprehensive Electronic Medical Records (EMR), and a Management Information System (MIS) for efficient healthcare delivery. As of September 2024, more than 16,000 hubs and more than 128,000 spokes have been operationalized. (Ministry of Health and Family Welfare, n.d.)

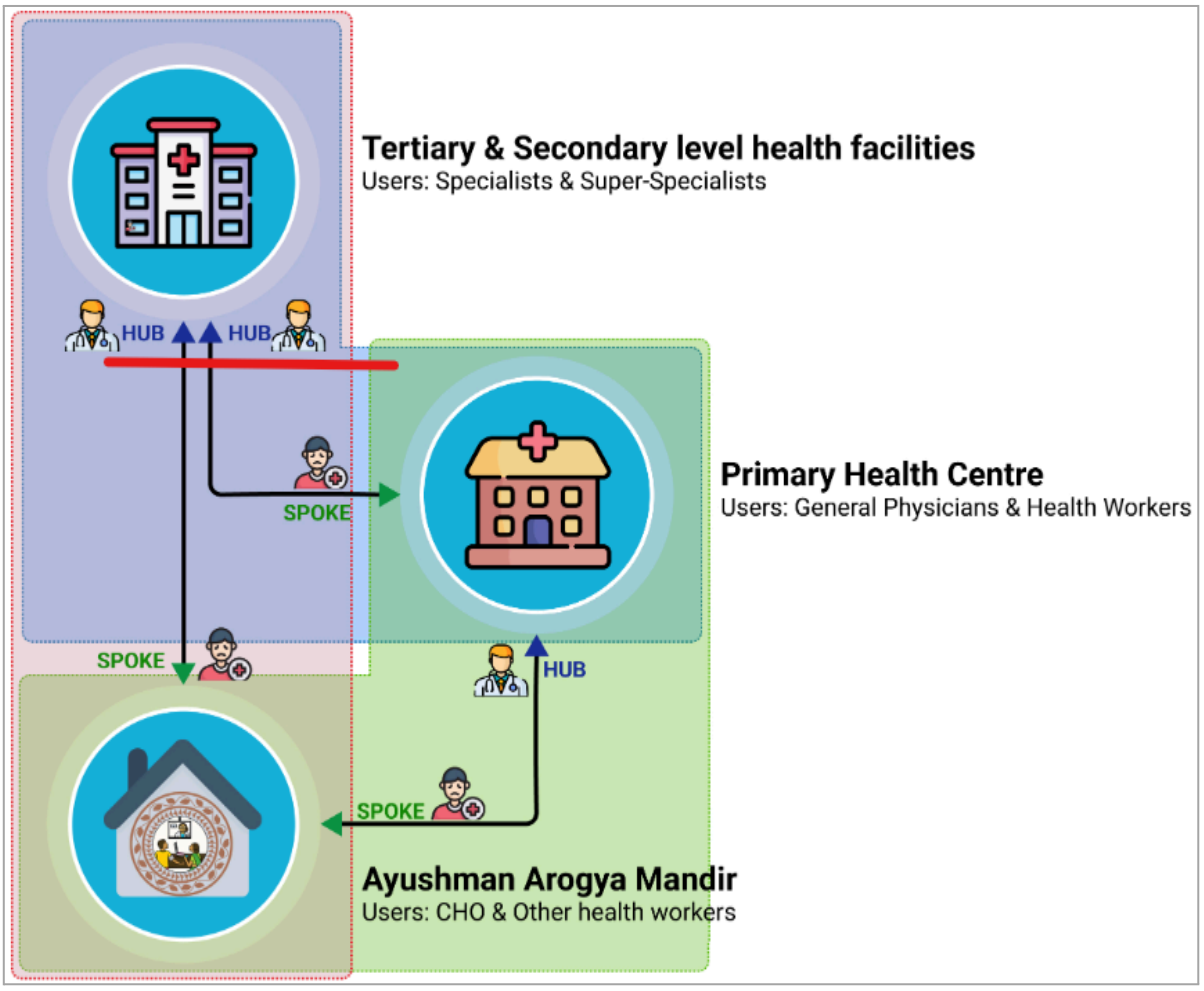

Figure 1: A representation of the hub and spoke model for the assisted National Telemedicine Service *Source: [Official website of eSanjeevani]*

3.3. Rapid Digital Adoption and Consolidation (2020-Present)

With the onset of the pandemic and the momentum provided by the National Digital Health blueprint, the consolidation of Digital Health Systems began in 2020.

3.3.1. Telemedicine Practice Guidelines 2020 (Board of Governors-Medical Council of India & NITI Aayog, 2020)

The Ministry of Health and Family Welfare, India, issued 'Telemedicine Practice Guidelines' in 2020 during the COVID-19 pandemic, for registered allopathic medical practitioners, which were developed by the Board of Governors of the Medical Council of India in collaboration with NITI Aayog. The guideline provided definitions, scope, and protocols with roles and responsibilities of the patients, Registered Medical Practitioners (RMPs), healthcare workers, and telehealth platforms and restricted the teleconsultations to the jurisdiction of India. The guidelines exclude: tele-assisted/remote surgeries, research, health worker education, and hardware, software, infrastructure, and data management standards specifications.

This Guideline outlines provisions for seeking patients' consent and ensuring their privacy. RMPs must obtain informed consent before a consultation, especially when initiated by a caregiver or healthcare worker. They must also ensure the use of secure, non-public platforms to protect patient data, adhering to privacy laws.

Further, RMPs can prescribe medications during teleconsultations but are restricted to certain drug categories. List A and List O for first consultations, where List A includes drugs that are safe and without any abuse potential and List O includes drugs that are available over the counter. List B is added for follow-ups, which includes add-on drugs that are used to optimize regimens for the existing illness. However, they cannot prescribe controlled substances like those under Schedule X, or narcotic drugs.

The guidelines also allow for easier follow-up consultations if the patient has already been seen by the doctor in person or virtually, and the doctor is familiar with the patient's medical history. Further, it prescribes the use of only secure and privacy-enhancing platforms for consultations. The guidelines recommend using platforms that can integrate with electronic medical record systems, if available, ensuring all interactions are secure. One of the benefits of the guideline is that it allows interstate and cross-country teleconsultations that could enable fast, easy, and equitable access to all parts of the country.

Telemedicine consultations typically involve direct interactions between patients and healthcare providers via video or audio calls. Sometimes, a health worker or a family member may be present to assist the patient. According to the qualitative interviews, trust in telemedicine is influenced by factors such as the perceived competence of the provider, the ease of accessing the service, and the assurance of data privacy.

Limitations (Dinakaran et al., 2021)

Although this guideline is expected to enhance access and efficiency in healthcare delivery, it has certain important limitations.

Technological barriers remain, although their degree has reduced over time with the progress in smartphone penetration and Internet access in the country. Both physicians and patients need stable Internet connections and compatible devices, which may limit access for some. Moreover, physicians are expected to manage and troubleshoot the technical aspects of the platform, including audio and video quality, which can be a challenge for less tech-savvy individuals, due to low digital literacy in the country.

The legal and ethical responsibility lies with the RMPs and the same regulations for in-person consultations apply to Teleconsultations as well. Physicians are required to maintain detailed records of consultations and ensure that the patient's identity is verified. They are also responsible for maintaining the confidentiality and security of patient data, which can create an additional burden.

Another challenge is the legal jurisdiction for grievance redressal in the case of cross-country teleconsultations. When a grievance arises from interstate teleconsultation, the legal jurisdiction of such case proceedings is not clarified.

3.3.2. eSanjeevani OPD (Ministry of Health and Family Welfare, n.d.-a)

eSanjeevani OPD is a patient-to-provider telemedicine platform based on the cloud-based eSanjeevani National Telemedicine platform, which allows citizens to access health services from anywhere in the country through smartphones and laptops and is free for all. The application (app) can be downloaded from Google, or Apple's App Store. The process flow of the consultation process is depicted in the figure below.

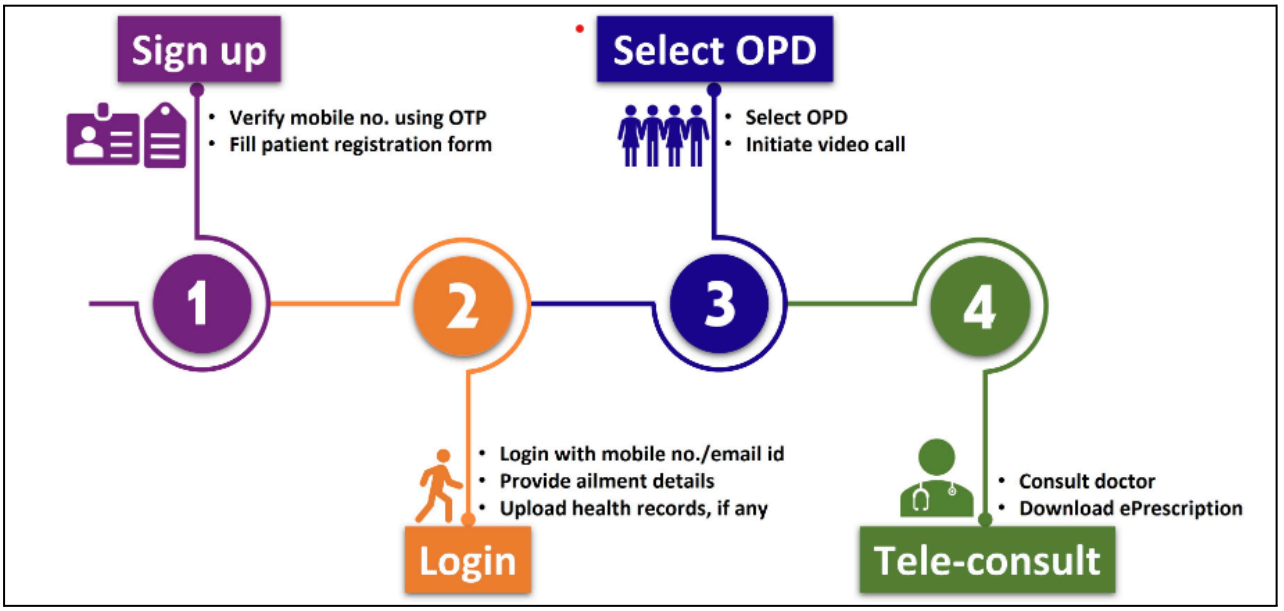

Figure 2: Process flow for availing of consultations on eSanjeevani OPD

Source: Official Website of E-Sanjeevani

The service has been launched in a phased manner across all states and union territories in India. The bucket of services includes General Outpatient Department (OPD) and a different list of specialist services across various states and union territories. The website and app provide details on available services in various States and their timings. The app/website is also available in 12 different regional languages of India to overcome the language barrier.

Limitations (Nirupam Bajpai & Manisha Wadhwa, 2021)

Bajpai et.al. list three important limitations of this type of large-scale digital platform: abuse of the platform and free service, shortage of doctors/specialists and platform access by the digitally excluded population.

Abuse: One limitation of the eSanjeevani OPD platform is the lack of identity proof during registration. The process involves verifying a phone number via OTP and filling out a form with personal details like name, age, and address. However, without identity verification, the platform is vulnerable to misuse, as individuals can provide false information and remain untraceable. While OTP confirms access to the phone number, it does not ensure the person's identity.

Shortage of Doctors/Specialists: A key challenge in providing online consultations via the eSanjeevani OPD platform is the shortage of doctors and specialists. Patients have reported long waiting times due to the unavailability of doctors, with specialist consultations being even harder to access. Additionally, a review by *Metrolife* reporters at the *Deccan Herald* highlighted other issues with the platform, including poor connectivity, long wait times, and limited opportunities for patient queries.

Access Issues: The eSanjeevani platform relies solely on video-based consultations, requiring patients to have a smartphone or laptop with an Internet connection. However, as per the State of India's Digital Economy (SIDE) Report, 2024, 48 per cent of Indians do not access the Internet. Further the rural, urban, and gender divide also exists in India. The urban-rural divide stands at 58 per cent and the gender divide stands at 10 per cent. These divides are also significantly higher in low-income and lower-middle-income groups. The figure below depicts the divide as per income level, region, and gender. Bajpai et. al. mention that the divide could be attributed to individuals either having feature phones with no Internet connection or not having a mobile phone.

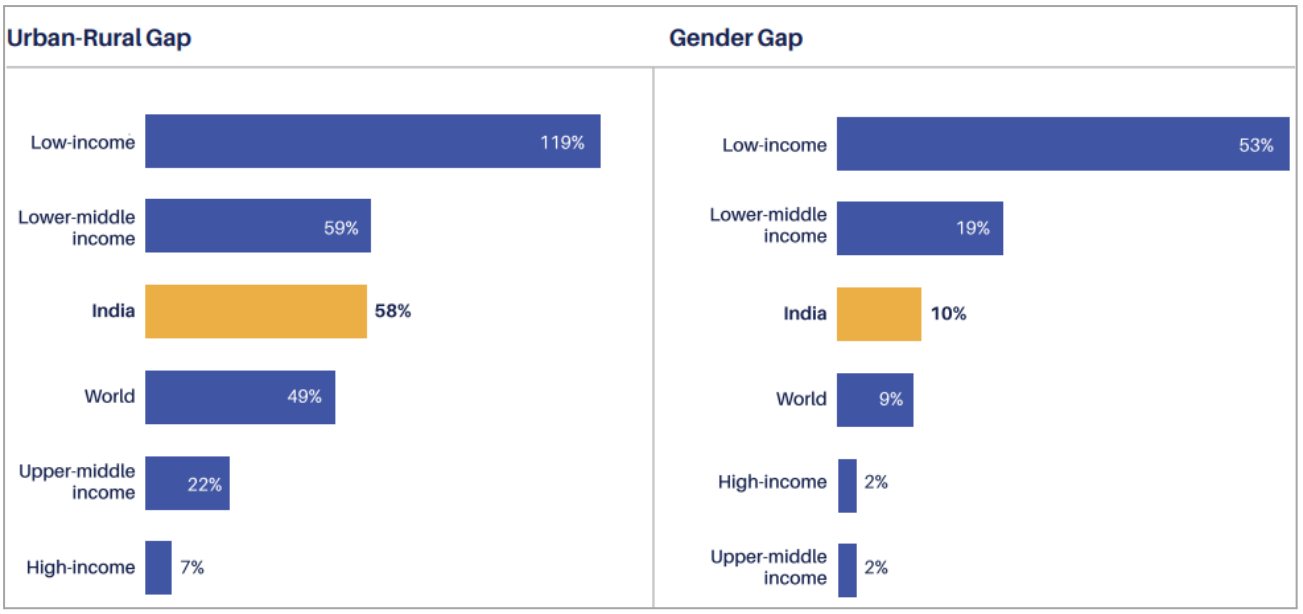

Figure 3: Digital Divides in India; *Source: State of India's Digital Economy Report, 2024*

3.3.3. National Digital Health Mission/Ayushman Bharat Digital Mission

The architecture proposed by the National Digital Health Blueprint was operationalized by launching the National Digital Health Mission in 2020, renamed Ayushman Bharat Digital Mission in 2021. India's robust public digital infrastructure, including systems like Aadhaar, the Unified Payments Interface (UPI), and widespread Internet and mobile access offered a strong foundation for the Ayushman Bharat Digital Mission (ABDM). ABDM envisions facilitating secure data exchange between stakeholders on its network, ensuring patient consent is obtained before any sharing of information. Through ABDM-compliant applications, patients can control which health records are linked to their ABHA (Ayushman Bharat Health Account), store digital records on their devices, access them online, and share them with healthcare providers securely, with their consent. (National Health Authority, 2021) Only data for central registries like the ABHA, Healthcare Professionals Registry (HPR), and Health Facility Registry (HFR) are stored centrally, as these are crucial for interoperability, trust, and a unified system across digital health platforms. Further, the system would allow access to all digital health services, both private and public, through a common interface that will be linked to the registries. Figure 4 represents an overview of the ABDM architecture.

