# Leveraging Digital Solutions for Universal Health Coverage

## Study of a Digital Health Initiative in Kolar, Karnataka



**Sankala Foundation**

August 2024

> **"** Let us facilitate equitable availability of technology. This initiative will allow countries in the Global South to close the gap in healthcare delivery. It will take us one step closer to our goal of achieving universal health coverage (UHC).

**Shri Narendra Modi**

**Hon'ble Prime Minister of India**
**(G20 Health Ministers' Meeting in Gandhinagar, 18th August, 2023)**

# Leveraging Digital Solutions for Universal Health Coverage

Study of a Digital Health Initiative in Kolar, Karnataka

sankala

## Sankala Foundation
Voice for a sustainable planet

**Front cover:** Image of a video consultation at a DiNC-enabled health facility in Kolar, Karnataka

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*Note: This report is an effort of Sankala Foundation to record an innovative and promising digital health initiative that has the potential to transform the landscape of healthcare in the country.*

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# Acknowledgements

## About Sankala Foundation

Sankala Foundation is a non-profit organisation dedicated to advancing research, training, and advocacy in the field of climate and sustainability. Sankala Centre for Climate and Sustainability, established by the Foundation, is working on climate resilience, water and sanitation, energy, public health, and education to improve the lives of marginalised communities. The Centre collaborates with government bodies, NGOs, and experts to develop innovative, evidence-based solutions that address climate change, resource management, and poverty eradication.

## About this report

Transforming public health care is one of the core priorities of the Foundation. Post the COVID-19 pandemic, the need for a more resilient health care system has become abundantly clear. The health sector faces several challenges, such as affordability and accessibility concerns, poor infrastructure, shortage of skilled health personnel, and low coverage of insurance. Sankala Foundation seeks to identify sustainable, practical, and replicable solutions that can address key gaps in the country's health system and improve the overall well-being of people.

In this direction, Sankala Foundation set out to study a potentially beneficial digital health initiative in Karnataka, the contributions of which are still mostly unknown. The study was carried out over a period of three months, starting November 2023. This report serves as a documentation of a digital initiative in practice, intending to inspire further research and collaboration in the field of digital health.

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**8 August, 2024**

## Message

India has made impressive strides in the last decade in improving outcomes of reproductive, maternal and child healthcare. There has been a substantial increase in infrastructure and human resource skilling while a renewed focus on combatting communicable diseases has gathered momentum.

India's target of achieving Universal Health Coverage by 2030 needs special attention. Providing accessible, affordable and quality medical services to the largest population in the world is indeed an enormous task. However, our COVID-19 experience has demonstrated how digital technologies can revolutionise public health systems, making them more responsive and equitable. Virtual consultations, telemedicine and AI driven services have shown to improve the health delivery across regions.

In India, a variety of digital health models have energised primary health centres (PHCs), offering basic health services to the community even in largely remote areas. One such initiative is the Digital Nerve Centre (DiNC) model, operating in Kolar district (Karnataka) since 2017. This model offers quick access to primary care through PHCs, sub-district and district hospitals using a combination of physical and digital elements like telemedicine, electronic records and patient care-coordinators. The impact of such an initiative needs to be documented for future replicability.

I congratulate Sankala Foundation for undertaking the study of the DiNC model and highlighting the usefulness of digital technologies in successfully addressing gaps in primary healthcare. This study serves as an opportunity to discuss the transformative potential of digital health innovations. I am hopeful that this study will go a long way in promoting the use of digital technologies for achieving equitable and affordable healthcare.

**( Vinod Paul)**

स्वच्छ भारत
एक कदम स्वच्छता की ओर

भरत लाल
महासचिव
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Secretary General

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# Foreword

The right to health is integral to the realisation of all human rights. In addition to access to food, housing, clean water, work, and information, the right to primary healthcare is essential to lead a productive life. In the world's most populous and diverse country, providing basic healthcare is quite challenging. Nonetheless, the Government of India has accorded high priority towards improving access to affordable quality healthcare for its citizens through various schemes, like the National Health Mission (NHM), Mission Indradhanush, Pradhan Mantri Jan Arogya Yojana (PMJAY), Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP), eSanjeevani (teleconsultation) programme, etc.

In rural India, Primary Health Centres (PHCs) have been the first port of call for most citizens. While some states have achieved significantly better health outcomes, others continue to lag in basic health indices. Access to these services has been fragmented and inadequate, and challenges such as access, affordability and quality continue to impact citizens' healthcare experiences.

The Ayushman Bharat Digital Mission underscores the Government's commitment towards improving accessibility and encouraging preventive and promotive practices. The COVID-19 experience demonstrated how use of digital technology can offer promising solutions to bridge gaps in healthcare.

The National Human Rights Commission (NHRC), India, believes that continued investments, reforms and use of technology in healthcare sector can ensure better access to quality and affordable healthcare services. In recent years, the Commission has advocated for access to mental healthcare services for all. During the peak of the COVID-19 pandemic, the Commission issued comprehensive advisories to ensure adherence to human rights and enhance access to care for both patients and the public.

Given their potential, there has been a need to examine the impact and replicability of some of the technology-driven healthcare service delivery models. I am happy that the Sankala Foundation has undertaken this task. Their study, 'Leveraging Digital Solutions for Universal Health Coverage: Study of a Digital Health Initiative in Kolar, Karnataka', provides an insightful account of an innovative and promising digital healthcare service delivery model in practice since 2017. The Digital Nerve Centre (DiNC) initiative, owing to its collaboration with the Department of Health and Family Welfare, Government of Karnataka, has been able to augment several national and state health schemes. Such initiatives by private entities not only strengthen the healthcare system but also set a precedent for other technology and healthcare innovators.

I congratulate the Sankala Foundation and its team of researchers for undertaking this meaningful study. This study comes at an opportune time, when the country is aiming to achieve Universal Health Coverage (UHC) for every citizen. Documentation of such digital solutions for healthcare can be guideposts to the entire Global South striving to achieve the SDGs by 2030 and be equally relevant to the developed world desiring cost-effective and efficient healthcare services.

**[ Bharat Lal ]**

New Delhi
August 23, 2024

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| | | | | |
|---|---|---|---|---|
| **ABDM** | Ayushman Bharat Digital Mission | | **MIS** | Management Information System |
| **ABHA** | Ayushman Bharat Health Account | | **MoHFW** | Ministry of Health and Family Welfare |
| **AIIMS** | All India Institute of Medical Sciences | | **MRI** | Magnetic Resonance Imaging |
| **AI** | Artificial Intelligence | | **NPHCE** | National Programme for Health Care of the Elderly |
| **ANC** | Antenatal Care | | **NCD** | Non-Communicable Diseases |
| **ANM** | Auxiliary Nurse and Midwife | | **NHM** | National Health Mission |
| **ASHA** | Accredited Social Health Activist | | **NHS** | National Health Service |
| **AWS** | Amazon Web Services | | **OOPE** | Out-of-Pocket Expenditure |
| **BPL** | Below Poverty Line | | **OPD** | Outpatient Department |
| **CDR** | Concentric Data Repository | | **PCC** | Patient Care Coordinator |
| **CPHC** | Comprehensive Primary Health Care | | **PCM** | Patient Care Manager |
| **CHC** | Community Health Centre | | **PHC** | Primary Health Centre |
| **CHO** | Community Health Officer | | **PHR** | Personal Health Record |
| **DH** | District Hospital | | **RBSK** | Rashtriya Bal Swasthya Karyakram |
| **DiNC** | Digital Nerve Centre | | **RCH** | Reproductive and Child Health |
| **DoHFW** | Department of Health and Family Welfare | | **SDG** | Sustainable Development Goals |
| **GoK** | Government of Karnataka | | **SHC-HWC** | Sub Health Centre- Health and Wellness Centre |
| **EHR** | Electronic Health Records | | **SOP** | Standard Operating Procedures |
| **HMIS** | Health Management Information System | | **Tata MD** | Tata Medical and Diagnostics |
| **HFR** | Health Facility Registry | | **TB** | Tuberculosis |
| **HPR** | Healthcare Professionals Registry | | **TCS** | Tata Consultancy Services |
| **IDI** | In-depth Interview | | **TH** | Taluk Hospital |
| **IDSP** | Integrated Disease Surveillance Programme | | **UHC** | Universal Health Coverage |
| **IFA** | Iron-Folic Acid | | **UHI** | Unified Health Interface |
| **KCD** | Known Citizen Drive | | **UHID** | Unique Health ID |
| **MAST** | Model for Assessment of Telemedicine | | **V-POD** | Virtual Pod |
| **MCH** | Maternal and Child Health | | **WHO** | World Health Organization |
| **MEL** | Monitoring, Evaluation, and Learning | | | |

# Executive Summary

India's quest for Universal Health Coverage (UHC) for its over 1.4 billion citizens is marked by several achievements and a few challenges. The country's complex network of modern and traditional healthcare institutions has achieved significant milestones since independence, leading to improvements in life expectancy and overall quality of life. This accomplishment has been possible due to continued efforts to prevent infectious diseases, investments in advanced technology and infrastructure, and adaptable strategies to tackle emerging health concerns like the effects of climate change and lifestyle diseases.

India's extensive primary health care system is central to its commitment to global Sustainable Development Goals (SDGs) and UHC. Primarily, UHC includes health promotion, prevention, treatment, rehabilitation, and palliative care for all. However, accessibility and affordability to quality essential healthcare services have continued to remain a challenge for many. This is compounded by issues such as the shortage of skilled health professionals, poor infrastructural capacities, low coverage of health insurance, and concerns about patient safety and security. In recent decades, out-of-pocket health spending has put immense pressure on the already burdened patient community.

The government is increasingly collaborating with varied stakeholders to identify newer and innovative methods and technologies that can bridge the existing gaps in health care and foster equitable access to treatment. In this context, digital health is a rapidly evolving landscape. With the proliferation of smartphones and the ubiquity of the internet, it has the potential to revolutionise health care in India by enhancing access, delivery, and quality of healthcare services, thus improving patient outcomes.

In 2015, the Ministry of Health and Family Welfare (MoHFW) solicited Tata Consultancy Services (TCS) to develop a digital solution, aiming to address patient overload and improve care coordination, quality, and delivery for the AIIMS Outpatient Department (AIIMS-OPD) in Delhi. The outcome was the Bridgital model, blending physical and digital elements to address overcrowding and streamline processes at AIIMS-OPD. As a result, the average waiting time after getting an appointment fell from six hours to two. Four in five patients arrived with appointments, up from one in five.

Inspired by the success of the Bridgital model in AIIMS-OPD, the Government of Karnataka (GoK), in 2017, invited TCS to consider developing a digital tool to enhance patient experience and care for citizens of Kolar, in rural Karnataka. Such a programme was needed to streamline processes in public health facilities, reduce patient overload in secondary and tertiary hospitals, and increase the utilisation of primary health centres (PHCs). A unique health care delivery model was devised and implemented in Kolar district, namely, the Digital Nerve Centre (DiNC),

currently managed by the Tata Medical and Diagnostics (Tata MD) in collaboration with the Department of Health and Family Welfare (DoHFW- GoK).

The DiNC in Kolar enables quick access to primary health care and provides a well-coordinated continuum of care for citizens visiting government health facilities. A toll-free number enables citizens to connect with the DiNC personnel and patient care coordinators (PCCs) at health facilities help service users have a seamless and uninterrupted care experience. The initiative leverages existing public healthcare infrastructure, with the key objectives of increasing the utilisation of public health facilities, digitising patient health data, reducing out-of-pocket expenditure (OOPE), and promoting the acceptability and adoption of various national health programmes. It combines patient navigation, care coordination, telehealth, and health promotion functions. It comprises three crucial elements—healthcare centres (including those in rural and remote areas), a nerve centre, and a virtual network of care providers—underpinned by technology, people, and processes.

Given its promising nature, Sankala Foundation undertook this study to understand DiNC's usefulness for healthcare users and providers, changes in service utilisation, its integration with other digital interventions, and learning about its operational efficiency and financial implications. The study revealed numerous advantages of the DiNC initiative while shedding light on operational challenges and identifying areas for improvement.

## DiNC Strengthens the Healthcare Delivery Process

The DiNC's innovative use of digital technologies has encouraged greater utilisation of public health facilities by helping service providers more effectively manage hospital processes. The initiative has been able to streamline administrative processes through the use of the digital application, called HealthX. The Concentric Data Repository (CDR), a centralised platform, complements HealthX by consolidating data from multiple healthcare units and providing a comprehensive view of patient's medical records for robust clinical assessments. This digitisation has contributed to increasing the overall efficiency of the healthcare system in Kolar.

The provision of connecting with the nerve centre using a toll-free number has shown several advantages. Patients who would previously hesitate to visit public health facilities due to long queues and complex procedures can now seek informational support, book appointments, and have other queries addressed through a quick call to the nerve centre. Subsequently, a comprehensive population enumeration drive, led by Accredited Social Health Activists (ASHA) workers, has enabled better healthcare planning and resource allocation.

This initiative ensures proactive engagement, follow-up, and a continuum of care for service users. The doctors can meet more patients in a day. Virtual pod (V-POD) rooms built in each health facility enable uninterrupted service delivery, sometimes even in the absence of doctors. The increasing use of DiNC's video consultation at PHCs showcases its potential to deliver care in remote areas. These efforts are supplemented by nurses at the Nerve Centre (known as digi-nurses) who provide virtual counselling emphasising accurate nutrition and healthy lifestyle practices.

The DiNC initiative has also promoted various national health schemes, increasing their adoption and acceptability among citizens. The DiNC has

demonstrated the ability to reduce out-of-pocket expenditure for patients by reducing the need for private healthcare services and has displayed economic efficiency with the relatively low marginal cost of adding additional PHCs to the network. Cumulatively, these unique and innovative features of the DiNC have reduced waiting hours, improved appointment booking, and increased service utilisation and community engagement while restoring faith in the public health system.