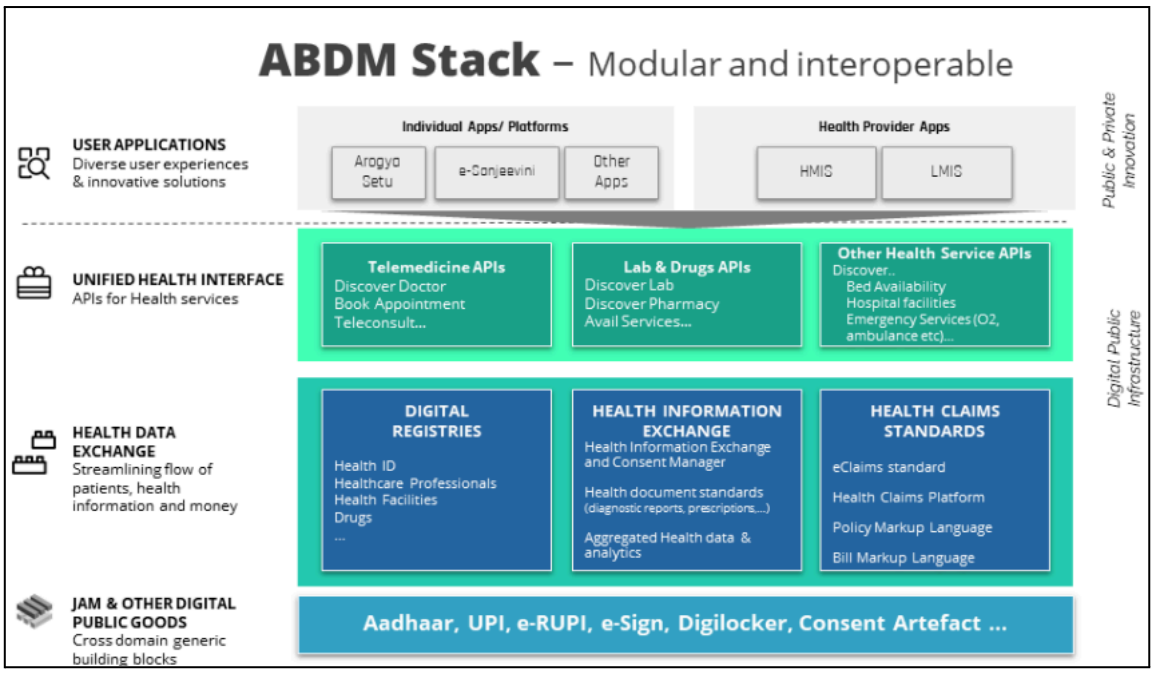

Figure 4: ABDM architecture

Source: [Guide on ABDM by National Health Authority, Ministry of Health and Family Welfare]

Various components of ABDM are explained below(National Health Authority, n.d.-a):

ABHA ID is being created, offering a unique ID based on some basic details including demographic and location, family/relationship, and contact details. The ABHA number is used to uniquely identify individuals, verify their identity, and link their health records across various systems and stakeholders, with the patient's informed consent.

The **ABHA Mobile App** is being built which is the Personal Health Record (PHR) System. This system would conform to interoperability standards set up by National Health Authority (NHA) and draw from multiple sources, while allowing the individual to control and share their personal health information. This includes access to a comprehensive longitudinal record comprising all health data, such as lab reports, treatment information, and discharge summaries, from one or multiple healthcare facilities.

The **Healthcare Professional Registry** (HPR) is being created to register all healthcare providers from both modern and traditional systems of medicine. By enrolling in the registry, they will gain access to India's digital health ecosystem.

The **Healthcare Facility Registry** (HFR) is an extensive database of health facilities across various systems of medicine in the country, covering both public and private sectors, such as hospitals, clinics, diagnostic labs, imaging centres, pharmacies, and more. By registering in the Health Facility Registry, these facilities can connect to India's digital health ecosystem.

Unified Health Interface (UHI) is designed as an open protocol for connecting various digital health services. It will function as a network linking end user applications (EUAs) and participating health service provider (HSP) applications. UHI aims to facilitate a range of services from government and private providers between patients and healthcare providers,

such as appointment booking, teleconsultations, and service discovery, creating a seamless digital health ecosystem.

As per the official communications from National Health Authority, the strategy for integrating services under ABDM focuses on creating a unified digital health ecosystem with interoperable platforms. The continuum of care covered by ABDM includes preventive, curative, and post-care services.

Limitations

ABDM envisages using digital health technologies to facilitate Universal Health Coverage. Chakravarthi, 2024 reviewed various expert opinions, including that of the Indian Medical Association (IMA) and Nandi, 2024 further provided a critical overview of the programme, which raises the following concerns.

Healthcare infrastructure and funding: India lacks adequate infrastructure and trained personnel, especially in primary care, and wellness centres have not made a significant impact. Strategic purchasing through the Pradhan Mantri Jan Arogya Yojana (PMJAY) under Ayushman Bharat is limited due to insufficient funding and low package rates, causing tertiary care hospitals to not participate. The IMA argues that improving public health infrastructure, and human resources, and addressing social determinants of health should be prioritized, which is also crucial for the success of ABDM. Substantial infrastructure, hardware, software, and cybersecurity upgrades are needed in under-resourced public hospitals, particularly in rural areas, for telemedicine and electronic health records (EHR) to function effectively. Furthermore, the IMA criticized the unclear funding for NDHM and warned that diverting funds from the National Health Mission (NHM) could undermine public healthcare, particularly primary care.

Privacy concerns: The IMA also highlighted weak privacy laws in India, expressing concern about the consent mechanism in digital health platforms, especially given the low literacy rates in the country. The consent process outlined by NDHM is viewed as inadequate to protect patient privacy, as the concern lies around the citizens' ability to provide informed consent due to low literacy rates. Stakeholders from civil society organizations also expressed concerns about data privacy and limited trust in digital solutions, which hinder the expansion and implementation of ABDM.

Consent in digital health systems under ABDM is granular and point-in-time, meaning users can choose which records to share and revoke consent at any time. However, the process varies across platforms, and concerns about informed consent and data privacy persist. Hence NHA officials and civil society stakeholders emphasized that the challenges with data security and privacy could be addressed as all platforms become ABDM compliant.

Digital divide and literacy: Digital inequalities further complicate NDHM's implementation. The Internet access gap is notable between genders, regions and various income groups. Internet availability alone doesn't ensure people can effectively use digital healthcare tools, and many healthcare facilities still lack the infrastructure for digital operations. For those without digital skills, reliance on others can lead to vulnerability to fraud and manipulation, further widening health disparities. Digital access, as noted, is becoming a key social determinant of health, which needs to be accounted for.

While smartphone penetration in India is high (around 75 per cent), digital literacy remains a challenge, particularly in rural areas. To address these issues, NHA official guidance is that ABDM should focus on simplifying user interfaces, engaging local NGOs for capacity building, and promoting digital literacy through awareness campaigns. The organization also emphasizes the importance of creating youth-friendly platforms and involving young people in co-creating solutions.

The civil society stakeholders also state that low user awareness about ABDM is one of the challenges hindering ABDM adoption. To address these issues, the government has launched awareness campaigns, introduced financial incentives for providers, and engaged with youth and community groups to improve outreach.

Navigating diverse stakeholder groups for implementation: The Ayushman Bharat Digital Mission (ABDM) proposes a federated, API-enabled, and interoperable health information ecosystem that utilizes India's widespread mobile phone access and unique ID systems. Rather than storing all data on centralized servers, only health IDs and registries for healthcare professionals and facilities will be centralized to ensure interoperability.

Challenges remain in managing diverse stakeholder practices and interests, aligning them with new digital health integration processes while addressing privacy concerns related to data storage and use. To ensure the success of this ecosystem, flexible standards and processes must be developed to accommodate India's varied institutional setups. The ABDM's modular architecture relies on defining interoperability standards and interfaces (which is yet to be defined), while ensuring integration of data protection and patient consent management across the system. Planners must also address the need for change management among stakeholders to adapt to this new digital health framework.

3.4. Focus on youth in the digital health ecosystem in India

The review of India's progression toward digital health systems over the past three decades reveals a significant transition from a product-focused or solution-oriented methodology to a system-based framework. The development leading to the launch of the Ayushman Bharat Digital Mission (ABDM) underscores the government's commitment to establishing a cohesive system that facilitates convenient access to health services for citizens through a unified platform, thereby enabling effective management of health-related information. This initiative reflects a broader intention to advance toward a digital-first health system; however, India remains at an early developmental stage, grappling with various infrastructural and socio-economic challenges, which is a potential hindrance to this advancement.

When evaluating the role of youth as a critical stakeholder in the design of India's digital health ecosystem, the findings are inconclusive. The digital health solutions and policies implemented to date tend to address the population at large rather than focusing on specific age demographics. Furthermore, the initiatives have not concentrated on health issues of particular relevance to youth, such as sexual and reproductive health, mental health, and lifestyle-related diseases. Rather, the emphasis has been on optimizing the overall ecosystem instead of creating targeted solutions. Additional insights will emerge as specific interventions are examined more closely to determine whether barriers exist that hinder youth from accessing the available digital health solutions.

Moreover, the involvement of youth in the conceptualization and design of policies and programmes related to digital health has been minimal. The prevailing approach has largely been top-down, wherein policymakers and stakeholders within the healthcare ecosystem have predominantly dictated the trajectory of the digital health landscape in India.

4. MAPPING OF DIGITAL HEALTH SOLUTIONS PROVIDED AT NATIONAL LEVEL

In this section of the report, the solutions provided by the Government of India will be mapped against WHO's Services and Application Type Classification.

Table 2: Mapping of Digital Health Solutions provided by the Government of India directly to Citizens

Digital Health Solutions	Point of Service	Health System/ Provider Administration	Registries and Directories	Data Management Services	Surveillance and Response
eSanjeevani HWC					
eSanjeevani OPD					
Tele-Manas					
Aarogya Setu					
CoWin					
ABHA App					
Online Registration System					
e-Raktkosh					

5. ASSESSMENT OF DIGITAL HEALTH SOLUTIONS

5.1. eSanjeevani HWC

eSanjeevani HWC is a telemedicine initiative launched by the Ministry of Health and Family Welfare, Government of India, under the Ayushman Bharat scheme. It is designed to provide doctor-to-doctor teleconsultations between Health and Wellness Centres (HWCs) and specialists at designated hub hospitals. The platform leverages technology to deliver equitable, affordable, and high-quality healthcare services, focusing on rural and underserved regions. (Ministry of Health and Family Welfare, 2021b) It is an essential component of Ayushman Bharat Digital Health Mission (ABDM), ensuring that specialized healthcare services are accessible at the grassroots level.

eSanjeevani HWC connects Community Health Officers (CHOs) at HWCs with specialists in multiple medical domains, including general medicine, paediatrics, gynaecology and obstetrics, dental, dermatology, ophthalmology, psychiatry and mental health, cardiology, general surgery, pulmonology, ENT, family medicine, anaesthesia and AYUSH. (Ministry of Health and Family Welfare, n.d.-d) Specialists at hub hospitals provide diagnosis, treatment plans, and referrals for advanced care when needed.