## Recommendations to Enhance the Programme's Effectiveness

The DiNC has illustrated several advantageous features that enhance the primary care system of Kolar. However, some improvements can enhance the programme's effectiveness Expanding the physical and digital infrastructure to Sub Health Centres-Health and Wellness Centres (SHC-HWCs) can significantly enhance primary health care delivery by enabling end-to-end coordination. Incorporating an emergency care response module into its service package can also contribute to building resilience and sustainability of health systems.

Enhanced compliance with Ayushman Bharat Digital Mission (ABDM) standards can be achieved by addressing specific data capture and software improvements, as well as by strengthening mechanisms for the safety and confidentiality of patient information. Software modifications that provide improved data analytics and generate standard health indicators can further improve the system. Additionally, encouraging all healthcare providers, including medical officers, to update health records and view patient health history during consultations can be transformative. Change management workshops can focus on integrating them into the digital framework.

Finally, establishing a dedicated monitoring, evaluation and learning (MEL) team can provide continuous insights and adaptations needed to enhance the system and offer valuable information for replication and scale-up.

# Introduction

Good health lies at the fulcrum of a well-functioning society as healthy individuals are more productive and innovative, leading to the economic prosperity of a nation. Healthy individuals have better emotional and mental health, allowing citizens to engage in community activities, and build familial and social bonds, thereby creating a harmonious and supportive society. Thus, health is considered a fundamental human right of all citizens and refers to 'complete physical, mental, and social well-being and not merely the absence of disease or infirmity' (as defined by the World Health Organization [WHO]). In this direction, Sustainable Development Goal 3 (SDG 3) aims to 'ensure healthy lives and promote well-being for all at all ages.'

The primary focus of SDG 3 has been to improve reproductive and child health, reduce the incidence of, and effectively tackle communicable and non-communicable diseases, and improve access to affordable medicines and vaccines, amongst other related goals (UNICEF Data, 2023).

Globally, however, progress on SDGs has slowed, with little headway in reducing child mortality and almost no improvement in terms of maternal mortality, since 2015 (WHO, 2023). There has been some noteworthy progress in lowering the prevalence of tobacco use and HIV (WHO, 2024). Still, the low and middle-income countries continue to battle some foundational challenges. For example, these countries face a double burden of diseases,

communicable as well as non-communicable diseases (NCDs). Shortages in funds, under-resourced community health workers, poorly trained health professionals and high out-of-pocket expenditures on health have been the barriers to effectively addressing the health system's needs (Langlois et al., 2020).

The COVID-19 pandemic was a wake-up call since it directly affected health systems across the globe and revealed many of their flaws. The overburdened health systems collapsed across countries revealing shortages of resources and poor infrastructure with a sudden surge in demand for care. Disruptions in supply chains hindered the supply of medical products, leading to shortages of essential drugs and diagnostics in many parts of the world. Further, as individuals avoided visiting health facilities even for follow-ups or acute-care needs out of the fear and anxiety of possibly contracting the virus, facility utilisations ware disrupted. The optimal utilisation of health services was limited during this period because of nationwide lockdowns, disrupted transportation systems, diversion of healthcare personnel towards COVID-19 units, and reduced incomes (Haileamlak, 2021).

Low- and middle- income nations fared worse than developed nations due to factors like poor sanitation, lack of clean water, and substandard health systems which led to higher chances of viral transmission.

## Harnessing Technology to Combat COVID-19

The use of digital tools emerged as a solution during the pandemic to reach individuals remotely. Citizens embraced digital alternatives to seek necessary care with overburdened health systems and disruptions in health services due to lockdowns across the globe Virtual consultations and telemedicine served as a primary source of healthcare information and service delivery. The pandemic significantly contributed to countries' increased acceptance of digital technologies. Over 87% of WHO member states now have a policy or strategy on digital health (Erku et al., 2023).

Teleconsultations proved beneficial for a variety of people, including the elderly and immobile, women in some regions, those living in isolated and marginalised locations like tribal communities, and those impacted by transportation disruptions. The ability of teleconsultations and virtual care delivery to limit hospital overcrowding and the spread of the virus emerged as a benefit during this time. Simultaneously, the use of innovative contact tracing methods, the digitisation of case records, and the real-time exchange of health data across nations improved national planning and infection control. Some notable examples of mobile applications used for contact tracing were TraceTogether (Singapore), Corona100 (South Korea) and Aarogya Setu (India).

## Global Scenario: Digital Health in Practice

It is important to remember that digital solutions are not a product of COVID-19 and have been around for a while. Digital health encompasses a broad spectrum of technologies and applications, ranging from electronic health records (EHRs) and telemedicine to wearable devices and artificial intelligence (AI). Many of these initiatives have revolutionised the public health systems in various parts of the globe by

making health care more accessible, affordable, and responsive. The Nordic countries, Canada, Britain, South Korea and Japan are some of the leading examples in this regard.

The Nordic countries (Denmark, Finland, Iceland, Norway, Sweden, and the Faroe Islands) have one of the highest adoption rates of EHRs. In Denmark, 90% of all clinical communication between primary and secondary health facilities has been undertaken digitally since 2010 (Kierkegaard, 2013). In addition to a comprehensive EHR system, Denmark also has e-prescription and e-ambulance programmes which are enabled through the electronic health ID. Ambulances benefit from this ID as they get a complete and comprehensive record of the patient's medical history and can take subsequent measures accordingly (IMF, 2023).

In Sweden, 99% of all medical records and prescriptions are digital in nature. This has helped track the incidence of diseases and predict future epidemics (International Trade Administration, n.d.). The public health surveillance system has also helped Sweden achieve very high immunisation rates as vaccination status is regularly updated and monitored digitally. Estonia, also situated in northern Europe, is another country that has shown tremendous progress in digitising its public health system. The country is the first to use blockchains in the healthcare sector, wherein all medical records are secured by blockchains for enhanced data safety (NHA, 2022).

In countries like Canada, the digital healthcare market covers a variety of tools, ranging from mobile health applications to wearables and AI tools, worth $16.8 billion (Insights10, 2022). In South Korea, all tertiary care facilities have already digitised in many aspects, storing patient data and clinical images digitally. The country has now shifted its focus towards medical AI tools with a more than 50% adoption rate of Electronic Medical

Records (EMRs) and widespread use of computerised physician order entry systems in hospitals and clinics. (Kim et al., 2017). Britain's public health care system has also achieved several milestones since the introduction of the National Health Service (NHS) app. Currently, in the sixth year of its operation, the NHS app now has 33 million registered users, who can view their health records online, manage hospital appointments, and nominate their preferred pharmacy (BBC News, 2024).

Within Asia, Japan has been one of the frontrunners, showing much technological prowess over the years, with innovative tools such as wearables that can monitor vital signs and sophisticated teleconsultation software (Hanaman, 2024). Digital solutions appear to promise some convenient options for remote monitoring and consultations to the ever-increasing elderly population of Japan.

## Health Care Progress in India

India's journey to addressing key public health issues has been rather unique. It became imperative for the nation to make a strong policy move addressing primary health care with close to 65% of the nation's population residing in rural areas, and only a quarter of the health facilities situated here. Thus followed the launch of the National Rural Health Mission (NRHM) in 2005 (later subsumed into the National Health Mission [NHM]) with the core component being health system strengthening to improve primary health care delivery.

At the foundation of India's primary health care ecosystem lies the three-tier system including sub-health centres – health and wellness centres (SHC-HWCs), primary health centres (PHCs) and community health centres (CHCs) which act as the first points of contact for rural and remote populations. The mission has focused immensely on reproductive, maternal, neonatal, child and adolescent health and communicable and non-communicable diseases.

The NHM has contributed significantly towards improving infrastructure, human resource availability, community engagement, programme management, and more. The impact of the mission can be seen by tracing improvements in key health indicators over the years. Maternal Mortality Rate (MMR), which stood at 254 (PIB, 2013) in 2004, now stands at 97 (PIB, 2022) per 100,000 live births, as of 2018-20. Simultaneously, the Infant Mortality Rate (IMR) stood at 30 (PIB, 2022) nationally in 2019, as compared to 58 per 1000 live births in the year 2005 (Kumar et al., 2013). The mission and various vertical programmes under it addressed the high burden of communicable diseases in the country, to a huge extent. India too is shifting its attention from curative to promotive and preventive healthcare practices with changing demographics and the increasing burden of NCDs (or lifestyle diseases).

To fulfil its SDG commitments and address emerging health issues, concerned stakeholders need to ensure that health facilities have the requisite resources and infrastructure to offer the range of services envisioned by the NHM. However, recent statistics indicate that some significant gaps remain. As per Rural Health Statistics (2021-22)[1], CHCs responsible for providing specialised care, on average, lack 80% of the recommended specialist staff. The report also indicated a significant shortfall of doctors at the PHC level in Odisha

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[1] The Rural Health Statistics (RHS), an annual exercise by the MOHFW, provides data on the infrastructure existing at various public health facilities across states and union territories (UTs).

(298) and Chhattisgarh (279) (Rural Health Statistics, 2021-22).

## India's E-health Transformation

Today, an increasing number of healthcare providers and patients are resorting to digital health practices to suffice their healthcare needs. The Ministry of Health and Family Welfare, which released the National Health Policy of 2017, instituted a committee that produced the National Digital Health Blueprint (NDHB) or the Ayushman Bharat Digital Mission (ABDM) acknowledging the imperative for a comprehensive overhaul. The blueprint laid out the building blocks and an action plan for India's digital health implementation. The core aim of ABDM is to create a seamless online platform to facilitate real-time exchange of information and interoperability with other health applications, whilst involving all health stakeholders. As of March 2024, close to 58.6 crore Indians had a Health ID (known as the Ayushman Bharat Health Account) as envisioned under ABDM (Sridhar B.G.N., 2024).

The pandemic accelerated India's transition to digital health care more than ever. India launched eSanjeevani, a revolutionary telemedicine service, in 2019, right at the onset of the pandemic. Through this initiative, patients from remote and rural locations could visit the closest SHC-HWC and electronically consult with a doctor or specialist, typically located in a hospital, medical college, or tertiary care facility. An e-prescription

generated at the end of the consultation allowed beneficiaries to avail necessary medicines. By February 2023, eSanjeevani had provided services to more than 10 crore people. Of the total beneficiaries, 57% were women and 12% were senior citizens. This shows the innovation's ability to reach not just rural and remote areas, but also the most vulnerable groups of the society (PIB, 2023).

Another example of success in this regard is the CoWIN application. Between April and November 2021, the country administered nearly 37.5 lakh doses on average, daily. By 2022, India managed to fully vaccinate (received two doses) more than 64% of its population, and more than 96 crore individuals had received at least one dose (UNDP, 2022).

The various milestones reached in public health utilising digital health tools reflect its potential to enhance health care delivery. The Indian government is increasingly collaborating with private entities to identify newer and innovative methods and technologies that can bridge the existing gaps in health care and foster equitable access to treatment. One such initiative is the Digital Nerve Centre (DiNC), operational in Kolar, Karnataka, managed collaboratively by Tata Medical and Diagnostics (Tata MD) and the Department of Health and Family Welfare, Government of Karnataka (DoHFW-GoK). Given the limited knowledge of the programme's benefits, Sankala Foundation set out to study and document its features, the findings of which are presented in this report.

DiNC-enabled Doddashivara PHC, Malur Taluk, Kolar

# Chapter 1

# Study Framework

The Digital Nerve Centre (DiNC) is a digital health initiative piloted in the Kolar district of Karnataka since 2017. The DiNC is a collaborative effort of the Department of Health and Family Welfare, Government of Karnataka (DoHFW-GoK) and the Tata Medical and Diagnostics (Tata MD), earlier under the umbrella of Tata Consultancy Services (TCS). The objective of this initiative is to improve access to healthcare for the citizens of Kolar by improving care coordination for health care delivery.

The DiNC platform is the first port of call for patients, enabling care coordination by facilitating forward and backward communication between patients, hospitals, and doctors irrespective of their geographical location. The Nerve Centre (DiNC hub located at the Kolar District health officer's premises) staff help plan and manage patient journeys throughout the treatment cycle. Patient Care Coordinators (PCCs) stationed at health facilities guide the patients to the doctor, help them understand prescriptions, encourage them for follow-up visits, and provide any additional support as needed. The DiNC personnel (situated at the nerve centre as well as health facilities) feed in-patient data into an online platform called HealthX. This creates a comprehensive digital repository of the patient's health history which can be referred to in the future to make well-informed clinical decisions.

The initiative by Tata MD connects three crucial elements—rural or remote health care centres, a nerve centre, and a virtual network of care providers—underpinned by technology, people, and processes. It enables the delivery of virtual care with consistent and continuous communication using clinical intelligence. Thus, patients from remote villages can access top-quality medical consultations without travelling long distances. To summarise, it combines the benefits of teleconsultation and a medical helpline for care coordination into one innovation.

Limited evidence existed concerning the impact of this initiative on access, the care experience of service users, and its utility for health systems. There was also insufficient understanding of its clinical efficacy, the real-time availability of services, responsiveness, patient safety (particularly regarding data security), and service user satisfaction with care. For planning a scale-up of such an initiative, it is crucial to understand its usefulness for healthcare providers, its integration with other digital models, and learn about its operational efficiency and financial implications. Given this context, Sankala Foundation initiated a study of the DiNC in the Kolar district of Karnataka, between November 2023 and January 2024.

## Objectives

The study focused on understanding the Bridgital model of DiNC, reviewing its functionality, utility, and

impact in terms of the value it adds to both service users and health systems.

***The specific objectives of the study were:***

a)  Understanding the features of the DiNC along with its digital application, technology infrastructure, and implementation mechanism;

b)  Assessing digital integration, interoperability, data privacy, and confidentiality including patient safety features of DiNC;

c)  Ascertaining the additional capital and recurrent costs associated with the DiNC;

d)  Documenting healthcare services and continuum of care practices being addressed by the DiNC along with its role in health prevention and promotion;

e)  Reviewing the initiative's effects on the use of healthcare services, continuum of care, treatment adherence/completion particularly for maternal and child health, Rashtriya Bal Swasthya Karyakram (RBSK), mental health, geriatric care, and tuberculosis; and

f)  Exploring the perspectives of service users, service providers, and health systems administrators working in the Kolar area and identifying potential model adaptations to enhance the care experience.

## Evaluation Framework and Study Design

Based on the scope and timelines, the research team used a descriptive study design to conduct a multifaceted study of the DiNC, with a focus on the following key domains:

a)  Characteristics of the application

b)  Economic aspects of the initiative

c)  Data safety measure

d)  Key activities and processes of DiNC

e)  Health services covered

f)  Service use and benefits perceived by the patients

g)  Service provider and health administrators' perspectives

These domains were adapted based on the WHO's Model for Assessment of Telemedicine (MAST) which provides a standard comprehensive framework for telemedicine evaluation (Pan American Health Organization, 2016)

## Methodology

***We adopted mixed methods for the study.***

a)  Objectives a), b), and c) were analysed through a review of project reports, process documentation, presentations available on DiNC, direct observations of the DiNC pathway and processes, and interactions with DiNC facility managers, coordinators, and service providers.

b)  Objectives d) and e) were assessed through review and analysis of secondary data of patient service utilisation statistics obtained from the DiNC dashboard, and conducting in-depth interviews (IDIs) of both service users and providers.

c)  To meet objective f), we conducted IDIs with service users, service providers, and programme administrators to understand their experience with the DiNC.

A DiNC-enabled Primary Health Centre in Narasapura, Kolar

## Study Participants, Eligibility Criteria, and Sampling

To identify study participants, purposive and maximum variation in sampling was used. Study participants comprised various stakeholders integral to the DiNC's functioning and directly influenced by its services. This includes technology experts working at the DiNC, individuals working within the DiNC as service providers, officials belonging to the state health administration, and citizens availing healthcare services through the DiNC. Participants were chosen with assistance from the DiNC delivery manager and PCCs. Those receiving outpatient care in health facilities were invited for interviews, and only those who agreed and provided consent were interviewed. The range of stakeholders interviewed helped the research team gain perspectives about the DiNC and gather findings related to the various identified domains for the study.

The details of the participants interviewed across these stakeholder groups are included in Table 1.1. Altogether we interviewed 52 stakeholders. A thematic saturation was achieved with 19 interviewee patients, 13 DiNC core team members including technology experts, eight frontline workers, 12 programme officers, and health facility in-charges.

The framework to analyse the initiative helped harness the benefits of both quantitative and qualitative research methodologies. Analysis of quantitative data utilising descriptive statistics helped in getting first-hand information about the uptake of DiNC's services. Subsequently, qualitative interviews with stakeholders at different levels provided insights into the underlying contextual factors and participant experiences. Cumulatively, the approach helped obtain a holistic perspective on the initiative's uptake and benefits.

**Table 1. 1**

**List of study participants for in-depth interviews, eligibility criteria, and sampling**

| S. No | Type of participants | Eligibility Criteria | Sample |
|---|---|---|---|
| 1. | DiNC staff<br><br>• Product development team<br>• DiNC delivery managers in- charge of the DiNC centre<br>• Software team<br>• Medical experts involved in developing the clinical pathways and algorithms<br>• Patient Care Coordinators (PCCs) and Patient Care Managers (PCMs) | • Over 18 years of age<br>• More than one year of experience of engaging with DiNC<br>• Able to provide consent<br>• English/Kannada speaking<br>• PCCs from health facilities with higher utilisation to understand the management of care coordination with high caseloads | 13 |
| 2. | Frontline workers<br><br>• Community Health Officers (CHOs), Auxiliary Nursing Midwives (ANMs), and Accredited Social Health Activists (ASHAs) | • Over 18 years of age<br>• More than one year of experience of engaging with DiNC<br>• Able to provide consent<br>• English/Kannada speaking | 8 |
| 3. | District health administrators and health facility in-charges<br>• District Health Officer (DHO)<br>• District Programme Officer<br>• District Reproductive and Child Health (RCH), Non-Communicable Diseases (NCD), Tuberculosis (TB) Officers<br>• Health facility in-charges from PHCs, CHCs, Taluk Hospitals (TH), and District Hospital (DH) | • Over 18 years of age<br>• More than one year of experience of engaging with DiNC<br>• Able to provide consent<br>• English/Kannada speaking | 12 |

Table 1.1 continued

| S. No | Type of participants | Eligibility Criteria | Sample |
|---|---|---|---|
| 4. | Patients, service users and caregivers | • Over 18 years of age<br><br>• About six months of experience engaging with DiNC<br><br>• Mix of those who are registered as service users for Maternal and Child Health (MCH), Rashtriya Bal Swasthya Karyakram (RBSK), NCD, or TB service packages<br><br>• Able to provide consent<br><br>• English/Kannada speaking | 19 |
| | | Total Sample | 52 |

## Data Collection and Analysis

a) **Qualitative data:** The team conducted semi-structured interviews with the sample of key informants. A comprehensive interview guide was developed based on existing literature and discussions among the investigators (Refer to Appendix B). The interviews with the DiNC team focussed on several features of DiNC, its operational resources, transition and sustainability plans, and challenges faced in the implementation. The service providers and service user interviews covered their perspectives about the DiNC, its benefits, challenges experienced, and their ideas for potential adaptations. A team of researchers with expertise in IDIs and extensive knowledge of public health in rural India conducted stakeholder interviews. The interviews began with open-ended questions, and probes were used to elucidate emerging themes. Each interview lasted 30-40 minutes.

Interviewers took detailed notes and audio recordings in Kannada, which were thereafter transcribed verbatim to ensure utmost accuracy.

Interview responses for each respondent type were summarised into a priori codes from the interview guides and new themes emerging from the interviews. These summaries were consolidated using a rapid thematic analysis to identify benefits, challenges, strengths, and areas for improvement to strengthen our understanding of DiNC experiences from the perspectives of multiple stakeholders.

b) **Quantitative data:** Tata's innovative digital application, namely the HealthX, contains data gathered at various levels of the DiNC. The dataset includes outpatient citizen particulars such as the unique health ID (UHID), name, age, gender, contact details, health condition, past and future appointment details, inbound

and outbound call summaries, and more. Upon understanding the type of data captured by the platform, the research team prepared a data collection format in Microsoft Excel which was shared with the Tata MD team to retrieve data on service utilisation patterns, treatment adherence, continuum of care, and follow-ups ensured under the DiNC initiative, specifically for mother and child health (MCH), NCD, TB, mental health and geriatric/elderly care. Apart from data shared in the Excel format, the DiNC dashboard also served as a source of major secondary data.

Descriptive statistics was used as a fundamental tool to summarise and comprehend the gathered data. Bar graphs, pie charts, and other visual aids made using Microsoft Excel were employed to depict trends across the periods, offering a clear representation of how service utilisation has progressed over time, and also among different demographics.

## Limitations

A key limitation observed during the data collection process was that the majority of the data obtained encompassed only process-level indicators, such as the number of registrations, inbound and outbound calls, and in-person and virtual consultations. Most of the clinical data captured into the system was in unstructured formats making it a lengthy and difficult process to retrieve data on outcome indicators. To an extent, a few of these gaps were filled by using Tata MD's internal monitoring survey, which helped gain some valuable insights into maternal health outcomes in the district. Other services, which include NCD, TB, child health, RBSK, mental health, and geriatric care were not included in this survey and thus the study does not comment on the outcome indicators associated with them.

## Ethical Considerations

The study was approved by the ACE Independent Ethics Committee, Bangalore (Refer to Appendix A), registered under the Office of Drugs Controller General, India (DCGI). An informed consent form was prepared in both English and Kannada to provide participants with details about the study and each interview was conducted only after obtaining consent in verbal and/or written format. The research team adhered to strict confidentiality protocols. Any data collected with the participant's identity was only accessible to research team members.

## Structure of the Report

Besides **Chapter 1,** below mentioned is the structure and summary of content for each of the chapters.

**Chapter 2 – *DiNC Ecosystem: Infrastructure, Activities, and the Technology Stack:*** Details the DiNC's physical and digital infrastructure, key activities, processes, health stack, front end and back end functions, and insights from the strengths and challenges of these functions based on interviews, field interactions with the DiNC team, and direct observation of the care coordination processes both at DiNC Nerve Centre and the health facilities.

**Chapter 3 – *Cost Analysis:*** Discusses the costs involved in implementing the DiNC system, both aggregate capital and recurring expenses of the DiNC programme, across different health facilities and a component-wise detail of costing within each of the service areas.

**Chapter 4 – *Services Covered by DiNC and Utilisation Patterns:*** This explains the service packages offered by DiNC, the utilisation trends, and observed changes in select maternal health outcomes.

**Chapter 5 – *Perspectives from Service Users, Service Providers, and Programme Administrators:*** Brings together the perspectives and experiences of service users regarding the acceptability and perceived benefits of DiNC support and service provision. It also details insights from service providers and programme administrators, mainly covering how DiNC is helping them augment the key national health programmes of Reproductive and Child Health (RCH), Rashtriya Bal Swasthya Karyakram (RBSK), district mental health programme, NCD, and TB. It summarises their ideas about the challenges and programme adaptations that can be planned to improve DiNC services.

**Chapter 6 – *Impact of DiNC in Kolar:*** Provides a summarised view of the strengths and advantages demonstrated by the DiNC in Kolar.

**Chapter 7 – *Recommendations:*** Consolidates the insights garnered from this study and delves into the primary recommendations derived from the findings detailed in the preceding chapters of this report. Additionally, it elucidates the principal limitations of this study and outlines prospective future research that should be considered.

An ASHA worker shows how the HealthX app registers patients

# Chapter 2

# DiNC Ecosystem: Infrastructure, Activities, and the Technology Stack

## The Bridgital Model

The Digital Nerve Centre (DiNC) employs a unique approach called the Bridgital model and is currently being piloted in the Kolar district of Karnataka. The innovative use of a mix of digital and physical components to improve patient experience, decrease waiting time and overcrowding, and streamline processes at hospitals gave rise to the term 'Bridgital'. Rather than viewing technology as a threat to existing human-centric jobs, the Bridgital model views it as a tool for generating newer employment opportunities and bridging social inequalities using digital means.

The innovation spans three elements namely processes, technology, and workers. It redefines what is needed to deliver a service, in a manner that prioritises the challenges of those without access. It deconstructs and reimagines the roles and services, and redesigns the delivery of the tasks. It works on the concept of 'Task Shifting' and helps doctors treat more patients by reducing their administrative duties and reassigning those duties to a new cadre of digitally literate and technology-augmented workers. In this manner, it aims to offer a unique solution to India's twin challenges of jobs and access.

This chapter summarises DiNC's historical background, and the thinking behind its development and objectives; details its physical and digital infrastructure; reviews its operations in health facilities of Kolar districts; documents its key processes; and finally, assesses its health stack by comparing with national standards prescribed under the ABDM.

The sections in this chapter were crafted through a review of the standard protocol document and presentations provided by the DiNC team. We gained insights from DiNC staff to grasp the infrastructure and activities comprehensively. Subsequently, we conducted non-participant direct observations to understand the process flows and mechanisms for care coordination.

## The Historical Context of DiNC

The DiNC originated from a precursor initiative designed to streamline the Outpatient Department (OPD) operations in AIIMS, New Delhi. Despite serving a large population from Delhi NCR and beyond, AIIMS OPD faced challenges due to excessive workloads of all types of care exacerbated by deficient gatekeeping and poor-quality care offered by other government as well as private facilities. In 2015, the Ministry of Health and Family Welfare (MoHFW) solicited Tata Consultancy Services (TCS) to develop a digital solution, aiming to rectify system shortcomings and improve care coordination,

quality, and delivery for AIIMS-OPD.

The outcome was the Bridgital model, blending physical and digital elements to address overcrowding and streamline processes at AIIMS OPD. The model led to the creation of a new class of workers known as Patient Care Coordinators (PCCs), who facilitated more efficient doctor-patient coordination with the use of a dedicated digital platform. This initiative aided AIIMS OPD to streamline operations, introduce online patient bookings, and reduce administrative paperwork. As a result, the average waiting time after getting an appointment fell from six hours to two. Four in five patients arrived with prior appointments, up from one in five.

The TCS reimagined a similar programme upon getting a request from the National Cancer Grid for the nation's four major cancer hospitals, namely, Tata Memorial Hospital in Mumbai, Tata Medical Centre in Kolkata, Cancer Institute (WIA) in Chennai, and Regional Cancer Centre in Thiruvananthapuram, Kerala.

## The Inception of DiNC in Kolar

The Government of Karnataka (GoK), in 2017, invited TCS to explore the potential of a digital solution towards enhancing primary health care in rural Karnataka seeing its successful implementation in major tertiary care hospitals. Such a programme was needed to streamline processes in public health facilities, reduce patient overload in secondary and tertiary hospitals, and increase the utilisation of PHCs. The result was a pilot initiative in the Kolar district of Karnataka, namely, the DiNC, jointly managed by Tata Medical and Diagnostics and the Department of Health and Family Welfare, Government of Karnataka (DoHFW, GoK).