5.1.1. Development

The platform was designed, developed, and is maintained by the Digital Health Innovations Group at Centre for Development of Advanced Computing (C-DAC), Mohali. The group developed Sanjeevani – an integrated telemedicine technology – in early 2000 and has been working since 2018 with the Ministry of Health and Family Welfare (MoHFW), Government of India, to conceptualise a population-scale telemedicine application: eSanjeevani. (Ministry of Health and Family Welfare, n.d.-d) They are providing end-to-end services from design, development, deployment, operationalisation, management, capacity building and technical support services to all the users of eSanjeevani in all the states and union territories across India. (Ministry of Health and Family Welfare, n.d.-d)

5.1.2. Target Audience

The target audience of eSanjeevani HWC includes rural and remote populations, economically disadvantaged communities, and vulnerable groups such as women, children, and the elderly. (Intelehealth & Transform Rural India, 2022)It provides critical healthcare services to those with limited access to specialists, particularly for managing chronic diseases and addressing primary health concerns. Community health officers (CHOs) and primary healthcare facilities also benefit as they can connect seamlessly with specialists for timely patient care. (Intelehealth & Transform Rural India, 2022)

5.1.3. Workflow of the App

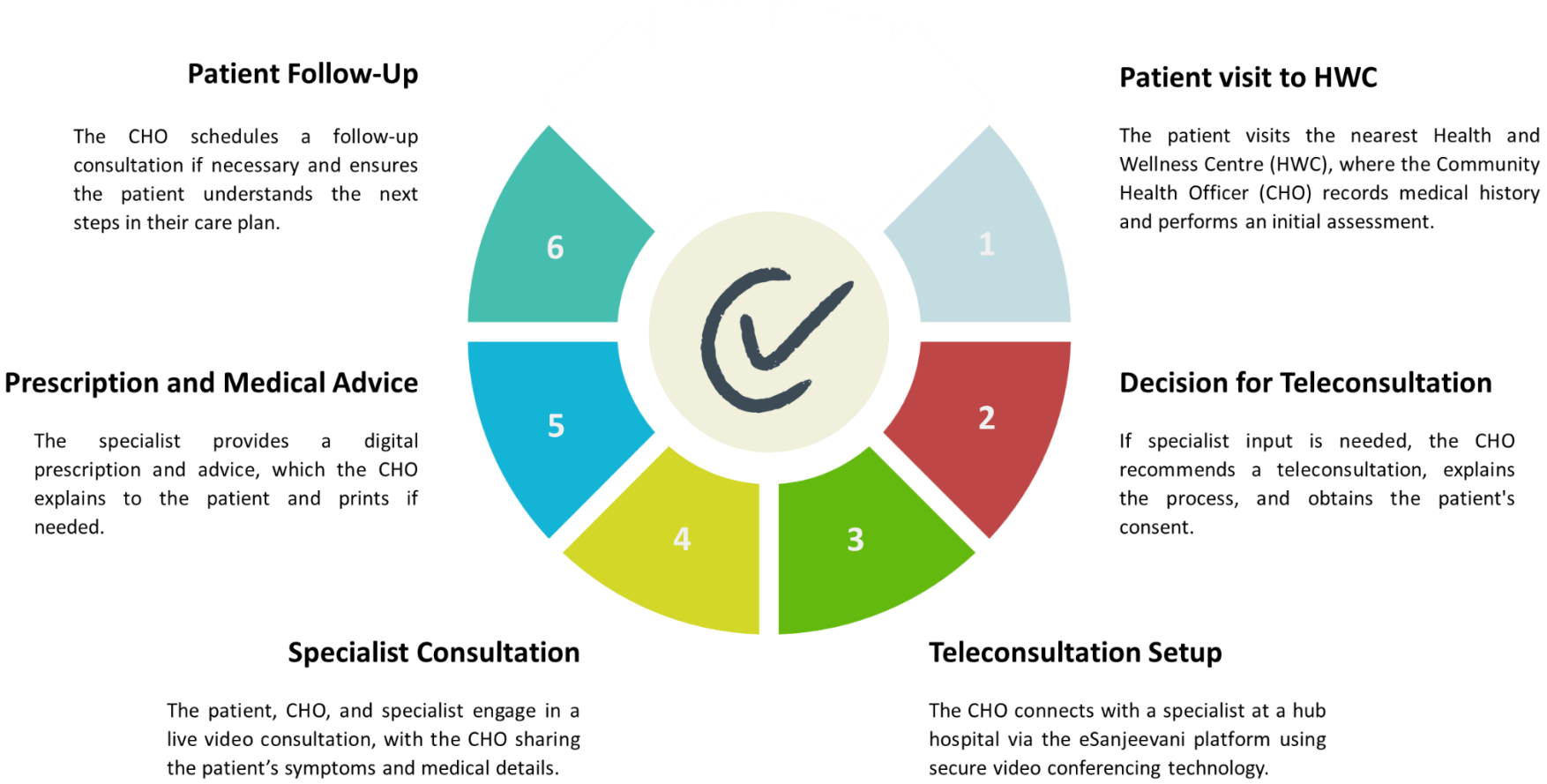

Figure 5: Workflow of the eSanjeevani HWC app (Ministry of Health and Family Welfare, n.d.-d)

5.2. eSanjeevani OPD

eSanjeevani OPD is an online telemedicine platform launched by the Ministry of Health and Family Welfare, Government of India, on 13 April 2020. (Ministry of Health and Family Welfare, 2021b) It enables patients to access outpatient healthcare services remotely through a secure digital platform, reducing the need for physical visits to healthcare facilities. Initially designed to mitigate the challenges of in-person consultations during the COVID-19 pandemic, the platform has now become a critical component of India's healthcare infrastructure, supporting a wide array of medical consultations from general health advice to specialized care. (Ministry of Health and Family Welfare, 2021b) It integrates video and audio consultations with digital prescription services, ensuring a seamless virtual healthcare experience.

5.2.1. Development

eSanjeevani OPD was developed and is managed by the Centre for Development of Advanced Computing (C-DAC), Mohali. (Nirupam Bajpai & Manisha Wadhwa, 2021)

5.2.2. Target Audience

eSanjeevani OPD caters to diverse groups like rural population with limited health facilities, urban residents seeking an alternative for non-emergency situations and elderly population with constraints for visiting a facility. (Ministry of Health and Family Welfare, n.d.-d)

5.2.3. Workflow

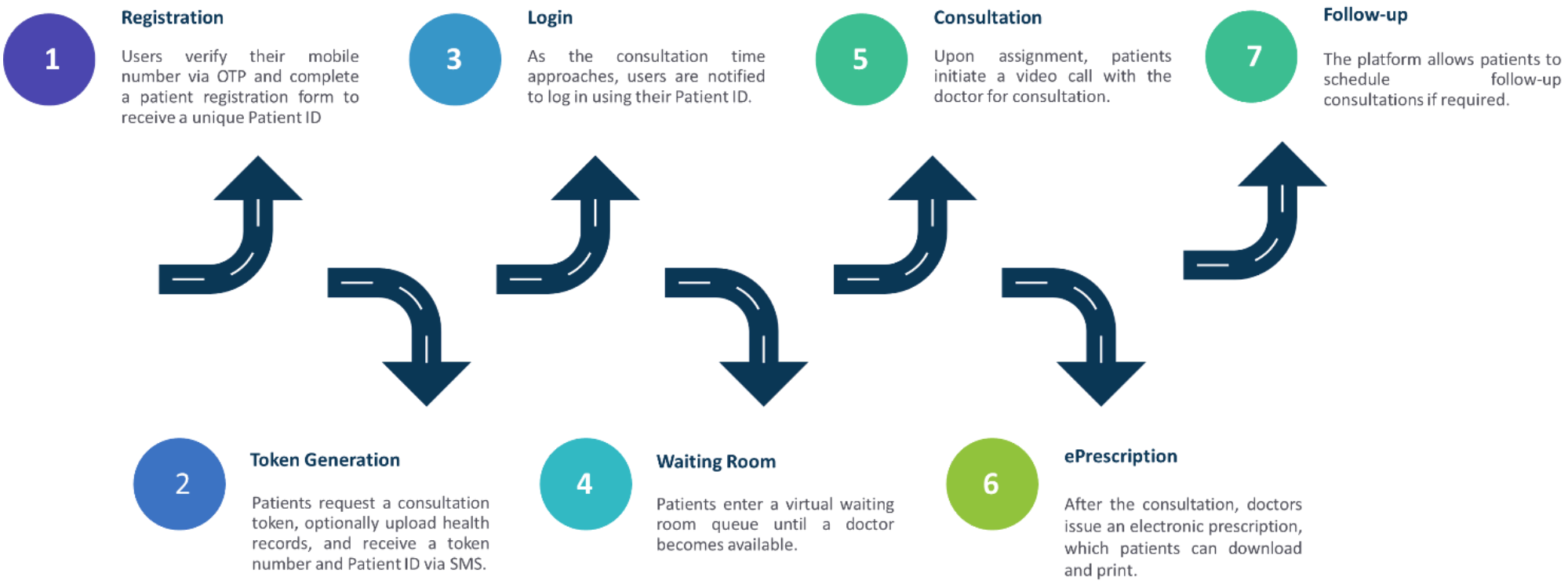

Figure 6: Workflow of eSanjeevani OPD (Ministry of Health and Family Welfare, n.d.-d)

5.2.4. Assessment of eSanjeevani HWC and OPD as per Youth Friendliness Framework

Youth-driven development

The platform was developed by the Centre for Development of Advanced Computing (C-DAC) under the Ministry of Health and Family Welfare. There is no publicly available information indicating that youth were actively involved in the design process. (Intelehealth & Transform Rural India, 2022) The rollout of eSanjeevani HWC has been primarily managed by government agencies and healthcare professionals. While young professionals may be part of the workforce, there is no evidence of targeted youth engagement in the implementation strategy. (Dr. Sanjay Sood & Dr. Neha Verma, 2024) Hence, the available literature does not highlight any programmes or initiatives within eSanjeevani HWC or OPD that specifically aim to involve youth in its processes.

Equitable

By design, eSanjeevani provides equitable access. It has a **neutral, inclusive language and design,** and the platform offers services in 12 different regional languages other than English, ensuring that users from various linguistic backgrounds can access healthcare without language barriers. The interface and services are designed to be gender-neutral, avoiding discrimination based on gender, religion, caste, or age. Although, the digital divide between genders and age could be indirectly affecting the use of the platform. (Gupta et al., 2024) Recognizing challenges in digital literacy, the platform involves Community Health Officers (CHOs) who assist patients in navigating the system, ensuring that individuals with limited digital skills can access telemedicine services.

The platform aims at bridging the urban-rural divide as it operates on a hub-and-spoke model, connecting Health and Wellness Centres in rural areas (spokes) with specialists in urban hospitals (hubs), thereby providing quality healthcare services to underserved populations. Although further improvement in the training of health workers at the spoke level is required. (Ministry of Health and Family Welfare, 2021c) Further, eSanjeevani HWC services are provided free of charge, reducing financial barriers for economically disadvantaged groups and promoting inclusive healthcare access. This divide further widens the access issues for eSanjeevani OPD.

Confidentiality and Privacy

eSanjeevani's privacy policy outlines that personal information provided during registration is encrypted before being uploaded to secure servers. However, the policy document contains technical terms that may not be easily understood by all users. (Ministry of Health & Family Welfare, n.d.-a) The platform's privacy policy indicates that user data is collected with consent, primarily for facilitating teleconsultations. However, the process for obtaining explicit informed consent from users before data collection or purpose for sharing collected data is not detailed in accessible language. (Ministry of Health & Family Welfare, n.d.-a) The current system does not provide users with customizable privacy settings to manage their personal information. Users have limited control over their data beyond the initial provision during registration. (Ministry of Health & Family Welfare, n.d.-a) While eSanjeevani employs standard security measures to protect user data, there is room for improvement in enhancing

transparency, obtaining explicit informed consent, and offering customizable privacy settings to empower users in managing their personal information.

Accessibility

The platforms provide a multilingual interface, offering services in multiple regional languages, ensuring that users from various linguistic backgrounds can access healthcare without language barriers. (C-DAC, n.d.) Effective use of eSanjeevani HWC and OPD requires a stable Internet connection with sufficient bandwidth to support video consultations. (DGHEALTH, n.d.) However, many rural areas in India face challenges with Internet connectivity, which can hinder access to the platform. Users need access to digital devices such as smartphones, tablets, or computers equipped with cameras and microphones to utilize eSanjeevani HWC or OPD services. (DGHEALTH, n.d.) The availability of such devices can be limited in economically disadvantaged regions at the spokes, affecting the platform's reach. The platform employs CHOs who assist patients in navigating the digital interface, addressing cultural and technological barriers. This approach helps in building trust and acceptance among communities that may be hesitant to adopt digital health solutions. (Intelehealth & Transform Rural India, 2022)

Availability

eSanjeevani HWC and OPD requires a stable Internet connection, ideally with a minimum speed of 2Mbps (megabits per second) for seamless video consultations. While urban users generally meet this criterion, rural areas continue to struggle with poor connectivity. Data from TRAI (Telecom Regulatory Authority of India) indicates that many rural regions rely on speeds lower than 1Mbps, which adversely affects telemedicine services. This limits the platform's usability in areas where it is most needed.

As of 2024, there were 751.5 million Internet users in India, representing 52.4 per cent of the total population. This suggests that nearly half of the population remains offline, potentially limiting access to digital health services like eSanjeevani OPD. (Tanushree Basuroy, 2024)

The Government of India has implemented various programmes like BharatNet to expand broadband coverage in rural areas. Although such initiatives are improving Internet availability, the pace of infrastructure development remains inadequate to fully support eSanjeevani HWC's potential reach. Community Health Officers (CHOs) at Health and Wellness Centres partially mitigate this gap by assisting patients without personal access to digital devices or stable Internet. However, not all HWCs consistently meet the infrastructure requirements.

Affordability

While eSanjeevani HWC is free, accessing it requires a smartphone or computer with Internet connectivity. In India, the cost of smartphones can be a barrier for low-income households. A recent initiative by the GSMA highlights efforts to make smartphones more affordable in low and middle-income countries, acknowledging that device cost remains a significant barrier to Internet access. (Reuters, 2024)

India is known for having some of the world's lowest mobile data costs. Despite low data costs, the affordability relative to disposable income varies. For individuals in low-income brackets, even minimal data expenses can be burdensome, especially when combined with the cost of devices. The Alliance for Affordable Internet emphasizes that affordability should be measured

as a proportion of income, suggesting that broadband becomes affordable when 1GB (gigabytes) of mobile data is priced at 2 per cent or less of average monthly income. (Alliance for Affordable Internet, 2021)

5.3. Tele-Manas

Tele Mental Health Assistance and Networking Across States (Tele-MANAS) is an initiative by the Government of India to provide free, round-the-clock tele-mental health services nationwide. Launched on 10 October 2022, on World Mental Health Day, it aims to offer equitable, accessible, and quality mental healthcare, particularly to individuals in remote or underserved areas. (Ministry of Health and Family Welfare, 2022b) As of December 2024, there are 53 Tele-MANAS cells established across 36 states and union territories. (Press Trust of India, 2024)

It operates a two-tier system to provide comprehensive mental health services across India. (Ministry of Health & Family Welfare, n.d.-b)

Tier 1: State Tele-MANAS Cells

- Counsellors: Trained professionals who offer initial support, including psychological first aid, emotional support, and basic counselling.
- Mental Health Specialists: Psychiatrists, clinical psychologists, and psychiatric social workers who provide advanced mental health interventions as needed.