Kolar, located in the south of Karnataka, has an estimated population of 16 lakh individuals (District Census Handbook: Kolar, 2014). The district consists of 2092 villages spreading across six talukas (sub-districts), namely Bangarapet and Kolar Gold Fields, Kolar, Malur, Mulbagal, and Srinivaspur. Poor socio-economic status, under-equipped health systems, and connectivity have long been a problem in the district hampering citizen's healthcare experiences. Additionally, there is a concerning prevalence of stunted growth in 32% of children under the age of five, and a substantial proportion of women (23%) aged 15 to 49 are underweight (IIPS, 2021). Simultaneously, there has also been an increase in the burden of Non-Communicable Diseases (NCDs) or chronic diseases (Lall, 2019). Citizens would often bypass PHCs, due to the unavailability of doctors or long waiting times and seek care directly from higher health facilities or private clinics and hospitals.

The DiNC in Kolar aims to enable quick access to primary health care and provide a well-coordinated continuum of care for citizens. It does so by connecting three crucial elements—health care centres (including those in rural and remote areas), a nerve centre, and a virtual network of care providers—underpinned by technology, processes, and people. At present, 90 health facilities including 82 PHCs, two Community Health Centres (CHCs), five Taluk Hospitals (THs), and one District Hospital (DH) are covered by the DiNC.

## Aims and Objectives of DiNC

The DiNC leverages the existing public health care infrastructure, with the key objectives of:

a)   Increasing utilisation of public health facilities;

b)   Digitising patient health data;

c)   Reducing out-of-pocket expenditure; and

d)   Promoting the acceptability and adoption of various National Health Programmes and schemes.

## Physical Infrastructure at DiNC and Health Facilities

### The DiNC Setup

The Nerve Centre which is located within the premises of the District Health Officer's (DHO) office serves as the hub of the DiNC. The space and personnel at DiNC are deployed based on the population of the district and the services being provided by the DiNC. To cater to a population of 16 lakhs in the district with selected services, Tata MD created a 32-seater office space, with an area of 2,500 square feet.

Being co-located within the premises of the government institution (DHO office) offered the advantage of working in close collaboration with district health administrators. The setup has the requisite hardware, software, and network components, which apart from basic facilities includes, the server room, virtual pod (V-POD) rooms, and an uninterrupted power supply (UPS) generator for ensuring continued services.

### Facility Level Setup

In all the DiNC-enabled healthcare facilities (PHCs, CHCs, THs, and DH), there exists a DiNC Micro-arena run by a PCC and a V-POD room for virtual consultation.

The DiNC Micro-arena is a single window facilitation service that acts as a reception and is manned by PCCs who help with appointment booking, printing, scanning, and uploading of documents and more. For this purpose, a dedicated area (approximately 6' X 4' square feet), is earmarked with a designated desk and proper signage near the entrance of the health facility.
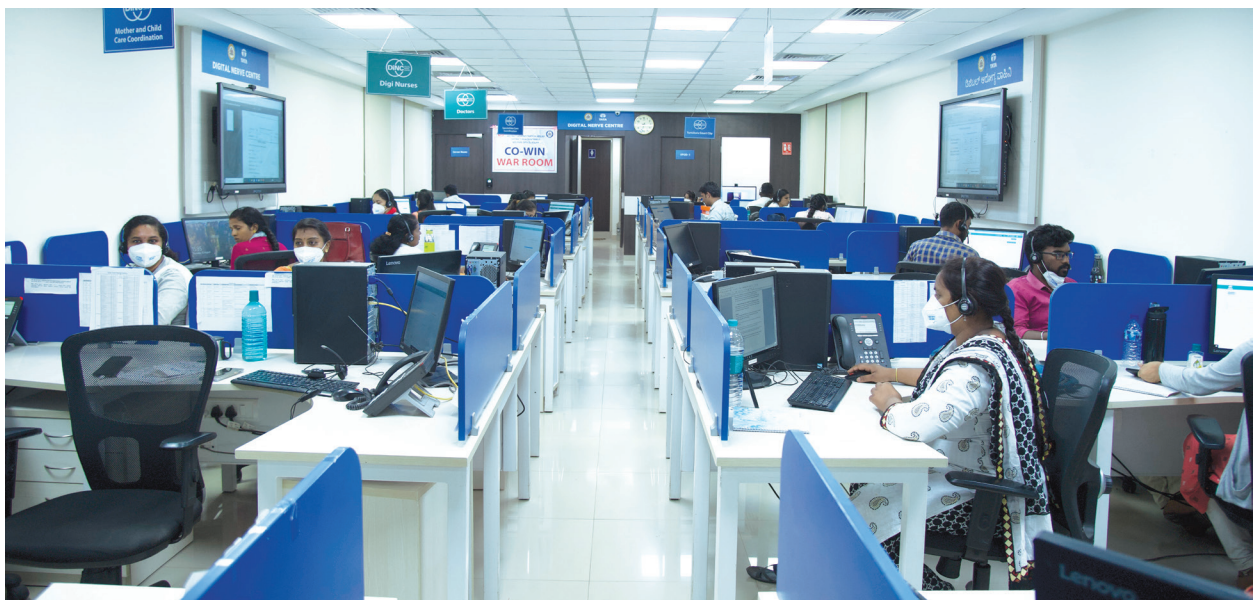


A 32-seater Digital Nerve Centre located within the premises of the DHO Office, Kolar

PCCs seen assisting patients at the DiNC Micro -arena, SNR District Hospital

Similarly, in each health facility, a closed room, a V-POD room, with a minimum area of 8' X 8' square feet is created for delivering virtual services, like doctor's consultations. The room has a desktop, CPU with a camera, and required electric and network points for virtual consultations.

## Human Resource

The DiNC, with its necessitated mandate, requires a multi-professional team to deliver services. Accordingly, each health facility is managed by a PCC and/or Patient Care Manager (PCM). At the Nerve Centre, overall implementation is managed by the delivery manager with the help of other professionals which include care coordinators, digi-nurses, doctors (specialist/general practitioners), and IT professionals.

## Branding

To increase awareness and communicate with citizens about the services being offered through DiNC, and to guide about the process involved, a common branding with the use of communication boards and signages, across all the DiNC-enabled facilities is ensured. Before the introduction of DiNC, facilities lacked proper signages and information boards guiding citizens through their medical journeys.

## Power Backup and Connectivity

To ensure continuous availability of electricity during operational hours, DiNC is equipped with 3-phase dedicated electrical connectivity, backed by a diesel generator and a Central UPS system.

## Digital Infrastructure

The DiNC has various applications as technology enablers to ensure the implementation of required functions. The HealthX, the Concentric Data Repository (CDR), the Clinicograph, mobile apps, web applications, and virtual care platforms are examples of such enablers available for various healthcare providers.

### HealthX Application

The HealthX (See Figure 2.1) is the core digital application having convenient accessibility through various omnichannel sources including web/kiosks, tablets, and phone-based applications, with each platform offering a set of services customised for the end user (Refer to Appendix C). The application is designed to capture, analyse, and aid in the flow of information. It allows access to store and update medical information, sends reminders for follow-up appointments, conducts basic medical screenings, and facilitates virtual consultations with specialists.

The application assigns a unique identifier to each patient, which allows for retrieving patient data, in both structured and unstructured formats, from past consultations. Unstructured data encompasses voice recordings, videos, text messages, scanned documents, images, and more. Whereas the structured data is derived from third-party systems like the Hospital Information System (HIS) or Digital Imaging and Communications in Medicine (DICOM) images such as Computed Tomography (CT) scans and Magnetic Resonance Imaging (MRIs).

Healthcare professionals within the DiNC ecosystem can access all relevant data, including patients' previous interactions, assessments, and case incidents, to provide tailored counselling and pertinent information.

Additionally, it offers a configurable tag-based support system for easy data retrieval. All these features collectively assist Analytica in delivering customised services for either a specific group of patients or individual patients. The HealthX tool further facilitates communication and coordination among care providers to benefit patient care.

### Concentric Data Repository (CDR) and the Clinicograph

The CDR is a centralised repository that aggregates data from multiple healthcare units, facilitating a single view of a patient's medical records and history for a robust clinical assessment and diagnosis. The tool can rapidly integrate patient information from multiple sources without hampering previous aggregations.

The software tool is built for handling large amounts of data, as well as to transform and standardise it. It allows for regular feeds from different hospitals, keeps them up-to-date, and undertakes extensive analytics, making useful information available in real-time to patients, doctors, and DiNC coordinators.

### The CDR has the following functionalities:

a) Extraction of data from many sources and types (structured and unstructured data stream)

b) Rapid replication in the cloud

c) Intelligent processing to achieve data standardisation

d) Data access to doctors in an easy-to-interpret way

e) Generating the aggregated data stream in new insightful formats

f) Generation of the patient's clinicograph, a

## Figure 2. 1

### Features of the HealthX application



**Omni-channel Patient Registration**
Toll-free/in-campus registration, quick registration using a QR code

**Unified Patient Information**
Collating structured/unstructured information about patients across disparate sources

**Care Coordination Services**
Dynamic, tag-based platform to flexibly support a multitude of care coordination services

**Universal Access**
Cloud-enabled anytime/anywhere access to patient health information such as Thayi Card, OPD slips

**Chat-based EMR**
Intuitive platform enabling multidisciplinary care teams to chat with each other for seamless patient-centric care

**Analytics**
Analytics for guiding personalised interventions and ongoing process optimisation

snapshot of the patient's background and medical history

**Platforms**

**a) Mobile or Tablet Apps:** Mobile applications have been created for ASHA workers, ANMs, specialists, and General Practitioners (GPs). Initially, ASHAs used this application to conduct Known Citizen Drives (KCD) for population enumeration, which (ASHA mobile tablets) have been made inactive now.

The app updates case details, scans health records, requests appointments, and submits assessments. Specialists and GPs can prepare cases, tag comments, view, and upload documents,

conduct virtual consultations, add care members, and manage case closures. Furthermore, specialists and general practitioners can also execute these tasks using the web portal, ensuring flexibility and accessibility across platforms.

**b) Web Portal:** The web portal caters to DiNC coordinators, PCCs, PCMs, assigners, nerve centre doctors, and digi-nurses, allowing them to register patients, update cases, upload records, book appointments, and conduct virtual consultations. Users can assign cases, tag comments, manage closures, add care members, communicate instantly, facilitate appointments, and conduct patient follow-up, thus streamlining patient care coordination.

**c) Virtual Care Infrastructure:** A virtual care

platform enables patients to connect with doctors and specialists from the nearest health facility or their home, through virtual means. It is also possible to establish a peer-to-peer connection during a consultation for a second opinion or guidance if required.

## Public Health Facilities Covered Under the DiNC

Ninety health facilities which include PHCs (82), CHCs (2), THs (5), and DH (1) are covered by the DiNC. PCCs stationed at each facility support intra and inter-facility patient navigation and enable data recording and communication flow. Similarly, each facility has a DiNC arena and V-POD room for functions such as data collection, uploading of documents, retrieval of past data, and virtual consultations.

The Sub Health Centres-Health and Wellness Centres (SHC-HWC) are not currently DiNC enabled, however, the PCC posted in a PHC, indirectly handles four to five SHCs aligned to his or her PHC. The Community Health Officers (CHOs), ANMs, and ASHAs, during outreach services, contact PCCs and refer patients screened and require further intervention for NCDs, Four Ds in children (Disease, Delays, Deficiencies, Defects) as part of RBSK and high-risk mothers and newborn identified during home visits, etc.

The CHOs also coordinate with PCCs when there is a need for a virtual consultation with a doctor and to confirm a doctor's availability while they are referring patients.

## Understanding the Core Activities

a) **Known Citizen Drive (KCD):** This drive was initiated at the programme's inception in 2017. The ASHA workers conducted door-to-door visits, collecting citizens' essential demographic information,

and spreading awareness about DiNC. A known citizen was identified through their Aadhaar, along with a verified mobile number. Secondly, the DiNC toll-free number offers citizens a direct line to connect with DiNC coordinators. Thirdly, citizens can visit the hospital and approach the DiNC arena where the PCCs assist citizens in registration.

Demographic data collected during the KCD includes information such as name, age, gender, blood group, Aadhaar card, mobile number, address with PIN code, and email (if available). Additionally, relevant medical history, covering NCDs, obstetrics and gynaecology, immunisation, and general medical problems, is also documented.

This has resulted in more than 24 lakh registrations as on March 2024. After the exercise of deduplication, 19,59,959 unique citizens are said to have been enrolled so far. The total phone numbers used for registration are 5,30,999, averaging 3.69 family members per phone number.

b) **Appointment Booking:** The DiNC system facilitates advance appointment bookings for hospital visits through phone calls to the Nerve Centre or through ASHA workers or ANMs. Patients with appointments receive priority for consultations, including for virtual consultations, if necessary. This system supports patients with a pre-planning and alert service, enables timely access to medical care, and allows healthcare providers to plan their workload efficiently.

c) **Care Coordination and Patient Navigation Support by PCC:** At the health facility, the DiNC arena staffed by a PCC, assists patients, whether they're walk-ins or have appointments. For walk-ins, the PCC assesses their health, registers them on HealthX if new, and schedules a consultation with a doctor who is available as a current booking. For those with appointments, the PCC confirms the doctor's

availability and guides them to the consultation room. They also upload relevant documents, coordinate lab tests, and schedule follow-up appointments or referrals as needed.

**d) Virtual Consultations:** The OPD doctors can refer patients to a specialist, or sometimes a specialist refers to another specialist for follow-up. In both scenarios, patients may request virtual consultations through the PCC, which are scheduled via the HealthX app. In cases where the doctor is unavailable at PHCs, a staff nurse assesses urgency, and the PCC arranges virtual consultations with the district hospital or neighbouring PHC doctors.

Similarly, DiNC doctors also conduct virtual consultations in cases of receiving requests from patients via the DiNC toll-free number, whereby they are directed to the nearest PHC. The PCC accompanies them to the V-POD room and oversees pre-consultation tasks, report uploads, post-consultation documentation, and follow-up procedures.

These virtual consultations are of great value for patients residing in rural or remote areas who are unable to access specialist consultations located far away. Then it also enables healthcare professionals serving in remote areas to have doctor-to-doctor consultations with specialists for complex cases. Finally, such virtual consultations ensure an efficient utilisation of limited clinical resources.

**e) Triaging:** DiNC's triage system aims to empower care seekers by assessing their medical needs and directing them to appropriate health facilities. Triage occurs at the nerve centre and the health facilities level.

At the nerve centre, DiNC coordinators guide patients to nearby facilities or provide medical assistance through digi-nurses or doctors. If specialist care is needed, patients are directed accordingly. Standard Operating Procedures (SOPs) for triaging are in place,

and staff are trained to conduct triaging as per the protocol.

At the health facility level, the PCC informs patients about available services and facilitates specialist consultations in coordination with DiNC. Together, this process facilitates gatekeeping and alleviates pressure on tertiary facilities, and bridges different levels of care.

**f) Referral:** In public health systems, a robust referral system aims to ensure easy, accessible, and affordable care for individuals. Referrals typically occur when a doctor recommends a patient to see a specialist or for follow-ups.

The DiNC coordinates both forward and backward referrals. Individuals at PHCs or CHCs may be referred to specialists at higher health facilities. The PCC then schedules appointments with the respective doctors according to the patient's convenience. Conversely, specialists at DHs may advise patients to consult PHCs for follow-ups, in which case the PCC of the district hospital schedules appointments accordingly.

Referrals are also crucial for second opinions, cross-references, diagnostic services, admissions, management at secondary and tertiary health facilities, and other rehabilitative services such as physiotherapy.

**g) Follow-up Care and Counselling:** After in-person consultations, PCCs at the DiNC Micro-arena schedule follow-up appointments for patients' convenience. The system sends timely reminders for diagnostic schedules and appointments, ensuring adherence to treatment plans. Patients are also regularly contacted by digi-nurses or care coordinators at the nerve centre to update HealthX records. The DiNC team actively guides patients through treatment and recovery, following doctors' recommendations.

Video consultation in a V-POD room at a DiNC-enabled health facility

The digi-nurses and doctors receive 15 days of training each in the standard protocols developed by Tata for clinical care provision, guidance, and the use of HealthX. The digi-nurses adhere to standardised protocols during patient counselling. These protocols are readily accessible to them through system scripts, which include guidelines on topics to discuss with patients, checklists for key questions and messages, and an Excel sheet for recording patient progress details.

## Assessing the Technology Stack of the DiNC Ecosystem

Assessing healthcare IT system technology features is vital to ensure alignment with provider, patient, and stakeholder needs. Similarly, ascertaining whether the technology features comply with relevant regulatory requirements and standards in the Indian context becomes necessary because adherence to these standards is crucial for avoiding legal issues and maintaining the privacy and security of patient information.

Good functionality of the IT system supports diverse healthcare workflows and efficient clinical decision-making. A comprehensive evaluation of the IT system's usability helps to determine if it's user-friendly for healthcare providers and other users. Usability problems can greatly affect productivity and satisfaction, and therefore is vital to assess.

Another crucial factor to consider is interoperability, guaranteeing smooth data exchange among various systems and devices. This facilitates effective information sharing across healthcare

environments and supports coordinated care delivery.

A thorough evaluation of an IT system's technology features should also include identifying potential data privacy and security risks. This involves reviewing encryption, access controls, and audit trails to safeguard patient information from unauthorised access or breaches.

Finally, assessing the scalability and future-proofing capabilities of an IT system is essential for ensuring its long-term viability. This involves determining whether the system can scale to meet future needs and accommodate new technologies and innovations, thereby ensuring that healthcare providers can continue to deliver high-quality care efficiently.

### User Interface (frontend) of the DiNC Initiative

The frontend of the DiNC system is the HealthX application which has users at various levels. At the community level, ASHAs and ANMs use this application for the enrolment of citizens by creating UHIDs. At the SHC-HWC level, the application is not implemented however, the referrals to PHC from CHOs, ASHAs, and ANMs take place physically by coordinating with the PCCs who are located at the PHC level and above.

At the facility (PHC and above) level, the application is used by the PCCs for fixing appointments (physical and virtual), issuing OPD tickets, and uploading treatment records. The Nerve Centre (DiNC hub) has users like care coordinators, digi-nurses, and DiNC doctors.

The Nerve Centre receives inbound calls through a toll-free number. The coordinators at the Nerve Centre receive the inbound calls and understand the patient's requirements. Further, they transfer this call to the nurse, doctor (virtual), or counsellor as per the

service requested. Outbound calls are managed by coordinators and nurses who call up the beneficiaries before their due date of availing treatment, counsel the patients, and fix appointments as per their requirements through the HealthX application. All the information captured through the inbound and outbound calls is tagged (unstructured data) in the HealthX application against the UHID of the beneficiary.

A DiNC coordinator explained how the inbound calls received at the toll-free number are managed. She said,

> 'I get around 25 to 30 inbound calls in a day. There are three types of calls, clinical (3-4 calls), semi-clinical, and non-clinical. If it is a clinical-related call, I transfer it to a doctor who is in the DiNC. If it is semi-clinical, I transfer it to the nurse. And if it is non-clinical, then I answer it. Clinical calls are related to medication, prescription, or post-surgery complications. Semi-clinical calls are related to prenatal and postnatal cases. To give an example, if a child has any swelling after immunisation, such minor complication cases are transferred to the staff nurses. Non-clinical calls can vary from queries regarding scanning availability to information about camps. Those calls I handle, and I also update the doctor about the same.'

Another coordinator explained the process of making outbound calls using the HealthX application,

> 'We make outbound calls to patients for appointment reminders. There is a feature in the HealthX application called appointment reminders. If we click on it, a list of patients whose appointments are for the next day pops up. We download
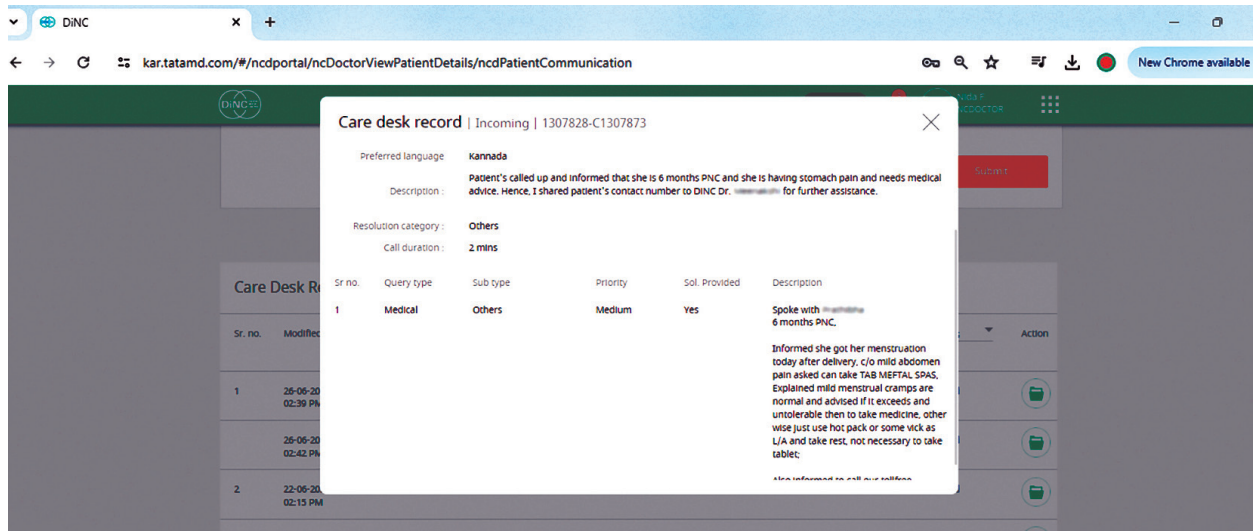
Snapshot of inbound call details recorded in the HealthX application

this list for making outbound calls. We make around 50 to 60 calls per head per day. So, the total of outbound calls is around 350 from all the coordinators in a day.'

**HealthX Application:** The application helps in knowing the patients who are going to visit the facility in advance, accessing patient information and previous records, digitising records, creating, and assigning UHID, etc. The PCCs, PCMs, nurses, coordinators, and DiNC doctor's experience of using HealthX was satisfactory. The only challenge quoted was the slowness of the software during the peak hours making it difficult to upload the records. As informed by a PCC,

‘Earlier patients did not go to public health facilities, especially the PHCs. They assumed that the doctor was not available and hence went to the taluk hospitals. But this has changed. Now, the patients call us at 9.30 am and take the update for their visit to the nearest health facility. We receive the doctor availability status through a WhatsApp group.'

**Design Responsiveness:** The HealthX application is optimised for various devices and screen sizes including desktops, tablets, and smartphones. At the community level smart phones or tables were used by ASHAs and ANMs for conducting the KCD. At the facility and DiNC level, desktops are used to run the application.

**Information Architecture:** The DiNC application is designed to be easily customised to meet specific requirements within a single instance for a particular service area. Initially, the system captured the Reproductive, Maternal, Newborn, and Child Health (RMNCH) services provided and later other services, as required by the government were added as additional modules to the same system wherein the service provider can access information from the same login. The same software can be replicated in other places by just creating another login instance.

As alluded to earlier, the HealthX application is the cornerstone. This application facilitates various aspects of health care delivery, including scheduling appointments and uploading health records. One of its key features is its integration with

the UHID system, which assigns a unique identifier to each patient. The UHID allows healthcare providers at all levels to access the patient's health records when needed, ensuring seamless and coordinated care. The HealthX application enables healthcare providers to schedule appointments efficiently, reducing waiting times and improving patient access to care. Providers can easily view their schedule and manage patient appointments, ensuring that patients receive timely care. Additionally, the application allows service providers to view the patient load at their facility, helping them manage their workload effectively and allocate resources efficiently.

A specialist doctor from the district hospital in Kolar noted,

> 'As the PHCs in Kolar are networked under DiNC, if a primary health centre doctor feels that the patient requires a specialist opinion, the patient is referred to the higher centres and the concerned specialist. In this way, the patient has better access to treatment and is less likely to visit a quack. An important factor is follow-up. The DiNC has details of all the patients that I treat in a day... So, it's good for us and it has increased the doctor-patient time interaction. The time taken for diagnosis also gets reduced.'

Another important functionality of the HealthX application is its ability to upload health records against the UHID of the patient. This feature ensures that all relevant health information is stored in a centralised and accessible manner, enabling providers to make informed decisions about patient care. Providers can access the patient's medical history, medications, allergies, and other vital information, ensuring that they have a comprehensive understanding of the patient's health status.

As informed by a doctor from the district hospital,

> 'I write the prescriptions in the OPD slip. The PCC documents the diagnosis and treatment I write. I take at least 5 to 6 minutes to examine the patient and another 5-6 minutes to counsel the patient. I take another 3 minutes to write the prescription. So, if I had to document the details again, I might spend another 5 to 10 minutes. But here the PCCs support me, and I just take a digital copy of the information they have fed into the system. In this way I save at least 7 to 8 minutes on each patient's treatment. Also, for the next patient visit, I l have a proper health record of the patient.'

**Data Validation Rules:** The HealthX application has the capability of capturing structured as well as unstructured data. Whenever a user inputs any information (clinical or non-clinical, images, demography, etc.), the system accepts this information and it is stored in the database. There are no rule-based validation mechanisms that exist. Integrating rule-based mechanisms can improve data quality and robustness.

### The Backend of DiNC Initiative

The DiNC is a combination of monolithic and microservice architecture. Being monolithic implies, that the application is constructed with a unified code base, consolidating multiple components into a single large application. The microservice architecture comprises smaller, independently deployable services. This approach is applied to ensure that in case, if a specific module fails, the remaining modules continue to operate, and the system remains functional. For example, if the appointment system goes down, the registration, NCD module, and others work.

The DiNC's technology stack is comprised of two components based on services being provided to the caregivers which include the physical visit and the virtual care. The HealthX application or the physical visit appointment system is built on Java and Angular. The virtual appointment system is built on the Angular web application which is hosted on Amazon Web Services (AWS). It also has a communication channel at the backend engine which runs on Node.js used for internal communication, similar to WhatsApp. Additionally, CDR, a centralised repository runs on an elastic search engine using Java script to store and retrieve patient information as needed.

For the DiNC system, data security is one of the key components prioritised as the system handles patient-centric information. The back end of the DiNC system is hosted in the AWS cloud-based solution and adheres to all security features as mandated and provided by AWS. For ensuring data security, PostgreSQL, an open-source object relational database system is used which extends the SQL language combined with many features that safely store and scale the most complicated data workloads and patient information. This encrypts all the data captured in the system and the data can be only decrypted with a key.

A senior software engineer from DiNC explained the security features,

> 'Encryption is implemented for patient information. All the rules are delineated between the team members also. Not everybody has access to the whole data. If team members have access, they only have access to development and QA server quality. If it is the patient care coordinator, they have access only to a dedicated login and that login is audit-trailed. For every single login and logout, we have a timestamp, and all actions are monitored. We have an audit trail of all the activities.'

Currently, DiNC is functioning in a stable mode in Kolar and the responsibility of the IT team is to ensure proper maintenance platform and keep it running. The system is fine-tuned with auto skills to load the balance with automatic load balancers configured. The downtime reported is four to six hours per year and as the application is developed on microservices, if any new services are to be added, it does not require downtime and does not affect the rendering of the existing services.