Tier 2: Specialist Consultation Services

- District Mental Health Programme (DMHP) Teams: Provide in-person consultations and follow-up services for cases requiring direct intervention.
- Medical College Resources: Offer specialized care and support for complex mental health conditions.

This structured workforce ensures that individuals receive appropriate mental healthcare, from initial counselling to specialized interventions, facilitating a seamless continuum of support.

5.3.1. Development

Tele-MANAS was developed by the Ministry of Health and Family Welfare (MoHFW), Government of India, with National Institute of Mental Health and Neuroscience (NIMHANS) serving as the nodal centre. The International Institute of Information Technology-Bangalore (IIITB) provides technology support, while the National Health Systems Resource Centre (NHSRC) offers technical assistance. (Ministry of Health and Family Welfare, 2023)

5.3.2. Target Audience

The service targets the entire Indian population, with a focus on individuals in remote or underserved areas who may lack access to traditional mental health services. It also aims to reduce the stigma associated with seeking mental health support by providing anonymous and confidential service. (Ministry of Health & Family Welfare, n.d.-b)

5.3.3. Workflow of Tele-Manas

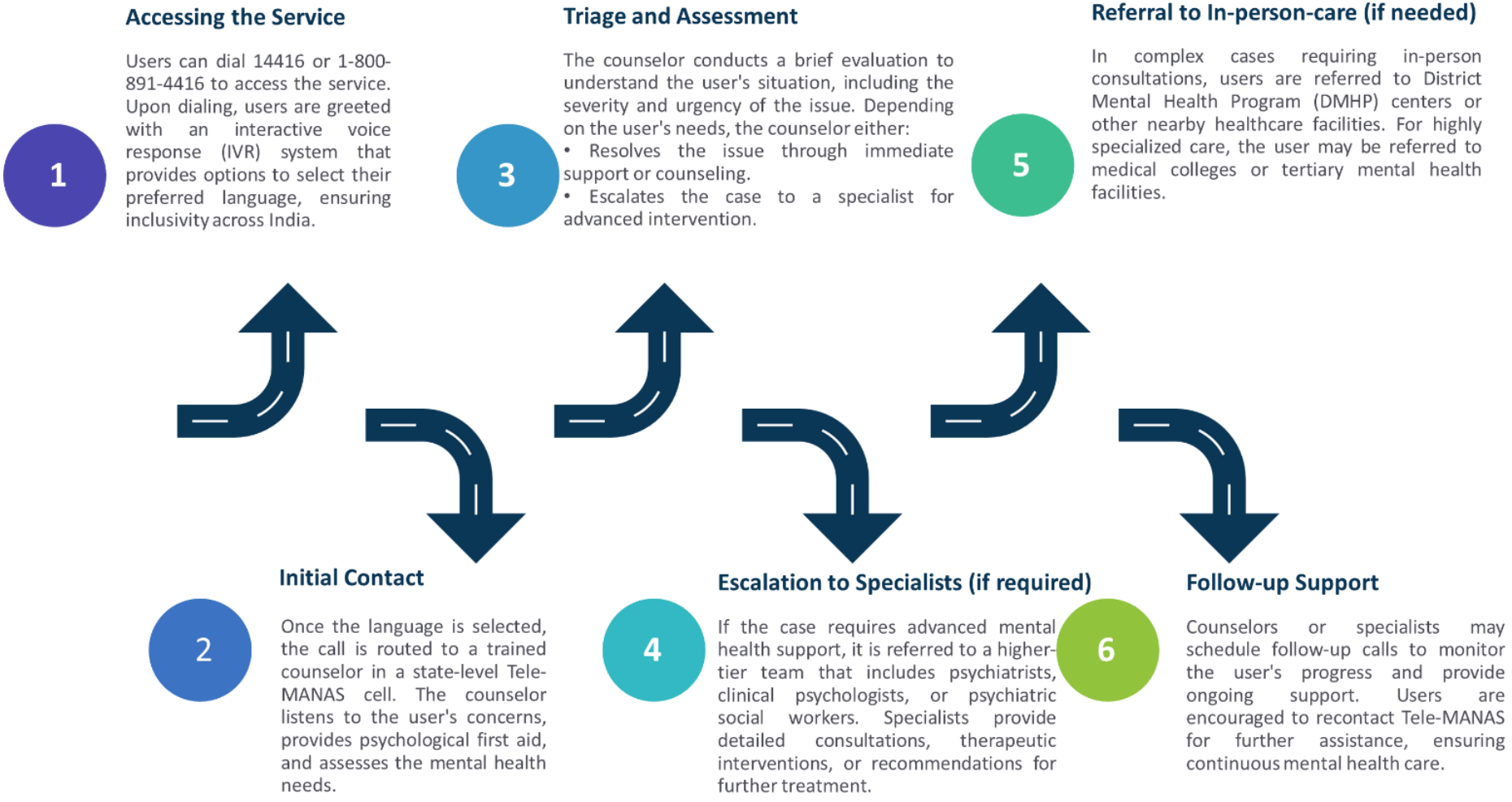

Figure 7: Workflow of Tele-Manas (Ministry of Health & Family Welfare, n.d.-b)

5.3.4. Assessment of Tele-Manas for Youth-friendliness

Youth-driven development

Current information does not indicate substantial involvement of youth in the design, implementation, or monitoring phases of Tele-MANAS. The initiative appears to have been primarily developed by governmental health agencies and mental health professionals, with limited direct input from young people. While Tele-MANAS serves as a crucial platform for mental health support across India, actively involving youth in its design, implementation, and monitoring could enhance its relevance and effectiveness for young populations. (Dessalegn, 2024)

Equitable

Tele-MANAS has a neutral, inclusive language and design as it offers services in multiple regional languages, ensuring that individuals from diverse linguistic backgrounds can access mental health support. (Ministry of Health & Family Welfare, n.d.) This approach promotes inclusivity and avoids discrimination based on language. The service is designed to be universally accessible, providing mental health assistance without discrimination based on gender, religion, caste, or age. By offering anonymous and confidential support, it encourages individuals from all demographics to seek help without fear of stigma. (Ministry of Health and Family Welfare, 2024)

Tele-MANAS aims to bridge the mental health service gap between urban and rural areas by providing tele-mental health services accessible via phone. This approach is particularly beneficial for individuals in remote or underserved regions who may lack access to traditional mental health facilities. (Ministry of Health and Family Welfare, 2024) By utilizing a phone-based system, Tele-MANAS reduces the need for advanced digital literacy, making it accessible to individuals who may not be proficient with smartphones or Internet-based platforms. This design choice helps in mitigating barriers related to digital literacy. (Ministry of Health and Family Welfare, 2024)

Data Confidentiality and Privacy

The Tele-Manas website mentions that no calls are recorded by the counsellors. (Ministry of Health & Family Welfare, n.d.) Instead, the details are documented in the computer system to keep a basic record. Further, it mentions that any information given by the caller is confidential and the counsellor, or the mental health professional, does not divulge any personal details or information to any other person, except in case the person, i.e., the caller, is at an immediate risk of suicide, or there is risk of the person causing harm to others. In that case, family members or those who can help the individual to take steps to reduce harm, are informed.

However, Tele-MANAS does not have a publicly available data privacy policy detailing how user data is collected, stored, or utilized. This absence means users are not informed about how their data is collected, stored, or used, which could potentially undermine trust in the service. (K, 2023) Without a clear data privacy policy, there is no structured process to obtain informed consent from users regarding the collection and use of their personal data. This gap raises concerns about user autonomy and the ethical management of sensitive mental health information. (K, 2023)

Accessibility

Tele-MANAS is a multilingual service which offers support in over 20 Indian languages, ensuring inclusivity for diverse linguistic groups across the country. (Ministry of Health and Family Welfare, 2024) The service operates primarily through toll-free helpline numbers, allowing users to connect via basic telephony without the need for Internet access or advanced digital devices. (Ministry of Health and Family Welfare, 2024) In October 2024, Tele-MANAS introduced a mobile app and video consultation service to enhance accessibility. While these features require Internet connectivity and compatible devices, the core helpline remains accessible without them.

By providing anonymous and confidential support, Tele-MANAS attempts to address cultural stigmas associated with mental health, encouraging individuals from various backgrounds to seek help. Although, the true potential of these services is hindered by a lack of awareness of the platform and the wider perception of mental health services as being coloured by stigma. (Dua, 2024)

Availability

Tele-MANAS offers a hybrid model of service delivery that accommodates users with varying levels of access to digital infrastructure. By providing a toll-free helpline, it ensures that individuals without Internet access or advanced devices can still receive mental health support. However, the expansion into app-based and video consultation services introduces additional infrastructure requirements that may limit availability for some users.

Affordability

Tele-MANAS services can be accessed using basic mobile phones or landlines, eliminating the need for smartphones or computers. This design choice ensures that individuals without advanced digital devices can still utilize the service. Accessing Tele-MANAS via the toll-free helpline does not require an Internet connection, thereby users incur no data costs. This feature is particularly beneficial for individuals concerned about data expenses.

For users opting to access additional services through the Tele-MANAS mobile application or video consultations, an Internet connection is necessary. India offers some of the most affordable mobile data rates globally, with the average cost of 1GB of data being approximately $0.17 (around ₹14). This affordability makes data usage feasible for a broad segment of the population. (Livemint, 2022)

The combination of free service access via toll-free numbers and the low cost of mobile data in India ensures that Tele-MANAS is economically affordable to underserved populations, including those with limited disposable income.

5.4. Aarogya Setu

Aarogya Setu was launched by the Government of India in April 2020, is a mobile application designed to track and mitigate the spread of COVID-19. The app utilized Bluetooth and GPS technologies to perform contact tracing, syndromic mapping, and self-assessment, aiming to inform users of potential exposure to the virus and provide relevant health advisories.

(Ministry of Electronics and Information Technology, n.d.-b) It has evolved into a comprehensive National Health App now which offers a range of digital health services powered by the Ayushman Bharat Digital Mission (ABDM). (Ministry of Electronics and Information Technology, n.d.-b)

Some of its current functions are as follows (Ministry of Health & Family Welfare, 2022):

- **Health ID Creation**: Users can create a unique Ayushman Bharat Health Account (ABHA) ID, facilitating seamless access to their digital health records across various healthcare providers.
- **Vaccination Services**: The app integrates with the CoWIN platform, allowing users to schedule COVID-19 vaccination appointments, download vaccination certificates, and check vaccination status.
- **Health Records Management**: Users can link and manage their digital health records, ensuring easy access to medical history and reports.
- **Telemedicine**: The app provides access to teleconsultation services, enabling users to consult with healthcare professionals remotely.
- **Health Facility Registry**: Users can search for nearby healthcare facilities, including hospitals, clinics, and laboratories, through the integrated registry.

5.4.1. Development

Aarogya Setu was developed and implemented by the National Informatics Centre (NIC) under the Ministry of Electronics and Information Technology (MeitY), Government of India. The application was created in collaboration with public and private sector organizations, leveraging India's technical expertise and digital infrastructure. (ET Bureau, 2020) The National Informatics Centre (NIC) were the primary developer and implementer of the application. The Ministry of Electronics and Information Technology (MeitY) oversaw the initiative to ensure alignment with national digital health strategies. Several private technology firms contributed to the development and scaling of the app, including design, functionality, and backend support. (Ministry of Electronics and Information Technology, 2020)

5.4.2. Target Audience

The app targets the entire population of India, aiming to provide individuals with information about COVID-19 risks and to facilitate contact tracing to control the spread of the virus. The target audience remains the same after the revamp of the platform.

5.4.3. Workflow

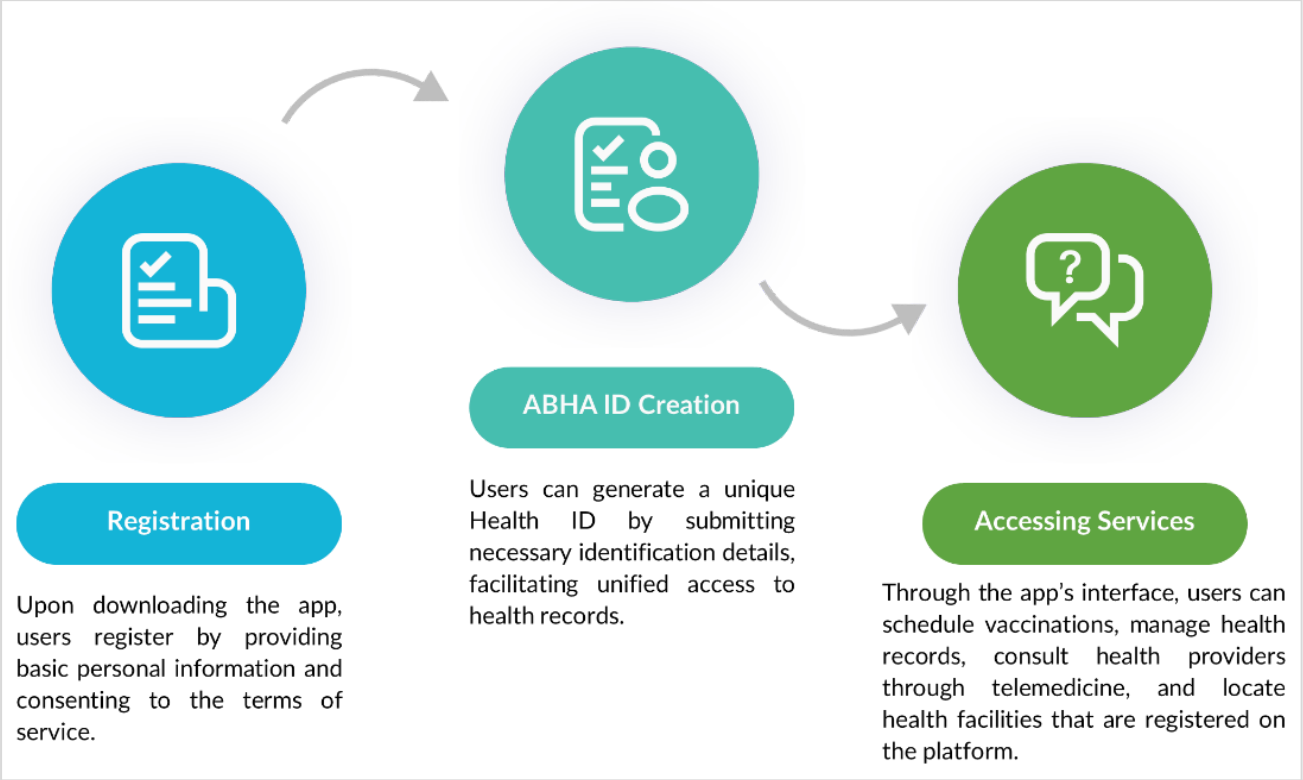

Figure 8: Workflow of Aarogya Setu

5.4.4. Assessment of Aarogya Setu for Youth-friendliness

Youth-driven Development

The development process primarily involved government agencies, private sector partners, and academic institutions. While the app was designed for widespread public use, including by youth, there is limited evidence to suggest significant involvement of young people in its design, implementation, or monitoring phases.