## Current Standards and Guidelines for Digital Health Systems in India

The Ayushman Bharat Digital Mission (ABDM) in India has set standards and guidelines for digital health systems to ensure interoperability, security, and accessibility.

### Key requirements as per ABDM standards include:

a) **Unique Health ID (UHID):** One of the key components of ABDM is the creation of a unique health ID for every individual known as Ayushman Bharat Health Account (ABHA ID). This unique health ID consisting of a 14-digit identification number generated with the consent of the patient will help in effortless navigation of healthcare facilities, access to a comprehensive Healthcare Professionals Registry (HPR), and seamless sharing of medical records with healthcare providers, which would lead to improved diagnosis and treatment outcomes.

b) **Electronic Health Records (EHR):** Implementing EHR systems that comply with ABDM standards for data structure, interoperability, and security. EHR will contain the patient's health records,

including medical history, prescriptions, diagnostic reports, and other relevant information.

**c) Personal Health Records (PHR):** Providing individuals with access to their PHR, which is an electronic record of health-related information, such as medical history, lab reports, prescriptions, allergies, etc, being managed, shared, and controlled by the individual through the ABHA app.

**d) Healthcare Professional Registry (HPR):** The HPR is an updated, comprehensive, and verified registry of public and private healthcare professionals involved in the delivery of care across all systems of medicine. Maintaining a registry of healthcare providers facilitates the renewal of licenses, and digital signatures, treating patients remotely with the help of telemedicine, reviewing health records with the digital platform seamlessly, and instilling trust among

patients to get the healthcare support for their needs.

**e) Health Facility Registry (HFR):** The ABDM also includes the establishment of a comprehensive health facility registry of the country across modern and traditional systems of medicine. It includes both public and private health facilities, including hospitals, clinics, diagnostic laboratories imaging centres, pharmacies, etc. This will instil trust in citizens seeking healthcare services by improving the discovery of health facilities more easily, especially in rural and remote areas. Similarly, health facilities signing up will be able to gain access to a host of digital services.

**f) Unified Health Interface (UHI):** The UHI is envisioned as an open protocol for various digital health services. UHI Network will be an open network of End User Applications (EUAs) and participating Health Service Provider (HSP) applications.



Citizens seen visiting a DiNC-enabled Urban Primary Health Centre in Kolar taluk, Kolar district

UHI will enable a wide variety of digital health services between patients and HSPs, including appointment booking, teleconsultation, service discovery, and others.

**g) Data Safety, Security, Privacy, and Consent Management:** Aligned to India's personal data protection bill, ABDM uses electronic consent artefacts to allow users to specify their consent to access health information by the HSP. Provision has been provided to the user to modify or revoke any or all the parameters for which consent was given at any point in time, wherein the HSP must remove user data.

**h) Health Analytics:** Implementing analytical tools to derive insights from health data for public health planning and management.

**i) Patient Rights & Empowerment:** Empowering patients with the right to access, manage, and share their health information as per ABDM standards.

**j) Training and Capacity Building:** Providing training and capacity-building programmes for healthcare providers and other stakeholders to effectively use digital health systems.

## DiNC Compliance with Current Standards and Guidelines for Digital Health Systems

Based on findings from the document review, IDIs, and direct observation, DiNC has made significant progress in its development, achieving three key milestones of ABDM.

**Milestone 1 (M1) – Patient Registration:** The system has successfully carried out registration of patients, including the creation of ABHA cards using Aadhaar ID, mobile, or driving license. Additionally, a robust process has been developed to collect and verify ABHA addresses

during patient registration, ensuring accurate and reliable record-keeping.

**Milestone 2 (M2) – Health Information Provider Services:** The DiNC has enabled users to discover their health records within the system and has implemented mechanisms for notifying or linking new health records with an ABHA address upon creation. Moreover, the system now supports the sharing of health records upon user request, following thorough verification of user consent. These records are structured in an interoperable format using Fast Healthcare Interoperability Resources (FHIR), ensuring compatibility and accessibility across different systems. The DiNC has also implemented support for consent revokes, deletion of ABHA addresses, and uptime ensuring the system's integrity and reliability.

**Milestone 3 (M3) – Health Information User Services:** The DiNC has enabled users to request access to health records linked with an ABHA address. The system efficiently fetches linked records from HPRs and organises and displays these records in a user-friendly manner. These milestones signify the DiNC's commitment to providing efficient, secure, and accessible healthcare information services to its users.

## Operational Constraints in Maintaining Compliance with the ABDM Standards

While the system demonstrates overall compliance with the standards and guidelines prescribed by ABDM, the direct observation of the technology stack and stakeholders interactions revealed certain operational constraints in maintaining these standards. Table 2.1 portrays the comparison of existing features of DiNC with ABDM standards along with the limitations identified through the IDIs and observations.

**Table 2. 1** Comparison of DiNC features with ABDM standards

| ABDM standards | DiNC features (existing) | Operational challenges |
|---|---|---|
| UHID | • UHID was issued to the population of Kolar through KCD after capturing basic demographic information.<br><br>• Healthcare providers can rapidly look up a Health ID by searching for the ID or mobile number to retrieve patient information.<br><br>• The system also supports the creation of a unique patient identifier, known as the ABHA card, which is used to link a patient's health records across different healthcare facilities. | • Single mobile number linked to multiple persons in the family.<br><br>• Duplication in the UHIDs: Kolar's total population is approximately 16 lakhs (District Census Handbook: Kolar, 2014), however, DiNC has over 24 lakh UHIDs as of now. This could be due to multiple reasons like, not all phone numbers are linked to Aadhar, people have changed their mobile numbers, deceased citizens are not removed from the system, etc.<br><br>• Since the UHIDs are created at the facility level, there is a strong possibility that certain individuals are not covered. |
| EHR | • Ability to capture and store health information from various sources, including hospitals, clinics, and laboratories. This allows for a more holistic view of a patient's health and facilitates better coordination of care among healthcare providers. | • There is no mechanism to get the consent of the patients to access their EHRs before it is accessed by the PCCs & DiNC personnel.<br><br>• Patients do not have access to their EHRs in the current system. |
| PHR | • This feature is currently not enabled for users and is likely to be enabled after ABDM integration through ABHA. | |
| HPR | • The HPR contains essential information about public healthcare professionals (doctors), including their qualifications, specialties, contact details, and practice locations. | |
| HFR | • DiNC has a system to categorise healthcare facilities based on various criteria, such as the level of care provided (e.g. primary, secondary, tertiary), the availability of specialised services (e.g. surgery, maternity care), and geographical location. | |

Table 2.1 continued

| ABDM standards | DiNC features (existing) | Operational challenges |
|---|---|---|
| UHI | • Seamless integration with telehealth platform for virtual consultations, enabling healthcare providers to deliver care remotely.<br><br>• Integrated appointment scheduling systems to manage patient appointments efficiently, reducing wait times and improving patient access to care. | • Tele-consultation facility as of now is not available for all SHCs and PHCs. |
| Data Security, Privacy, and Consent Management | • The user interface is designed based on user roles from the community to the facility level. Each user has restricted access to patient information based on the type of role and services assigned. | • Though the HealthX application has the provision for all types of users, it was observed that in the DiNC centres, the counsellors and nurses were also using the doctor's login. As a result, the data of patients (both unstructured and structured) were seen by all the staff at DiNC irrespective of their roles, which limits ensuring accountability and also is not completely compliant with data privacy norms. |
| Data Security, Privacy, and Consent Management | • The back end, hosted in cloud-based solution, adheres to all security features as mandated and provided by AWS. All patient information entered into the system is encrypted and the data can be only decrypted with a key.<br><br>• Secured authentication mechanisms to ensure that only authorised personnel can access patient data and system functionalities.<br><br>• Data encryption to protect sensitive information, ensuring that patient data is secure and private.<br><br>• Logging and tracking of user actions within the system, providing accountability and traceability in case of unauthorised access or data breaches. | • The systems are also limited in measuring the performance and productivity of individuals and quality aspects.<br><br>• There is no mechanism to get the consent of the patients to access their electronic health records by the PCCs and DiNC personnel as envisaged by ABDM standards.<br><br>• The data captured is hosted on AWS which enables more load balancing, good uptime, and better recovery tools. However, it was reported that during peak time the application slows down and is often unresponsive. To tackle this, the data is uploaded in different time slots to prevent overburdening the system. |

Table 2.1 continued

| ABDM standards | DiNC features (existing) | Operational challenges |
|---|---|---|
| Data Security, Privacy, and Consent Management | • Regular checks to ensure the integrity and accuracy of patient data, reducing the risk of errors or misinformation in patient records.<br><br>• Adherence to relevant healthcare regulations and standards as mandated by ABDM. | |
| Health Analytics | • CDR can capture patient information in structured and unstructured formats.<br><br>• Live dashboards are available for service-wise Management Information System (MIS) generation. | • The structured data captured in the system is not comprehensive (not indicator-based). The system is unable to provide access to minimal service utilisation or service coverage indicators that are available in Hospital Management Information System (HMIS) or other national portals, which are required to understand the outcome of the programmes.<br><br>• These indicators include trimester-wise number of pregnant mothers registered, number of vaccinations, mothers who have completed all four ANC check-ups, etc. The system is unable to track these key programme indicators and is also unable to communicate with other government applications of health systems like HMIS, ANMOL Portal, Nikshay, etc.<br><br>• The live dashboard links throw multiple errors or do not populate the data many times compelling the user to do multiple refreshes to view the information. |
| Interoperability Standards | • DiNC is compliant with ABDM in the health information exchange of patient registration, health information user services, and health information provider services. | • PCCs are currently responsible for uploading the patient case records to the system. When the patient load is high or if the PCC is not available for the day at the facility, the patient information is missed and not recorded in the system. |

An ASHA worker at the doorstep of citizens registering them using the HealthX application

## Key Takeaways from the DiNC Ecosystem

Our analysis has provided us with valuable insights into the established infrastructure that promotes continuity of care, enhances accessibility, and encourages the use of digital applications. We have presented a comprehensive overview of the initiative's strengths and challenges below.

### Strengths

**i) Robust Physical and Digital Infrastructure with Seamless Service Integration and Attempts for Care Continuum:** The DiNC platform demonstrates the potential to enable care coordination and continuity and integrates four key functions: connect, coordinate, consult, and communicate. Several features of DiNC enable seamless integration into the public health system from PHCs to tertiary care facilities of the government. Innovative infrastructure like V-POD rooms enables remote care access in the absence of doctors or for specialist consultations. A common gap frequently witnessed in the public health system is the absence of efficient follow-up care. Leveraging its virtual care features such as outbound calls, DiNC nurses and PCCs remain connected with patients, ensuring adherence to lifestyle modifications, and treatment plans, and providing counselling support and appointment reminders. By doing so, DiNC complements the follow-up responsibilities of the frontline workers.

**ii) A Unified Platform Accommodating Diverse Services and Programmes with the Ability to Add New Modules as Necessary:** DiNC is a single platform covering different national health programmes like RCH, NCDs, mental health, TB, etc., and integrates functions of e- Sanjeevani and e-Hospital.

**iii) Versatile and Easy-to-Use Digital Application:** HealthX is a versatile centralised tool accessible through multiple channels, offering tailored services for users. It captures, analyses, and manages medical information, providing features such as appointment reminders, basic screenings, virtual consultations, and instant messaging with real-time updates for informed clinical decisions across various levels of healthcare facilities. It assigns unique patient identifiers to retrieve both structured and unstructured data, aiding healthcare professionals in delivering personalised counselling and relevant information within the DiNC ecosystem. All this again enables the integration of primary and secondary care services.

**iv) Availability of Centralised Platform, Ease of Data Consolidation, and Ability to Handle Huge Volumes of Data:** The CDR, a centralised platform consolidates data from multiple healthcare units, providing a comprehensive view of patient's medical records for robust clinical assessments. It efficiently integrates information from various sources without disrupting previous aggregations, handling large data volumes while ensuring transformation and standardisation. With regular updates from hospitals and advanced analytics, it offers real-time insights to patients, doctors, and DiNC coordinators. Key functionalities include data extraction from diverse sources, rapid cloud replication, intelligent processing for standardisation, user-friendly data access for doctors, generation of insightful data formats, and creation of patient clinicographs to aid clinicians.

**v) Good Provider Satisfaction with the Application Design and Information Architecture:** The service

providers at the DiNC and government health facilities, the DiNC coordinators and nurses endorsed the ability of the HealthX application to integrate patient information with the UHID system, enabling seamless access to health records across healthcare providers for coordinated care. All stakeholders interviewed mentioned that HealthX streamlines appointment scheduling, reduces wait times, and improves patient access to care, while also allowing providers to efficiently manage appointments and workload allocation.

**vi) Compliance with the ABDM Standards:** DiNC has achieved three milestones specified within ABDM standards for patient registration, health information provider services, and health information user services.

**vii) PCC-Enabled Processes of Care Coordination and Navigation:** The DiNC initiative enhances public health care utilisation through population enumeration and registration, active support provided by PCCs for appointment scheduling, and responsive care with minimised waiting times and enabling prompt doctor consultations. The function of PCCs can be equated to that of patient navigators introduced in other nations. Their objectives include guiding patients through the complexities of care, overcoming barriers, facilitating timely access to necessary healthcare services, and ultimately enhancing care integration (Budde et al., 2022). Referral and triaging services efficiently guide patients to appropriate health providers, alleviating pressure on secondary and tertiary care facilities.