The app's development was led by the National Informatics Centre (NIC) under the Ministry of Electronics and Information Technology (MeitY), with contributions from industry and academia. However, specific details about the inclusion of youth perspectives, or direct involvement of young individuals in the design process, are not well-documented.

Its implementation strategies focused on rapid deployment and widespread adoption across the country. There is no substantial evidence indicating that youth were actively engaged in the implementation strategies or decision-making processes.

The monitoring of Aarogya Setu's effectiveness and user engagement appears to have been managed by governmental bodies and technical experts. Information on youth participation in monitoring or evaluating the app's performance is scarce.

Equitable

Assessing Aarogya Setu's current functionalities through the lens of equity involves examining its language inclusivity, design neutrality, and accessibility across diverse user groups.

The app is available in 12 languages – including Hindi, English, Marathi, Tamil, Telugu, Kannada, Malayalam, Punjabi, Bengali, Odia, Gujarati, and Assamese – therefore catering to a linguistically diverse population. The app's interface aims to be user-friendly, and there is limited available information detailing specific measures taken to ensure that the design avoids discrimination based on gender, religion, caste, or age.

The effectiveness of Aarogya Setu is influenced by smartphone penetration and Internet accessibility. Reports indicate that Internet penetration in India is around 52 per cent, with significant disparities between urban and rural areas, potentially limiting the app's reach among disadvantaged populations. (Data Reportal, 2024)

Concerns have been raised regarding the app's accessibility for individuals with disabilities. The Supreme Court of India directed the government to conduct a disability audit for the Aarogya Setu app to ensure it is accessible to persons with disabilities, highlighting the need for improvements in this area. (Reza, 2024)

Data Confidentiality and Privacy

Aarogya Setu provides a privacy policy detailing what data is collected, how it is stored, and the purpose of its usage. The app collects personal information, including name, phone number, age, gender, profession, travel history, GPS and Bluetooth data to determine proximity to others. (Ministry of Electronics and Information Technology, n.d.-a) The collected data is retained for 180 days unless anonymized and stored for research purposes.

However, the privacy policy includes technical and legal jargon, making it difficult for non-technical users to fully understand how their data is being used or shared. (Software Freedom Law Centre, India, 2020) The app has transitioned into a broader health application, but there is insufficient transparency on how the original data and new data are being repurposed. (Batra, 2021) (Parsheera et al., 2020)

Users' consent is sought during registration and they must accept the terms of service and privacy policy upon registration and when updates are made. Consent is explicitly required for key functionalities like Bluetooth tracking and location sharing. The Aarogya Setu Data Access and Knowledge Sharing Protocol, 2020, specifies that data can only be shared with government entities for pandemic management. (Ministry of Electronics and Information Technology, 2023) While users technically "consent" to data collection, the process does not provide granular options to opt in or out of specific features. This all-or-nothing approach limits autonomy. (Pant & Lal, 2020)

Regarding customizable settings, users can uninstall the app to cease data collection and request data deletion, though this process is not entirely automated. (Software Freedom Law Centre, India, 2020) However, Aarogya Setu does not provide customizable privacy settings, such as choosing which data types to share (e.g., only location or Bluetooth). This restricts user agency over personal information. Further, users cannot access logs to see how their data is being used, stored, or shared, which can have the effect of reducing trust. (Reza, 2024)

Accessibility

While Aarogya Setu offers substantial language support and has achieved widespread adoption, its accessibility is hindered by limitations in language inclusivity, reliance on smartphones and Internet connectivity, and varying levels of digital literacy among the population.

Despite a wide range of languages, several constitutionally recognized languages such as Urdu, Bodo, Santhali, Maithili, Dogri, Kashmiri, Sindhi, Konkani, and Manipuri are not supported, potentially limiting accessibility for speakers of these languages. Aarogya Setu is designed for smartphones operating on Android (version 5.0 and above) and iOS (Apple iPhone operating system version 10.3 and above) and Kaios. This dependency excludes individuals without access to compatible smartphones, particularly affecting populations in lower socioeconomic strata.

The app requires an active Internet connection for functionalities such as real-time updates and data sharing. In regions with limited Internet penetration or inconsistent connectivity, users may face challenges in accessing the app's features effectively. The app has been widely promoted by the government, leading to significant adoption across various demographics. However, concerns regarding privacy and data security have been raised, influencing public perception and acceptance. The app's effective use requires a certain level of digital literacy. Individuals unfamiliar with smartphone technology or app navigation may find it challenging to utilize the app's functionalities fully, potentially limiting its accessibility.

Availability

Recognizing the diverse user base, the app has been made available on the KaiOS platform, which is commonly used in feature phones. (National Informatics Centre, 2020) This expansion aims to include users who may not own smartphones, thereby enhancing accessibility. However, there is scope for more expansion.

The app requires an active Internet connection for functionalities such as real-time updates and data sharing. However, the data consumption is optimized to be minimal, ensuring that users with limited data plans can still effectively use the app. Certain features of the app, such as the self-assessment tool, can be accessed offline, providing users with essential services even in areas with intermittent Internet connectivity.

Affordability

Smartphone prices in India vary widely, with entry-level smartphones available for approximately ₹3,000 to ₹5,000 (around $40 to $70). Feature phones like the JioPhone are more affordable, priced around ₹1,500 (approximately $20). Despite these options, the cost of even the most affordable devices can be a barrier for individuals with limited disposable income.

India is known for having some of the lowest mobile data costs globally, with an average price of ₹7 per GB (less than $0.10). However, for individuals in lower-income brackets, even minimal data expenses can be significant when compared to their disposable income, although the app is designed to consume minimal data, primarily using it for updates and uploading necessary information. While the exact data usage varies based on individual usage patterns, the app's efficient design helps in keeping data consumption low.

Hence, for economically disadvantaged groups, the combined costs of acquiring a compatible device and maintaining data connectivity can be prohibitive, potentially limiting access to the app's services.

5.5. CoWIN

CoWIN (Covid Vaccine Intelligence Network) is a digital platform developed by the Government of India to manage and streamline the COVID-19 vaccination process nationwide. It facilitates registration, appointment scheduling, identity verification, vaccination, and certification for individuals receiving the vaccine. (Ministry of Electronics and Information Technology, 2024) The platform integrates with apps like Aarogya Setu and DigiLocker, allowing seamless access to vaccination records. It also features real-time monitoring of vaccine usage, coverage, and wastage, hence optimizing resource management.

Designed for scalability, CoWIN is now being adapted to support routine immunization programmes. Following the peak of the COVID-19 pandemic, the CoWIN platform is being repurposed to support India's Universal Immunization Programme. (United Nations Development Programme, India, 2022) It will facilitate booking slots for routine vaccinations like polio and hepatitis, allowing healthcare professionals to digitally track the immunization status of beneficiaries in real-time.

The application consists of five different modules, (Exemplars in Global Health, n.d.) serving different purposes other than providing appointments for COVID vaccination for beneficiaries:

- **Orchestration Module**: Manages the end-to-end vaccination workflow, including scheduling, resource allocation, and integration across various modules.
- **Vaccination Cold Chain Module**: Tracks vaccine stocks, storage conditions, and supply chain logistics to ensure vaccine availability and quality.
- **Citizen Registration Module**: Enables user registration, appointment booking, and rescheduling for vaccinations, catering to both online and on-site users.
- **Vaccinator Module**: Provides tools for healthcare workers to verify beneficiary details, record vaccine administration, and track doses in real-time.
- **Certificate, Feedback, and Adverse Event Reporting Module**: Generates digital vaccination certificates, collects user feedback, and logs adverse events following immunization (AEFI) for analysis and reporting.

5.5.1. Development

The development and implementation of CoWIN were carried out through a collaborative effort involving several key stakeholders. (Government of India, n.d.) The Ministry of Health and Family Welfare and NHA acted as the nodal body for policy formulation and overseeing the vaccination campaign. The National Informatics Centre (NIC) led the technical development, ensuring scalability and secure data management for the platform. The United Nations Development Programme (UNDP) provided technical assistance and expertise from the eVIN project, particularly in vaccine logistics and cold chain management. Technology Partners collaborated with private-sector technology firms and startups for app development, interface design, and cloud infrastructure. Further, NGOs and community organizations

assisted in spreading awareness and ensuring adoption among rural and underserved populations.

5.5.2. Target Audience

The CoWIN platform was designed to cater to a vast and varied audience, from individual citizens and healthcare providers to policymakers and international travellers. The entire adult population was the target audience for availing of the COVID vaccination: eligibility applied initially to healthcare workers and frontline workers, followed by different age groups.

5.5.3. Workflow

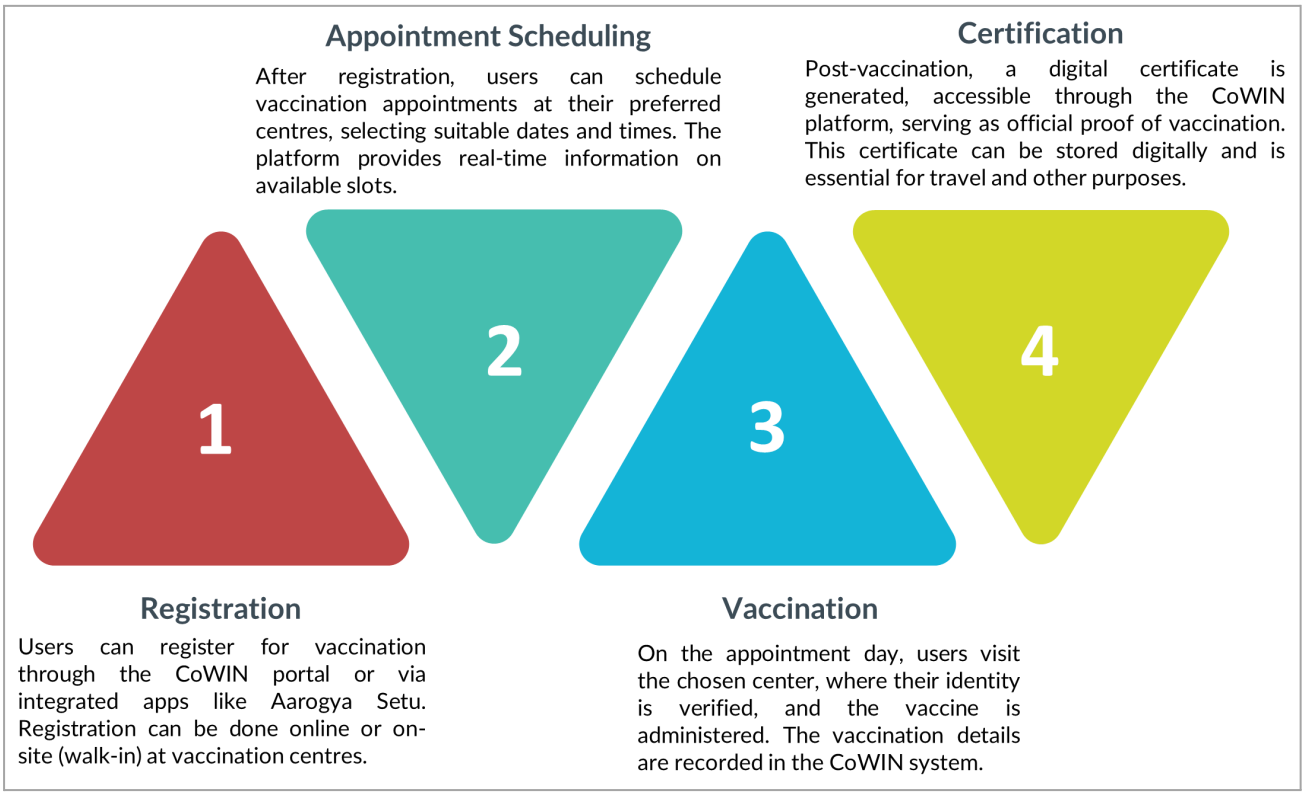

Figure 9: Workflow of CoWIN

5.5.4. Assessment of CoWIN for Youth-friendliness

Youth-driven development

The development of CoWIN was primarily led by government bodies such as the Ministry of Health and Family Welfare (MoHFW) and the National Informatics Centre (NIC), with technical support from organizations like the United Nations Development Programme (UNDP). There is scant evidence to suggest that young people were actively engaged in decision-making processes during its development. (Athavle, 2024) CoWIN's development process appears to have lacked substantial youth engagement, which is a critical component of youth-driven development.

Equitable

CoWIN was developed with inclusivity as a core principle. The platform is available in English and 11 regional languages, facilitating access for citizens across various states. (Team MyGov, 2022) This multilingual support aims to accommodate India's linguistic diversity, ensuring that language barriers do not impede access to vaccination services.