**viii) Adherence to Standard Protocols During Virtual Counselling and Follow-Up Care:** The need for high-quality and standard guidelines to support and guide virtual healthcare has been highlighted in various studies (Krupiński & Bernard, 2014, Holčapek et al., 2023). A distinguishing feature of this initiative is digi-nurses' virtual counselling, in which

A doctor at a DiNC-enabled health facility carrying out consultations for pregnant mothers

adherence to standard protocols and messaging is achieved by efficient use of standardised scripts and guidance on do's and don'ts. Additionally, these nurses demonstrated the ability to personalise messages according to individual patient questions and concerns. The providers' training through the standard clinical protocols has enabled the DiNC systems to provide clinical care and counselling with adequate quality and clinical safety.

## Challenges

**i) Lack of DiNC Infrastructure at the SHC-HWCs, Limiting the Possibility of End-to-End Health System Integration:** A critical gap in the initiative lies in the absence of DiNC infrastructure expansion

at SHC-HWCs, which could be vital. Expansion to SHC-HWCs would also ensure a 'time to care' approach of Comprehensive Primary Health Care (CPHC) within 30 minutes proximity, improve patient handover and support primary care teams for better follow-up care (NHSRC, 2018).

**ii) Lack of Facility-based Services:** Currently, the data variables are not customised to the facility-based services, as most of the information captured is unstructured via tagging. There is a need to develop service modules based on facility type from the SHC-HWC level to the tertiary care level in a structured way based on the service level indicators to make the system robust.

**iii) Lack of Annual Updating of Population Registrations and Duplicate UHIDs:** Another significant gap in the initiative is the lack of yearly updates to population registrations. Following a single citizen registration drive in 2017, subsequent registrations are only carried out for individuals seeking care at health facilities covered under DiNC. However, population data within the public health systems undergo annual updates of significance and relevance conducted through the community needs assessment survey for eligible couples, newborn, individuals aged 30 and above for universal NCD screening, etc. to name a few. Such surveys are necessary to maintain population health registries to deliver CPHC. Then there is duplication of UHIDs, which is currently over 24 lakhs for an estimated population of around 16 lakhs. This could be due to multiple reasons like, not all phone numbers are linked to Aadhar, people have changed their mobile numbers, deceased citizens are not removed from the system, etc.

**iv) Lack of Uniformity in Line List:** Some district programme officers provide a line list of beneficiaries to DiNC for undertaking follow-up, sending appointment reminders, and counselling. However, this is not uniform for all programmes. A line list for NCD patients is not shared with DiNC, leading to a lack of follow-up and support for all NCD patients. Expansion to the SHC-HWCs can support DiNC in gaining access to new citizen registrations at the population level.

**v) Incomplete Data Recording and Inadequate Health Analytics:** Despite the DiNC being operational for some years, challenges of incomplete data capturing, and inadequate health analytics persist. Incomplete data capturing leads to missed information during high patient loads or PCCs unavailability. Given the substantial investments in human resources and physical and digital infrastructure, the absence of technology

features facilitating comprehensive health analytics is difficult to explain. The system lacks comprehensive structured data and essential service utilisation indicators found in HMIS or national portals. Lack of monitoring of such indicators hampers programme outcome assessment, especially for the key indicators like trimester-wise pregnant mothers' registrations, vaccination uptake, and completion of antenatal checkups (ANC). In addition, the system fails to communicate with other government health applications and frequently encounters errors or fails to display data on live dashboard links, necessitating multiple refreshes for information retrieval. A programme officer highlighted the absence of progress reports on programme outcomes as the primary issue requiring attention within the DiNC system.

**vi) Not Fully Compliant with Patients' Rights and Empowerment Standards:** There is no mechanism to get the consent of the patients to access their EHR by the PCCs and DiNC personnel as envisaged by ABDM standards. Patients do not have access to their EHR in the current system.

**vii) Operational Challenges in Maintaining Data Security and Privacy Norms:** In DiNC centres, counsellors and nurses using doctor's logins undermine accountability, allowing users to access varied patient information, and breaching data privacy standards. Furthermore, the system lacks tools to measure individual performance and obtain patient consent for accessing their EHRs.

**viii) Non-Usage of HealthX Application by Government Health Providers:** Apart from the KCD, the HealthX application is exclusively utilised by trained DiNC professionals. At the facility level despite having login provisions, medical officers and specialists, are not using the HealthX application, only PCCs access it. Time constraints, patient load, and

lack of IT infrastructure were the reasons mentioned for not using this application. Most government doctors interviewed appreciated PCCs' role in maintaining the health data of the patients and called it a strength of the DiNC system.

**ix) A Problem of Duplication with other Programmes:** The overlapping objectives of the DiNC and the e-hospital application implemented by the GoK raise the issue of duplication of efforts.

Synergy and collaboration between these systems are crucial to ensure seamless integration and comprehensive digitisation of health records. These systems can work together to achieve a fully integrated and interoperable healthcare system, as envisioned by the ABDM, by leveraging each other's strengths. To a certain extent, this is currently happening where the DiNC team is supporting the e-hospital initiative through the provision of OPD slips and raising tokens.

Personalised care for an elderly woman at DiNC-enabled Medihala Sub-Health Centre

# Chapter 3

# Cost Analysis of DiNC

Performing a cost analysis enables individuals and organisations to track the precise financial resources allocated to the programme, categorised by type. This is particularly valuable in low and middle-income countries that face monetary constraints while delivering essential public goods. Public health solutions and interventions are often evaluated based on their cost-effectiveness. Hence, mapping investments and associated costs is a preliminary step that would aid in conducting cost-effectiveness evaluations when required.

During the seven years of its operations, Tata Medical and Diagnostics (Tata MD) has made significant investments to augment the health systems in Kolar through the Digital Nerve Centre (DiNC) initiative. This section includes a cost analysis of the expenses and investments associated with the DiNC system.

## Capital and Operational Expenditure

Every organisational activity, be it for profitable or non-profitable purposes, can be categorised under capital and operating expenditures. A distinction between the two allows businesses and others to organise themselves in a manner that minimises their recurrent/operational costs while obtaining maximum returns to capital expenditures, often substantial. A glimpse of the capital and operational expenditure incurred by DiNC is shared here.

In their first year, districts where the number of facilities is similar to that of Kolar are likely to incur close to

**Table 3.1** Resource requirement for the first year under DiNC

| Resource Requirement | Amount (Rs in Lakhs) | Type of Cost |
|---|---|---|
| Capital Expenditure (Total) | 391 | Non-recurrent (average useful life = 7) |
| Operational Expenditure (Per year) | 314 | Recurrent |

₹ 7 crores in expenditure (See Table 3.1). The average annual costs under the DiNC, as shown in Table 3.2, stand at ₹ 3.7 crores. Capital expenditures for the year were evaluated under the assumption that the useful life of capital is seven years.

**Table 3. 2** Resource requirement (annual average)

| S. No. | Resource Requirement | Amount (Rs in Lakhs) |
|---|---|---|
| 1 | Capital expenditure (Total) | 391 |
| 2 | Useful life of capital | 7 |
| 3 | Capital expenditure (Yearly)* | 56 |
| 4 | Operational expenditure (Yearly) | 314 |
| | Total annual costs (3+4) | 370 |

*Capital expenditure (Yearly) = Capital Expenditure (Total)/ Useful life of capital*

When calculated this way (See items 3 and 4 in Table 3.2), it is found that capital expenditure constitutes only approximately 15% of the total annual costs, with the remaining 85% allocated to operational expenses (See Figure 3.1).

**Figure 3. 1** **Capital and operational expenditure as a proportion of total costs per year**
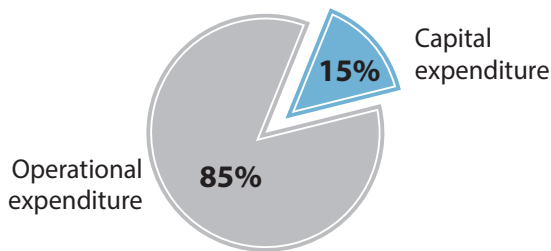


**Capital Expenditure**

In terms of capital expenditure, Tata MD incurred expenses of about ₹ 3.91 crores (see item 1 in Table 3.2) that can be attributed primarily to IT infrastructure and physical infrastructure at the health facilities as well as the nerve centre (Overview of capital expenditures in Figure 3.2). Within capital expenditure, a massive 67% has been attributed to IT infrastructure (Refer to Graph 1, Appendix D).

It is important to note here that capital costs are not representative or readily applicable to other settings and regions. The number of health facilities in a given region, the required resources for the upgradation of existing facilities, and the resources required in

**Figure 3.2** **An overview of capital expenditure under DiNC initiative**
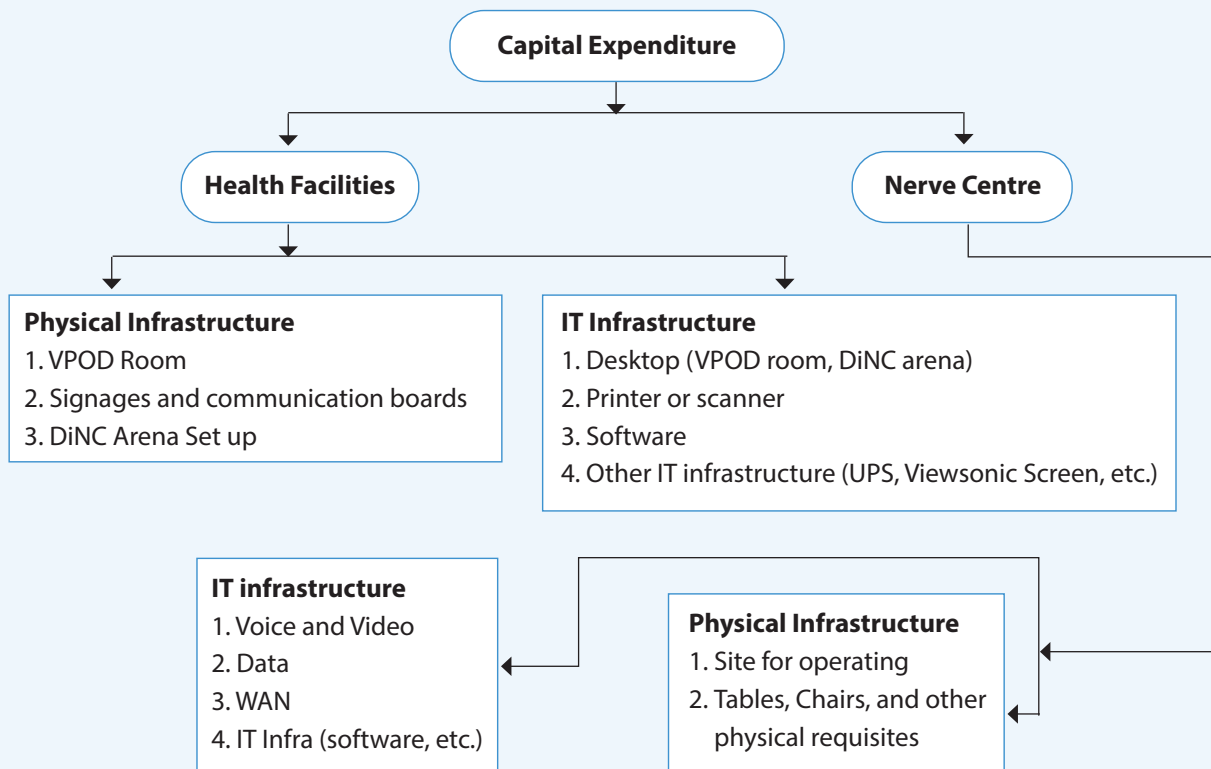
setting up the nerve centre would play a deciding role in ascertaining capital costs.

## Operational Expenditure

Besides capital expenditures, health programmes also incur operating costs, which encompass all expenses required to sustain and operate the project. As mentioned, operations alone make up 85% of the costs incurred in a given year. Salaries of all those employed under the DiNC framework alone make up about ₹ 3 crores of the ₹ 3.15 crores that are spent each year on operations.

At the level of Primary Health Centres (PHCs), Community Health Centres (CHCs), Taluk Hospitals (THs), and District Hospital (DH), the maximum is spent on operational costs, with physical capital infrastructure contributing the least. Operational costs at CHC, TH, and DH levels are higher as they are managed by both Patient Care Coordinators (PCCs) and Patient Care Managers (PCMs) (See Table 1, Appendix D).

## Per PHC Costs

Although the DiNC includes processes and mechanisms to engage with health system actors at the Sub Health Centres-Health and Wellness Centres (SHC-HWC) level, its physical and digital infrastructure currently extends only to the level of PHCs. This limitation necessitates considering PHCs as the smallest operational unit for a cost analysis.

Based on the above assumption, calculating the cost of delivering all DiNC services at the PHC level reveals an annual average requirement of ₹ 4.5 lakhs per facility to sustain the programme. This figure is exclusive to the district of Kolar and has been reached by dividing the total costs incurred by the number of PHCs. To reduce the average cost, more PHCs are brought under the ambit

of DiNC, and resource investments at the nerve centre will be distributed across a larger number of health facilities.

On a marginal level (additional costs of adding a PHC to the network), however, each additional PHC when integrated into the DiNC system, would require in its first year:

In the first year, an additional PHC within the DiNC framework would need around ₹ 4,13,800, covering human resources, IT expenses, and infrastructure enhancements. Subsequently, each PHC requires approximately ₹ 1,80,000 annually for operational expenses, mainly for manpower (see Table 3.3).