Despite these efforts, challenges persist in reaching certain disadvantaged groups:

- **Digital Literacy and Access**: The reliance on digital platforms for vaccination registration has highlighted the digital divide in India. Marginalized communities, particularly in rural areas, often lack Internet access or the digital literacy required to navigate online systems. (Jain, 2021) This has led to concerns about equitable access to vaccines.
- **Rural-Urban Divide**: While CoWIN offers a flexible framework for vaccination recording in rural areas – including provisions for walk-in registrations – disparities remain. Reports indicate that individuals in urban areas, especially those who are tech-savvy, have had advantages in booking vaccination slots, potentially sidelining rural populations. (Sharma, 2021)
- **Gender Divide**: The digital approach may inadvertently disadvantage women, who statistically have lower access to digital devices and the Internet compared to men in India. This disparity can hinder their ability to register for vaccinations through digital means. (Srivastava, 2021)

Data Confidentiality and Privacy

CoWIN's privacy policy outlines the collection, storage, and usage of personal information. However, the language used is technical and may not be easily comprehensible to all users, potentially hindering full transparency. (Ministry of Health and Family Welfare, n.d.-c) CoWIN incorporates user consent mechanisms, particularly through OTP-based authentication for accessing personal data. For instance, the KYC-VS (Know Your Customer's/Client's Vaccination Status) API is designed to be consent-based and privacy-preserving, ensuring that users authorize the sharing of their vaccination status. (Arora, 2021) Currently, CoWIN does not offer users the ability to customize privacy settings. Users cannot adjust preferences regarding data sharing or visibility, limiting their control over personal information.

Despite security measures, there have been reports suggesting potential data breaches. For example, unauthorized access to personal data via a Telegram bot raised concerns about the platform's data security. The government has denied any direct breach of the CoWIN system, emphasizing the platform's safeguards for data privacy. (Ministry of Health & Family Welfare, 2023a) (Singh, 2023)

Accessibility

Assessing CoWIN's functionalities through the lens of accessibility involves evaluating its provisions for language support, Internet connectivity requirements, availability of digital devices, and alignment with supportive cultural norms.

Language Support: CoWIN has been made accessible in 11 regional languages in addition to English, enabling users from different states to navigate the platform in their preferred language.

Internet Connectivity and Digital Equipment: The platform's reliance on Internet connectivity and digital devices has highlighted challenges related to India's digital divide. For a few phases of vaccination in 2021-2022, accessing COVID vaccinations required mandatory registration on CoWIN online. (Tanmay Singh, 2021) This had faced criticism due to India's ongoing struggles with digital literacy and limited access to digital infrastructure, particularly in rural areas. However, this was revised later on, allowing walk-ins and online registrations. (Ministry of Health and Family Welfare, 2022a)

Digital Divide: Despite India's rapid digital advancement, there is still limited access to digital infrastructure, including Internet connectivity, smartphones, and digital literacy. As of 2024, India's Internet penetration rate is expected to be 52 per cent, which limits access to the platform.

Digital Literacy: Low digital literacy was a bigger deterrent for accessing CoWIN platform. A survey conducted by BCG across towns, villages and cities with a sample size of 4,000 indicated that 63 per cent of individuals in rural areas and 43 per cent in smaller towns were unaware of how to register on the CoWIN app for vaccination. (Chandramouli, 2021)

Access Issues for Persons with Disabilities: A study by Vidhi Centre for Legal Policy highlighted accessibility issues for persons with disabilities (PwDs) in accessing CoWIN, including a lack of screen reader compatibility, inadequate provisions for hearing-impaired individuals, and the absence of user-friendly design for those with cognitive or physical disabilities. (Bajaj et al., 2022)

Availability and Affordability

The availability and affordability assessment for CoWIN was also similar to the other apps assessed in the previous sections.

5.6. ABHA App

The Ayushman Bharat Health Account (ABHA) app is a pivotal component of India's Ayushman Bharat Digital Mission (ABDM), designed to streamline healthcare management by providing citizens with a unified digital platform for their health records.

The ABHA app enables users to create a unique health identity, facilitating the seamless integration and management of personal health records across various healthcare providers. Key features include:

- **ABHA Number and Address Creation**: Users can generate a 14-digit ABHA number and a user-friendly ABHA address (e.g. username@abdm) using their mobile number, email ID, or other identifiers.
- **Health Record Management**: The app allows users to link, view, and manage their health records, including lab reports, prescriptions, and vaccination certificates, providing a comprehensive view of their medical history.
- **Consent Management**: Users have granular control over their health data, determining who can access specific records and for what duration, with the option to revoke consent at any time, ensuring privacy and security.

- **QR Code Registration**: The app facilitates quick registration at ABDM-compliant healthcare facilities through QR code scanning, expediting the check-in process.
- **Multilingual Support**: Currently available in Hindi and English, with plans to include additional Indian languages, enhancing accessibility for a diverse user base.

5.6.1. Development

The development of the ABHA app was spearheaded by the National Health Authority (NHA), The NHA is responsible for implementing the ABDM. In addition to the NHA's central role, several private sector organizations contributed to the app's development and integration.

Suma Soft has been involved in integrating various healthcare providers into the ABDM ecosystem, ensuring that the software used by these providers complies with ABDM guidelines. **Eka Care** developed the ABDM Connect, a suite of APIs designed to facilitate the integration of healthcare systems with India's national digital health infrastructure. **Dreams Technologies** contributed to the app's user interface and experience design, focusing on creating an intuitive and accessible platform for users.

5.6.2. Target Audience

The audience for the ABHA app includes Indian citizens seeking to manage their health records digitally, healthcare providers and facilities participating in the ABDM network. The user base ranges from individuals proficient in technology, to those with limited digital literacy. Anyone with a valid adult Aadhar card was eligible to register for an ABHA Id.

5.6.3. Workflow

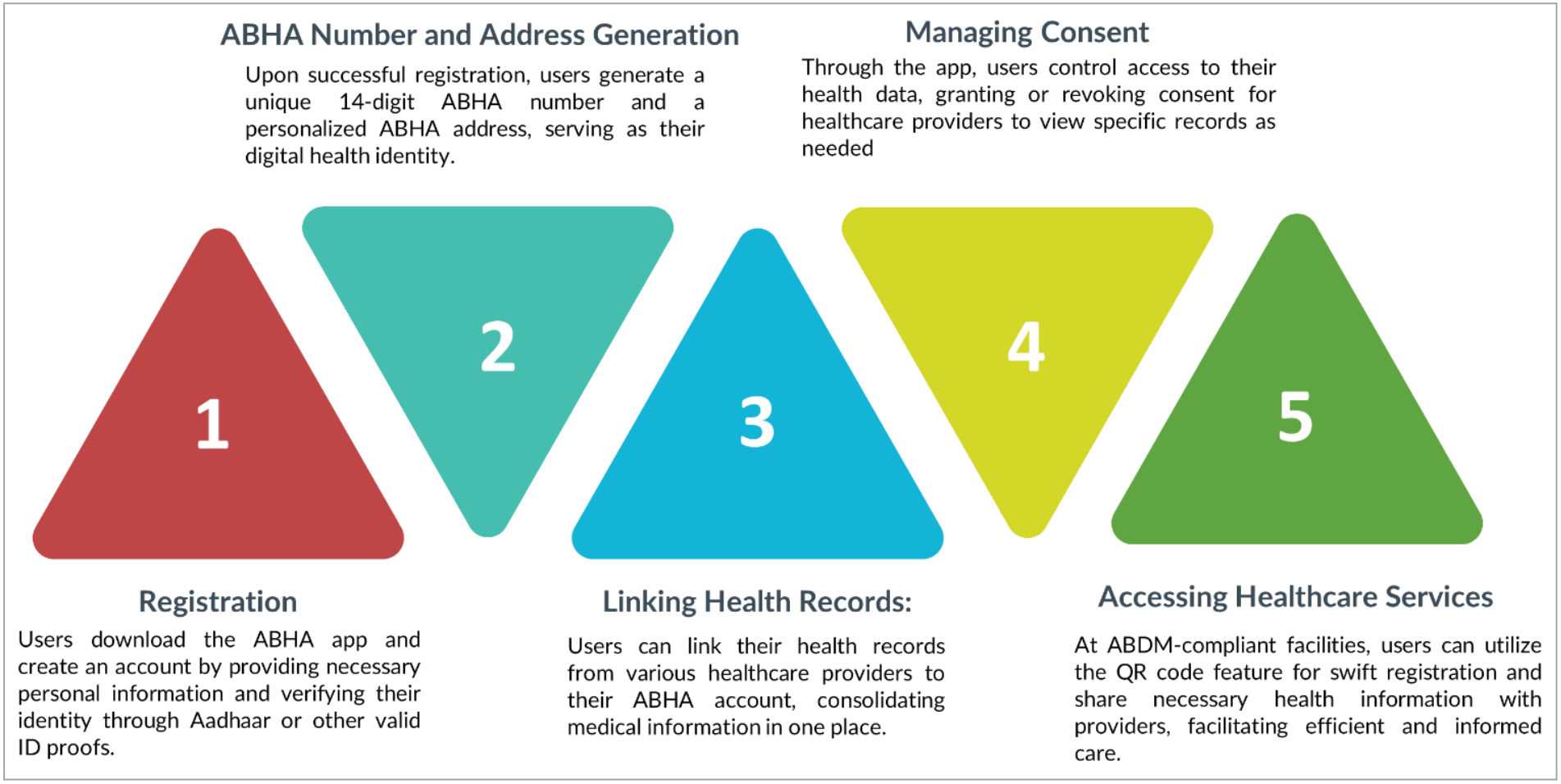

Figure 10: Workflow of ABHA App

5.6.4. Assessment of CoWIN for Youth-friendliness

Youth-driven development

While the ABHA app serves a broad user base, including the youth, there is limited evidence of direct youth involvement in its design, implementation, or monitoring processes.

Currently, there is limited publicly available information indicating direct involvement of youth in the design and implementation of the ABHA app. The development has been primarily led by the National Health Authority (NHA) under the Ministry of Health and Family Welfare, Government of India. While the app aims to serve all demographics, including the youth, explicit engagement of young individuals in the development process is not well-documented. The ABHA app is available on platforms like the Google Play Store, where users, including young people, can provide ratings and reviews. This feedback mechanism allows the youth to share their experiences and suggestions, indirectly contributing to the app's monitoring and iterative improvement. However, structured avenues for youth participation in formal monitoring or advisory capacities are not prominently featured.

Equitable

The ABHA app is currently available in Hindi and English, with plans to incorporate additional regional languages. This poses a challenge for India's linguistically diverse population. The app's eligibility criteria are inclusive, allowing all Indian citizens to register, irrespective of caste, religion, or gender. By design, there are not any discriminatory factors limiting the uptake or usage. However, challenges persist in reaching populations with limited digital literacy, particularly in rural areas. Limited Internet access and lack of educational resources in these regions can impede effective utilization of the app. In this scenario, it might be more favourable for urban populations.

Data Confidentiality and Privacy (National Health Authority, n.d.-b)

The ABHA app's privacy policy comprehensively details how personal health data is collected, processed, stored, and shared. It specifies that personal information, such as name, mobile number, ABHA number, and health data, including diagnostic records and prescriptions, is collected and securely stored in compliance with Indian data protection laws. The policy clarifies that data is used solely for facilitating healthcare services, improving app functionality, and fulfilling legal obligations. Data sharing with healthcare providers is conducted only with explicit user consent, and the policy ensures that data is not shared with third parties for marketing purposes without permission. While the policy provides a reasonable degree of transparency on data usage, it could be improved by offering more detailed information on data retention, deletion, and the anonymization processes, as well as by simplifying the language to enhance user understanding.

The ABHA app requires explicit user consent before collecting or sharing personal health data obtained through OTP-based authentication and a consent management feature that allows users to grant or revoke consent for sharing their health data with healthcare providers. Strengths include granular consent control, enabling users to manage access for specific purposes or entities, and a robust revocation mechanism that enhances user autonomy by allowing consent withdrawal at any time. However, the consent process could be improved by

providing brief, user-friendly explanations to help users better understand what they are agreeing to. This would help promote more informed decision-making.

The ABHA app offers basic privacy controls, allowing users to manage whether and with whom their data can be shared through its consent management feature. However, it lacks advanced privacy customization options, such as selecting specific data fields for sharing or adjusting preferences based on different scenarios (e.g., emergency versus. routine sharing). Introducing more granular privacy settings would enhance user control, while offering the option to share anonymized data for research or policy purposes, with clear benefits outlined, could improve user trust and participation.

Accessibility

The ABHA app is currently available in Hindi and English, with plans to incorporate additional regional languages to cater to India's diverse linguistic population. The app is designed for smartphone users, necessitating Internet access for full functionality. Recognizing connectivity challenges in certain regions, the Ayushman Bharat Digital Mission (ABDM) provides assisted and offline modes for creating ABHA accounts, accommodating areas with limited Internet connectivity or hardware constraints. (Ministry of Health & Family Welfare, 2023b) To address varying levels of digital literacy, applications like the ABHA app are designed to be intuitive and user-friendly, aiming to bridge the digital divide and ensure inclusivity across different cultural contexts. (Ministry of Health & Family Welfare, 2023b)

The ABHA app demonstrates a commitment to accessibility through multilingual support and provisions for users with limited Internet connectivity or digital literacy. However, ongoing efforts to expand language options and enhance user-friendliness are essential to fully accommodate India's diverse population.

Availability

The ABHA app is designed for smartphones, making it accessible to users with such devices. However, individuals without smartphones or computers may face challenges in accessing the app's digital health solutions. To address this, the Ayushman Bharat Digital Mission (ABDM) has introduced assisted and offline modes for creating ABHA accounts, facilitating access for those lacking personal digital devices. (Ministry of Health & Family Welfare, 2023b) While the app requires Internet access for full functionality, the ABDM has implemented features to accommodate users in areas with limited or no Internet connectivity. The offline ABHA creation feature enables individuals in such regions to generate their health accounts without immediate Internet access, thereby enhancing inclusivity.

The ABHA app is designed to be compatible with commonly used digital devices like smartphones and requires Internet connectivity for optimal use. Recognizing the digital divide, especially in remote areas, the introduction of assisted and offline modes for ABHA account creation reflects a commitment to ensure its availability, ensuring that individuals without personal digital devices or reliable Internet access can still benefit from the app's services.

Affordability

While the ABHA app offers digital health solutions that can enhance healthcare access, affordability challenges related to device ownership and data costs persist for underserved populations. The implementation of assisted and offline modes represents a positive step

toward inclusivity, but ongoing efforts are necessary to ensure that financial barriers do not impede access to digital health services for all citizens.

5.7. Online Registration System

The Online Registration System (ORS) is a Digital India initiative aimed at streamlining patient services by providing online access to various hospital facilities across India. It integrates multiple public hospitals, enabling patients to book appointments, access lab reports, and check blood availability online.

Appointment Booking: The ORS allows patients to schedule Outpatient Department (OPD) appointments with specific departments in participating public hospitals. By enabling online appointment booking, the system reduces the need for physical visits to the hospital just to secure a time slot, thus minimizing long waiting times and overcrowding in hospital premises. The system also allows users to choose convenient time slots based on availability, ensuring a smoother patient experience.

Lab Report Access: The ORS provides patients with online access to their diagnostic lab reports, allowing them to view and download results without physically visiting the hospital. This feature is particularly beneficial for patients who require frequent diagnostic tests, such as those undergoing long-term treatment or chronic disease management.

Blood Availability Inquiry: The ORS platform includes a feature that allows users to check the availability of blood units in affiliated blood banks. This real-time inquiry system is crucial in emergencies when locating a specific blood type quickly can be life-saving. By providing this information online, ORS helps patients and caregivers find nearby blood banks that meet their requirements.

Unique Health Identification (UHID) Generation: ORS facilitates the creation of a Unique Health Identification (UHID) for new patients during their first appointment. This UHID serves as a digital identity for the patient within the healthcare system, which will enable seamless interactions with hospitals in the future. Once generated, the UHID can be used for all subsequent registrations, ensuring faster check-ins and better record management.

Integration with Aadhaar: To ensure accurate identification and prevent duplication of patient records, ORS integrates with Aadhaar, India's national identity system. This integration enables Aadhaar-based verification during registration, ensuring that patient data remains consistent across hospitals. Additionally, Aadhaar linkage enhances security and minimizes the risk of fraudulent entries.

5.7.1. Development

The Online Registration System (ORS) for India's public healthcare system was developed by the National Informatics Centre (NIC) under the Ministry of Electronics and Information Technology (MeitY), in collaboration with the Ministry of Health and Family Welfare (MoHFW) as part of the Digital India initiative. NIC, a government agency responsible for providing

e-governance solutions, played a key role in designing and deploying ORS to improve healthcare service accessibility and efficiency.

5.7.2. Target Audience

The Online Registration System (ORS) primarily caters to a diverse group of users who seek healthcare services at public hospitals. By digitizing and streamlining appointment booking and other health services, ORS aims to enhance accessibility for various segments of the population. The ORS platform is designed for individuals across all age groups who require outpatient consultations or diagnostic services in government hospitals.

5.7.3. Workflow

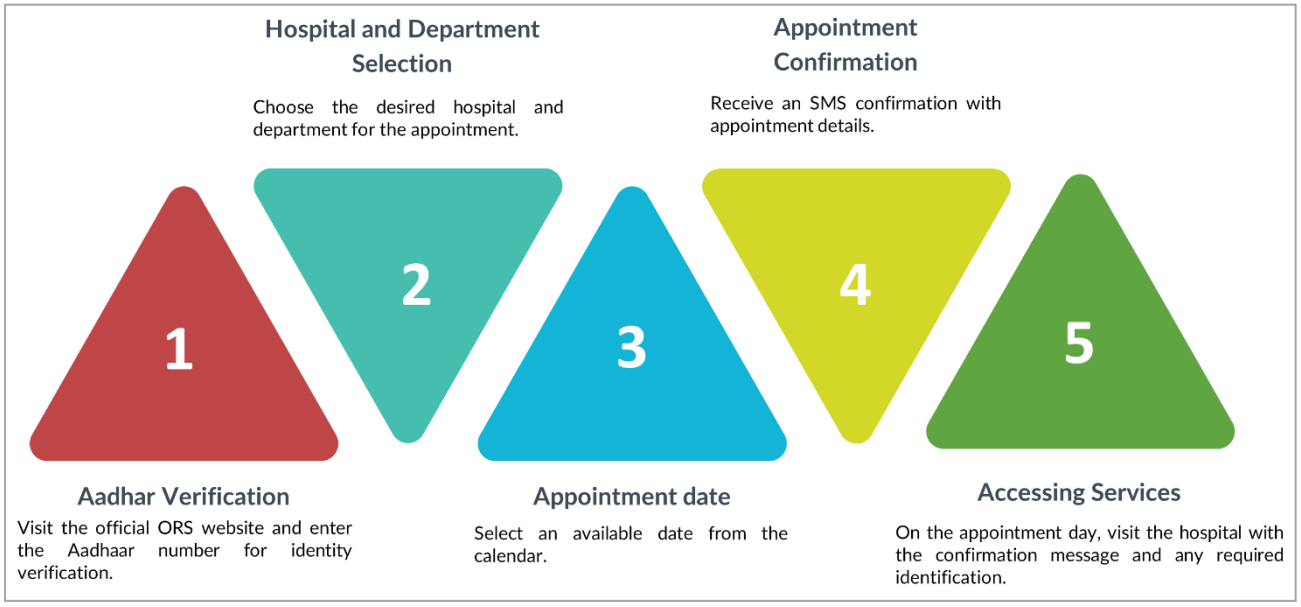

Figure 11: Workflow of ORS

5.7.4. Assessment of ORS as per Youth-friendliness Framework

Youth-driven Development

The development of ORS appears to have been primarily led by government agencies, with no publicly available information indicating the participation of youth or youth-led organizations in the design process. Implementation efforts have been managed by governmental bodies, focusing on integrating ORS into existing hospital systems. There is no documented evidence of youth engagement during this phase. Ongoing monitoring and evaluation of ORS are conducted by the responsible government departments. The absence of youth participation in these activities suggests a missed opportunity for incorporating fresh perspectives and innovative approaches.

Equitable

Neutral and Inclusive Language and Design

- **Language Inclusivity**: ORS primarily operates in English, which may pose challenges for individuals not proficient in the language. Given India's linguistic diversity, the absence of regional language options can hinder accessibility for non-English speakers.
- **Design Neutrality**: While ORS does not overtly discriminate based on gender, religion, caste, or age, the lack of tailored features for marginalized groups suggests a need for more inclusive design elements.

Consideration for Disadvantaged Populations

- **Digital Literacy**: The platform assumes a certain level of digital literacy, potentially excluding individuals unfamiliar with online systems. This is particularly pertinent in rural areas where digital education may be limited.
- **Rural-Urban Divide**: Internet connectivity issues in rural regions can impede access to ORS. Studies indicate that approximately 70 per cent of India's population has poor or no connectivity to digital services, exacerbating the digital divide. (India Development Review, 2023)
- **Gender Divide**: Societal norms and economic factors often restrict women's access to digital devices and the Internet, potentially limiting their use of ORS. The digital divide, especially the gendered digital divide, has emerged as a critical factor influencing educational outcomes in India, exacerbated by the COVID-19 pandemic. (Manchanda, 2025) Although by design, the app doesn't have any discriminatory features.

Data Confidentiality and Privacy

- **Transparent Data Policies**: As of the latest available information, ORS lacks a publicly accessible privacy policy detailing how user data is collected, stored, and utilized. This absence of clear communication may lead to user uncertainty regarding data handling practices. Without transparent data policies, users cannot make informed decisions about sharing their personal information, potentially undermining trust in the system.
- **User Consent**: ORS integrates with Aadhaar for user verification, which involves collecting personal data. However, the specifics of how user consent is obtained, recorded, and managed during this process are not well-documented publicly. The lack of explicit consent mechanisms may result in users being unaware of the extent to which their data is being processed, conflicting with principles of informed consent.
- **Customizable Privacy Settings**: ORS does not provide users with options to customize privacy settings or control the extent of data sharing based on personal preferences. The absence of customizable privacy settings limits user autonomy over personal data, which is a critical aspect of data protection and user empowerment.

Accessibility

ORS primarily operates in English, which may limit accessibility for non-English speakers in India. Given the country's linguistic diversity, the absence of regional language options can hinder effective utilization by a significant portion of the population. Lack of multilingual support may exclude individuals who are not proficient in English, reducing the system's overall accessibility and effectiveness.

ORS is an online platform requiring users to have Internet access to utilize its services. While Internet penetration in India has been increasing, disparities remain, particularly in rural areas where connectivity can be inconsistent or of low quality. Dependence on Internet access may disadvantage individuals in regions with poor connectivity, limiting their ability to benefit from ORS's services.

Accessing ORS necessitates the use of digital devices such as smartphones, tablets, or computers. However, not all individuals, especially in economically disadvantaged groups, possess such devices, potentially restricting their access to the platform. The requirement for digital devices may exclude individuals without access to such equipment, thereby limiting the system's reach and inclusivity.

The adoption of digital health solutions like ORS is influenced by societal attitudes towards technology. In some communities, especially in rural areas, there may be resistance or lack of familiarity with digital platforms, affecting the acceptance and utilization of ORS. Cultural resistance to digital platforms can impede the widespread adoption of ORS, particularly among populations that could benefit the most from streamlined healthcare services.

Availability

Device Requirements: Accessing ORS necessitates the use of digital devices such as smartphones, tablets, or computers. Individuals without access to these devices, particularly in economically disadvantaged groups, may face challenges in utilizing ORS services.

Internet Connectivity: ORS is a web-enabled application that requires Internet access for functionalities such as online appointment booking and viewing lab reports. Users in areas with limited or unreliable Internet connectivity may experience difficulties in accessing ORS services, potentially hindering their ability to benefit from the platform.

Affordability

Accessing ORS requires digital devices such as smartphones, tablets, or computers. While India has seen a significant increase in smartphone penetration, economic disparities mean that not all individuals, especially in rural or low-income areas, can afford these devices. The rising costs of digital devices further exacerbate this issue, potentially limiting access to digital health solutions like ORS. (ETGovernment, 2023) Individuals without access to affordable digital devices are effectively excluded from utilizing ORS, hindering equitable access to healthcare services.

India has been recognized for offering some of the most affordable mobile data rates globally, which has facilitated increased Internet usage across various demographics. However, recent trends indicate a rise in data tariffs by telecom providers, raising concerns about the sustainability of data affordability. Such increases can disproportionately affect low-income users, potentially limiting their ability to access online services like ORS. (ETGovernment, 2023) Elevated data costs may deter economically disadvantaged individuals from using ORS, thereby undermining the platform's goal of providing accessible healthcare services to all segments of the population.

5.8. e-Rakt Kosh

e-Rakt Kosh is a centralized blood bank management system which aims to connect, digitize, and streamline the workflow of blood banks across India, enhancing transparency, efficiency, and accessibility in blood donation and transfusion services. E-Rakt Kosh comprises of the following features:

Overview and Detailed Features

- **Real-Time Blood Availability**: e-Rakt Kosh provides real-time information on blood stock availability across registered blood banks, enabling patients and healthcare providers to locate required blood types promptly.
- **Donor Management**: The system maintains a comprehensive database of blood donors, facilitating efficient donor recruitment, retention and communication. It also allows donors to register online and receive notifications about upcoming blood donation camps.
- **Blood Donation Camps**: e-Rakt Kosh enables the organization and management of blood donation camps, providing information on upcoming camps and allowing potential donors to register for participation.
- **Thalassemia Request Management**: The platform offers a dedicated module for managing blood requests from thalassemia patients, ensuring timely and adequate supply for regular transfusions.
- **Blood Bank Directory**: Users can access a comprehensive directory of blood banks across India, including contact details and services offered, facilitating easy navigation and communication.

5.8.1. Development

e-Rakt Kosh was developed by the Ministry of Health and Family Welfare (MoHFW) in collaboration with the National Informatics Centre (NIC). It aims to create a unified and efficient blood bank management system across India.

5.8.2. Target Audience

- **Blood Donors**: Individuals willing to donate blood can register, find donation camps, and receive notifications through the platform.
- **Patients and Their Families**: Those in need of blood transfusions can search for available blood units and request assistance.
- **Thalassemia Patients**: Individuals requiring regular blood transfusions can manage their requests and ensure timely supply.
- **Healthcare Providers**: Hospitals and clinics can access the system to find blood units for patients and coordinate with blood banks.
- **Blood Bank Administrators**: Personnel managing blood banks can utilize the system for inventory management, donor communication, and reporting.

5.8.3. Workflow

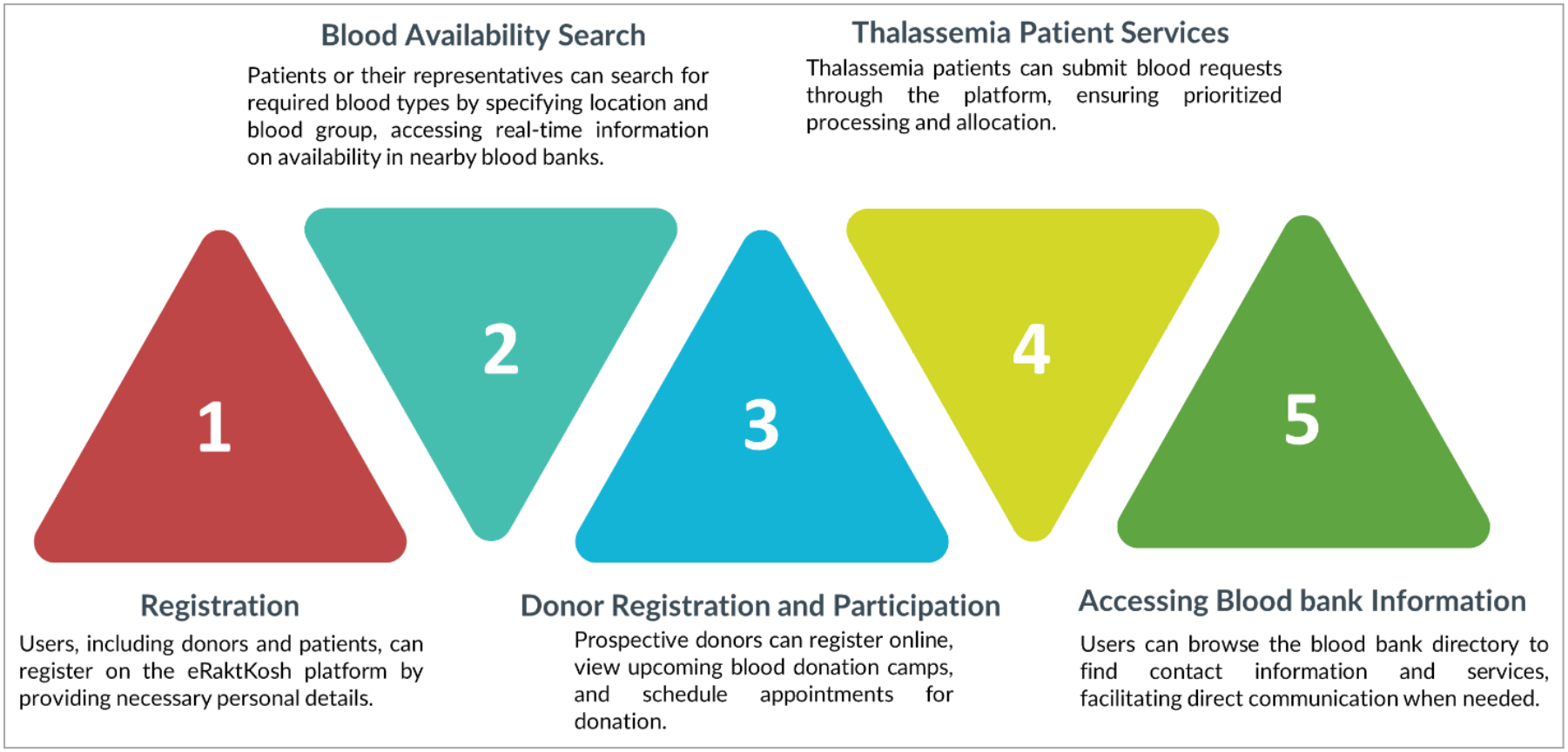

Figure 12: Workflow of e-Rakt Kosh

5.8.4. Assessment of e-Rakt Kosh for Youth-friendliness

Youth-driven Development

The involvement of youth in development of e-Rakt Kosh is similar to the other apps assessed in the previous sections.

Equitable

e-Rakt Kosh's interface is primarily in English, which may limit accessibility for non-English speakers in India. Given the country's linguistic diversity, the absence of regional language options can hinder effective utilization by a significant portion of the population. The lack of multilingual support may exclude individuals who are not proficient in English, reducing the system's overall accessibility and effectiveness.

The transition from traditional methods to a digital platform has posed challenges, particularly in areas with limited exposure to technology. The varying levels of digital literacy among staff can hinder the effective use of the system, affecting the overall efficiency of blood management. (Kulsum & Gopal, 2024) In some regions, especially rural or remote areas, the lack of infrastructure and connectivity issues can impede access to e-Rakt Kosh. This disparity can limit the platform's reach and effectiveness in ensuring equitable blood management services across the country.

Data confidentiality and Privacy

e-Rakt Kosh provides a privacy policy that outlines its data collection and usage practices. The policy states that the mobile app does not collect or share personal information such as names, passwords, or login details. It also mentions that location services are used to find nearby blood banks, with users having the option to disable this feature. However, the policy lacks detailed explanations about data storage, security measures, and the handling of any personal information collected through the website. (National Health Mission, n.d.) While the privacy policy provides some information, the lack of comprehensive details may leave users uncertain about how their data is managed, potentially affecting their trust in the platform.

The privacy policy indicates that users are informed about the collection of their location data and can choose to disable location services. However, there is limited information on how informed consent is obtained for other data collection practices, especially for users accessing the platform via the website. Without clear mechanisms for obtaining informed consent for all types of data collected, users may be unaware of the extent of data processing, which could lead to concerns about privacy.

e-Rakt Kosh allows users to disable location services within the mobile app, providing some level of control over personal data sharing. However, there are no additional customizable privacy settings that enable users to manage other aspects of their data, such as consent for data sharing or visibility. The limited availability of customizable privacy settings restricts users' ability to control their personal information fully, which is a key aspect of data privacy and user empowerment.

Accessibility

e-Rakt Kosh's interface is primarily available in English, which poses a challenge for non-English speakers in India. Given the country's linguistic diversity, the lack of regional language options may hinder a large portion of the population from effectively using the platform. This limitation can reduce inclusivity and prevent widespread adoption of the system. The absence of multilingual support risks excluding individuals who are not proficient in English, thereby lowering the overall accessibility and effectiveness of the platform in reaching diverse communities.

As a web-based application, e-Rakt Kosh requires Internet access for key functionalities such as searching for blood availability, locating nearby blood banks, and registering for blood donation camps. However, in rural and remote regions, where Internet connectivity is often unreliable or unavailable, accessing the platform can be difficult. Poor Internet infrastructure in many parts of India may create significant barriers for users, limiting equitable access to blood donation and transfusion information.

Using e-Rakt Kosh requires access to digital devices like smartphones, tablets, or computers. However, economic disparities across different regions can restrict access to these devices for economically disadvantaged populations, impacting their ability to engage with the platform. Individuals who lack access to appropriate digital equipment are excluded from the benefits of e-Rakt Kosh, undermining the platform's objective of providing equitable blood management services.

The shift from traditional blood bank management methods to a digital system like e-Rakt Kosh has created challenges, particularly in areas where exposure to technology is limited. Varying levels of digital literacy among users and staff can slow down the adoption of the platform and reduce its efficiency. Limited familiarity with digital platforms and resistance to adopting new technologies can prevent effective use of e-Rakt Kosh, especially in regions where digital solutions are not yet fully accepted as part of everyday life.

Availability

Utilizing e-Rakt Kosh necessitates access to digital devices such as smartphones, tablets, or computers. Despite the growth in smartphone owners, economic disparities can limit the availability of such devices among certain populations, affecting their ability to engage with the platform. Individuals without access to appropriate digital equipment are effectively excluded from the benefits offered by e-Rakt Kosh, undermining the platform's widespread availability.

e-Rakt Kosh is a web-based application that requires Internet access for functionalities such as searching for blood availability, locating blood banks, and registering for blood donation camps. As of January 2024, India's Internet penetration rate stood at 52.4 per cent, indicating that nearly half of the population lacked Internet access. Users in areas with limited or unreliable Internet connectivity, particularly in rural or remote regions, may face challenges in accessing e-Rakt Kosh's services, potentially hindering equitable access to blood donation and transfusion information.

Affordability

Accessing e-Rakt Kosh requires Internet-enabled devices such as smartphones, tablets, or computers. While India has witnessed significant growth in smartphone adoption, economic

disparities persist. These disparities can limit device ownership among underserved populations, affecting their ability to utilize digital health solutions like e-Rakt Kosh. Individuals from lower-income groups may find it challenging to afford the necessary devices to access e-Rakt Kosh, potentially excluding them from its benefits and undermining the platform's goal of widespread accessibility. Despite having some of the most affordable mobile data rates globally, even minimal data costs can be a barrier to accessing online services, including e-Rakt Kosh, for individuals with limited disposable income.

6. YOUTH VIEWPOINTS ABOUT DIGITAL HEALTH INTERVENTIONS

Five young persons in the age bracket of 18 to 30 years were interviewed to understand their perception and understanding of digital health services provided by the Government of India. Since the respondents weren't broadly aware of most of the digital health platforms, the interview was focussed on the overall perception and understanding of digital health services, instead of insights on each of the services discussed in the previous sections.

6.1. Respondent Profiles

A total of five young persons were interviewed. Two respondents belonged to the urban slums of Delhi, were male and female and were aged 18 and 19 respectively. They belonged to economically weaker sections of the society and were Below Poverty Line (BPL). They had both completed 12th grade and were waiting to enrol in college. Two other respondents were 20 and 21 years of age, male and female, and studying in the first and second year of college in law school respectively. They belonged to Tier 2 cities and were studying in reputed private law colleges in Tier 1 cities. The fifth respondent was a 26-year-old male resident of an urban part of Delhi, working in a local NGO focussing on children's education in Delhi slums and their employment post completion of their studies. He had completed his BA in Hindi.

6.2. Phone and Internet Usage Patterns

All five respondents owned a smartphone and had access to the Internet. They had access to high-speed Internet and had an average usage of above 6GB Internet data per month. All of them found their Internet usage to be affordable. In general, their usage of phones and the Internet was for social media, for gathering new information and for entertainment.

6.3. Awareness, Knowledge and Use of Government Provided Digital Health Solutions

All the respondents were probed about all the digital health solutions provided by the Government of India (listed in the previous sections). None of the respondents were aware of most of the solutions. Only three of the five respondents were aware of Aarogya Setu, one of them was aware about eSanjeevani. All the respondents were aware of CoWIN. None of the respondents were aware of the other solutions. All the respondents that were aware about some of the solutions, were aware about the basic function of that solution.

Out of the three respondents who were aware of Aarogya Setu, only one had used it. The other two had heard of the platform from their family and friends. One respondent who was aware of eSanjeevani had used the platform during the pandemic and got to know about it from a local

NGO. All the respondents had used CoWIN and heard of it from their friends and family, doctor and the media.

6.4. Perception of Digital Health Solutions

View on digital health solutions and its use: Participants mostly perceived digital health as being akin to online or teleconsultation services. Some of the respondents also referred to online repositories for information regarding healthcare providers as a digital health solution. In addition, online consultation booking services and ecommerce platforms for medicines resonated as digital health solutions to the respondents.

Equitable Digital Health Solutions: Participants found the current digital health solutions to be equitable and conducive for all genders, religions and caste. However, they anticipated some challenges in rural areas versus urban areas due to lack of high-speed Internet services and low digital literacy. They also anticipated some issues for older age groups as compared to younger age groups. Although, they were of the opinion that younger generations could help out older generations to avail of digital health services. The respondents believed that increasing digital literacy and design solutions, which have simpler user interfaces, would encourage higher uptake of the digital health solutions.

Confidentiality and Privacy: All the respondents had reservations about using the digital health platforms as they weren't confident about the safety of their data security and privacy. Historical issues relating to data leaks on government platforms like Aadhar and CoWIN in the past, were some of the examples they cited for their lack of trust in the digital health systems. Further, they were concerned about being spammed with marketing calls from private providers.

Accessibility, Availability and Affordability: All respondents felt that digital health solutions would be largely accessible as most people had smartphones these days. Although they were concerned about language barriers and digital literacy issues which could hinder access to digital health.

All respondents found that digital health services provided by the government would largely be affordable as the services were mostly free and the cost of data was primarily affordable for most people. They did not expect affordability to be a hindrance in accessing health services for young persons.

With respect to availability of services, all respondents expressed concern regarding Internet issues in some areas, especially rural areas. They felt that this could act as a hindrance for ensuring availability of digital health services in all parts of the country.

Appropriate and Comprehensive Services: Most of the respondents felt that it wasn't possible for digital health solutions to provide comprehensive services as some services required the individual to be physically present.

However, the female respondents expressed that digital health solutions did allow them some level of autonomy and privacy when interacting with health services related to sexual and reproductive health and rights (SRHR) or mental health. Although, they also agreed that offline

and physical components of healthcare provision were important to them and would usually be their preference.

Community Support and Involvement: All the respondents emphasized the circumstances within which their parents or guardians would or would not support the use of digital health. Offline/in person health services were primarily preferred by all the parents and they would urge their children to adopt the same. However, in case of unavailability or any kind of logistical constraints, parents viewed online consultations as an alternative. Although, it was observed that this preference could also be due to the limited understanding of digital health that existed within the respondents and their families.

6.5. Youth-driven Development of Digital Health

According to the respondents, their health priorities mostly revolved around having authentic information regarding their nutrition and fitness, having awareness about basic health conditions and access to genuine healthcare providers.

On being probed as to whether the current solutions catered to their needs, the respondents felt that it partially met their needs. Their concern was largely around misinformation circulating online regarding issues related to health. In addition, they were also sceptical of finding genuine healthcare providers online. Further, they were concerned about their data security while availing of health services online.

When asked how they would improve the digital health services, they mentioned ensuring the authenticity of health information and genuine healthcare providers, strong data security and privacy and a connected loop of offline services complemented by online health services.

7. CONCLUSION

The study highlights the remarkable progress in India's digital health ecosystem, emphasizing the development of a range of solutions aimed at improving healthcare accessibility, equity, and efficiency. Initiatives like eSanjeevani, Tele-MANAS, Aarogya Setu, CoWIN, ABHA, ORS, and e-Rakt Kosh have demonstrated the government's commitment to leveraging technology for enhanced healthcare delivery across diverse populations. However, the assessment against a youth-friendliness framework reveals notable gaps in areas such as youth-driven development, equitable access, data privacy, and overall usability.

Key insights from the study underscore the critical role of digital literacy, infrastructure, and privacy concerns in shaping the adoption and effectiveness of these solutions. While the platforms are designed to be equitable and inclusive, challenges related to the digital divide, affordability of devices, Internet availability in rural areas, and language barriers persist. Furthermore, the lack of structured youth involvement in the design, implementation, and monitoring of digital health solutions highlights an area for improvement. Engaging youth in co-creating digital health systems could enhance their relevance and foster greater adoption among young populations.

Feedback from youth respondents provided valuable perspectives on their expectations and concerns regarding digital health services. While they acknowledged the potential of these platforms to improve healthcare access and provide greater autonomy in certain aspects of care, concerns about data security, misinformation, and trust in digital healthcare providers were evident. Youth participants also emphasized the need for an integrated approach, combining digital health with offline services, to ensure comprehensive healthcare delivery.

Going forward, the successful realization of a youth-friendly digital health ecosystem in India will require collaborative efforts across government, the private sector, and civil society to address key barriers. This includes enhancing digital literacy, strengthening data privacy frameworks, expanding regional language support, and ensuring inclusive infrastructure development. With targeted improvements and increased youth engagement, digital health solutions can become more effective, trustworthy and widely adopted; ultimately contributing to better health outcomes for India's youth and broader population.

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About DTH-Lab

DTH-Lab is a global consortium of partners working to drive implementation of The Lancet and Financial Times Commission on Governing Health Futures 2030's recommendations for value-based digital transformations for health co-created with young people. DTH-Lab operates through a distributive governance model, led by three core partners: Ashoka University (India), DTH-Lab (hosted by the University of Geneva, Switzerland) and PharmAccess (Nigeria).

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GOVERNING HEALTH FUTURES 2030

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