### Table 3. 3 Resource requirement for an additional PHC

| Resource requirement | Amount (In Rs. ) | Type of Cost |
|---|---|---|
| Operational expenditure | 1,80,000 | Recurring |
| Capital expenditure (IT) | 1,73,800 | Non-recurring |
| Capital expenditure (Physical infrastructure) | 60,000 | Non-recurring |
| Total cost per PHC | 4,13,800 | Recurring + non-recurring (for the first year) |

### Additional Costs to the Government/State

a)  A 2017 Karnataka study assessed the annual human resource costs of running a PHC (Padvetnaya et al). After accounting for inflation, human resource costs currently stand at approximately ₹ 70 lakhs. If the State Health Authority of Karnataka were to adopt the DiNC initiative, and station one PCC at every PHC, the

costs of running a single PHC, from a manpower costs perspective, would see an increase of only about 2.6%.

b) Within public health systems in India, emphasis on digital infrastructure and technologies has been a more recent phenomenon. As a result, this study is unable to comment on the additional funds the state would require to set up the DiNC digital infrastructure. The study team may lack crucial data or insights into the financial implications of this initiative due to the nascent stage of digital health within the broader context of India's public health system.

## Costs Associated with Specific Services

### Activity Based Costing

Utilising the Activity Based Costing (ABC) method and employing a top-down approach to economic evaluation, this section explores capital and operational expenditures in detail, differentiated by services provided. This analysis aids in determining cost amounts, identifying key cost drivers, and estimating resources necessary to sustain or expand an intervention. The analysis does not delve into estimating resource requirements for scaling up the initiative due to the limited scope of this study. The reasons why such analysis was not possible at this point have been detailed in the limitations section at the end of this chapter.

In this costing analysis, the first step is to establish the entity that is expected to bear the costs associated with the programme. This is followed by the identification of the healthcare institutions where the initiative's services are provided. Thereafter, a list of key services which act as 'cost-centres' is mentioned. Each cost centre

is matched to the economic resources required and aggregate costs are calculated to reach the annual costs attributable to each cost header and each facility.

a) While currently being run and invested in entirely by Tata MD, this cost analysis is carried out from the perspective of government spending on healthcare, and the additional costs that the government would have to undertake if it adopts the DiNC initiative and scales it up to other districts of the state, or other regions of the country. The per-facility costs required to run the initiative will help determine the marginal costs attributable.

b) The DiNC established in Kolar leverages existing public health care facilities, which include District Hospital (DH), Taluk Hospitals (THs), Community Health Centres (CHCs), and PHCs to provide its services. Physical and digital infrastructural additions have been made as part of the initiative in all of these facilities, i.e. the DiNC micro arena and V-POD rooms.

c) Key government health services augmented:

- Maternal and Child Health (MCH)
- Non-Communicable Diseases (NCD)
- Mental health services
- Geriatric care
- Tuberculosis care

These services are the various 'cost-centres' under our costing methodology and help ascertain the proportion to which workload can be attributed to a specific service. Understanding how resources are spread out across various services helps identify the approximate costs that go towards each of them. The above-mentioned exercise is done for the nerve centre as well as health facilities.

**1. Costs Incurred at the DiNC by Service Type**

During field visits, it was noticed that the core tasks of the nerve centre personnel comprise the inbound or outbound calls, which may be clinical, semi-clinical, or non-clinical (See Table 3.4). These calls have been used as a proxy measure to ascertain the services towards which the staff contributes the most amount of time and the ratios in which they contribute to the workload at the nerve centre.

The ideal manner of conducting a cost analysis of this type would have been to observe in detail each of those employed at the nerve centre, the nature of calls they attend, and the distinction, if any, in the time allotted to different types of calls. However, due to the limited scope and short duration of this study, the research team restricts itself to the assumption that the number of calls provides a close representation of workload distribution at the nerve centre.

**Table 3. 4** **Costs associated with each service type, based on their contribution to the total workload at the DiNC**

| Service Type | Total Calls (Annually for the period 2022-23) | (In Rs.) | | |
|---|---|---|---|---|
| | | Costs associated at the level of DiNC (Capital + Operational) | Capital Costs (Non-recurring) | Operational Costs (Recurring) |
| Information Service | 30,662 | 65,78,329 | 39,87,193 | 25,91,136 |
| Mother and Child Care | 28,400 | 60,93,032 | 36,93,049 | 23,99,982 |
| Hospital Appointment | 22,794 | 48,90,301 | 29,64,062 | 19,26,239 |
| Rashtriya Bal Swasthya Karyakram | 21,638 | 46,42,289 | 28,13,739 | 18,28,550 |
| Non-communicable diseases | 10,305 | 22,10,869 | 13,40,031 | 8,70,839 |
| Mental Health | 7,609 | 16,32,460 | 9,89,451 | 6,43,009 |
| General Counselling | 7,308 | 15,67,883 | 9,50,310 | 6,17,573 |
| Tuberculosis | 6,370 | 13,66,641 | 8,28,335 | 5,38,306 |
| Non-medical | 1,044 | 2,23,983 | 1,35,759 | 88,225 |
| COVID-19 Care | 618 | 1,32,588 | 80,363 | 52,225 |
| Bed Management | 117 | 25,102 | 15,214 | 9,887 |
| Geriatric Care | 108 | 23,171 | 14,044 | 9,127 |
| Feedback | 58 | 12,444 | 7,542 | 4,901 |

**Analysis and Interpretation**

As can be seen from Table 3.4, the majority of calls within the DiNC system can be attributed to information services, followed by maternal care, hospital appointments, and RBSK and NCDs. Therefore, it can be inferred that a bulk of the investments towards the DiNC can be attributable to the above mentioned services and associated activities.

In this manner, the DiNC serves greatly to the non-clinical needs of Kolar's citizens. Likewise, within the spectrum of health services it enhances, MCH claims the largest share of both time and resources.

Such a segregated analysis of costs associated with various health services gives readers an idea of current resource distribution along with projections for future budgetary considerations. It's important to highlight that as the workload escalates, such as with the growing awareness of DiNC's toll-free number, additional resources will be necessary to address the heightened demand for services.

**2. Costs Incurred at the Health Facilities by Service Type**

Similar to the methodology used above, the costs attributable to each of the key services, at the level of facilities are calculated. In this case, Out-Patient

**Table 3. 5** **Costs associated with each service type, based on their contribution to the total workload at health facilities**

| Service | In-Person Care and Guidance (Annually for the period of 2022-23) | (In Rs.) | | |
|---|---|---|---|---|
| | | Costs associated at the level of facilities | Capital Costs (Non-recurring) | Operational Costs (Recurring) |
| Maternal and Child Health | 95,694 | 1,73,20,989 | 92,65,968 | 80,55,021 |
| Others | 44,668 | 80,85,083 | 43,25,164 | 37,59,919 |
| Geriatric Care | 43,737 | 79,16,569 | 42,35,016 | 36,81,552 |
| Non-communicable Diseases | 31,448 | 56,92,211 | 30,45,083 | 26,47,128 |
| Mental Health | 2,818 | 5,10,069 | 2,72,865 | 2,37,205 |
| RBSK | 1,280 | 2,31,685 | 1,23,941 | 1,07,744 |
| TB Care | 536 | 97,018 | 51,900 | 45,118 |
| Covid Care | 75 | 13,575 | 7,262 | 6,313 |

Elderly couple receiving care at a Health and Wellness Centre, supported by ASHA, CHO, and ANM

Department (OPD) consultation data (in-person care and guidance) is used to determine service-wise workload.

**Analysis and Interpretation**

Even when considering in-person care, a bulk of costs incurred at the facility level are a consequence of MCH services (See Table 3.5). Followed by MCH services are others (e.g. communicable diseases, checkups after surgery, etc.), geriatric care, and NCDs which also make up relatively large shares of the total costs.

For instance, to provide maternal and child care services, the DiNC initiative requires an investment of approximately ₹ 93 lakhs in capital costs (in the first year) and recurring costs of more than ₹ 80 lakhs each year.

This can be a helpful way to ascertain the amount of resources required at the facility level to operationalise maternal and child health services and similarly for other services.

## Summary of Insights from DiNC Cost Analysis

### Key findings

i) The cost analysis finds that a state with districts having a population and number of facilities similar to that of Kolar can replicate the DiNC initiative and would incur more or less similar costs. To introduce the programme in such a district, the state would undergo approximately ₹3.91 crores as capital expenditure upon establishment and ₹3.14 crores of operational expenditure in each of its years of functioning.

ii) In terms of human resources, at the level of a PHC, there exists only a 2.6 % increase in costs, which appears to be rather promising given the range of services a PCC supports. Critical services such as aiding patient navigation, preventive and promotive guidance, encouraging treatment adherence, referrals to specialists, video consultations, and more add abundantly to augment the existing public health system.

iii) Since the DiNC acts as a hub connecting with the many facilities in the district, an additional PHC added to the network does not result in very high set-up costs. The marginal cost of adding another PHC to the existing network is just about ₹ 4.14 lakhs.

iv) Currently, virtual enablement services in the Kolar district are only extended to the level of the PHC. If virtual services of the DiNC were to be provided even at the level of SHC-HWCs, some additional costs would have to be incurred to add the requisite infrastructure.

### Limitations

i) One prominent and recurring challenge faced by the research team was the insufficient sharing of data. Data received such as call data which include hospital bookings and information requests could not be matched to a specific health service, making it difficult to reach more robust service-specific costs. Such analysis would have provided a more comprehensive understanding of overall service-wise costs.

ii) In-person consultation data was also received in consolidated formats, lacking distinctions by health facilities. In the absence of such bifurcation, it was challenging to reach costs per patient for a specific service at the different health facility levels.

iii) In general, the initiative seems to have incurred modest additional costs from a health systems perspective, given the range of services it provides, namely appointment booking, virtual counselling, teleconsultations, follow-ups, referrals, patient navigation, and more. A full-fledged cost-effectiveness analysis involving calculating improvement in outcomes for each additional unit of investment and comparing such benefits with alternative digital public health models would yield more insights into the cost-effectiveness of DiNC.

iv) Upon assessing the activities of the DiNC, it became evident that some duplications exist. This includes registrations that occur both at

Leveraging Digital Solutions for Universal Health Coverage

the DiNC micro-arena and e-hospital desk, teleconsultations facilitated by the DiNC and eSanjeevani and follow-ups for NCD patients which are carried out by DiNC counsellors and dedicated government personnel. Such parallel operations should be identified to minimise duplications and further optimise costs.

DiNC patient care coordinator assisting patients at a health facility

# Chapter 4

# Services Covered by DiNC and Utilisation Patterns

The chapter is aimed at providing a comprehensive understanding of Digital Nerve Centre's (DiNC) key processes, which includes the known citizen drive (population registration), virtual care coordination (inbound and outbound calls), and video consultations and simultaneously assessing the impact of the initiative on specific programmes of Maternal and Child Health (MCH), Non-Communicable Diseases (NCD), Tuberculosis (TB), mental health and elderly care captured through service utilisation, follow-up care, referral appointments, and virtual consultations.

An attempt has been made to indicate utilisation trends across these processes and programmes to understand their uptake and evolution over the years, supported by DiNC. Analysis of service utilisation relies on secondary data made available from DiNC's HealthX application and Tata's health analytics dashboard. Additionally, Tata's internal monitoring survey has been used to evaluate progress on select maternal health outcomes for a sample of mothers.

## Known Citizen Drive (KCD) – Population Registrations

The KCD was initiated at the programme's inception in 2017 with the overarching objective of increasing service utilisation in public health facilities. Accredited Social Health Activists (ASHA) workers conducted door-to-door visits, collecting citizens' essential demographic information, and spreading awareness about DiNC. Then through word-of-mouth and in-person registrations at Primary Health Centres (PHCs), DiNC continued to expand its citizen database.

To an extent, this effort has achieved the goal of identifying Kolar's citizens with a need to continue such an exercise through day-to-day registrations at public health institutions and by conducting periodic and frequent door-to-door visits led by primary health care teams.

The DiNC engaged ASHA workers for the drive, starting in November 2017. Within just five months of the exercise, by March 2018, the DiNC managed to capture more than three lakh citizens. The number of registrations surged significantly in the following year as the DiNC became fully operationalised. By 2019, a substantial portion of the Kolar population was registered, leading to a decline in subsequent years, as near saturation was already accomplished. The slight uptick in registrations in 2021, compared to 2020, can be attributed to the COVID-19 pandemic, necessitating frequent visits to public health facilities (See Graph 1).

The HealthX application presently contains data for over 24 lakh registered citizens. However, a comprehensive review of their registration procedures has revealed discrepancies, leading to an overestimation of Kolar's population, which stands at approximately 16 lakhs. These inconsistencies stem

from the double counting of certain individuals, the failure to remove data of deceased persons, and the inclusion of transient populations.

No significant gender differences were observed in registration, reflecting DiNC's success in ensuring both genders seek health care (See Graph 2). Between 2019-20 and 2020-21, more male registrations were done. However, in 2022-2023, the rise in female registrations can be explained by more women availing of MCH services, in the post-COVID-19 period.

## Virtual Care and In-person Care Service Utilisation

### Virtual Care (inbound/outbound calls)

A key aspect of the DiNC initiative is its toll-free number (1800 425 4325), facilitating citizen's access to care coordinators. The system enables both inbound and outbound calls to the centrally located nerve centre, staffed with qualified digi-nurses and doctors. Inbound calls originate from citizens attempting to reach out to the nerve centre via the toll-free number, while outbound calls are initiated by nerve centre staff to connect with citizens during their care-seeking process.

This section examines trends in both inbound and outbound calls to understand the impact and breakdown of DiNC virtual care services in terms of accessibility and usage.

The higher number of total calls in 2020-21 and 2021-22 in comparison to 2022-23 can be explained by the fact that during the COVID-19 pandemic, DiNC was serving as a 'COVID War Room' for the entire district. The nerve centre played a central role in responding and disseminating critical information including COVID-19 appropriate behaviours and vaccination through virtual counselling of citizens (See Graph 3).

Outbound calls consistently outnumbered inbound calls throughout this period. This reflects the DiNC staff's proactive efforts in ensuring follow-up and counselling. Moreover, it was revealed during qualitative interviews that many service users contacted PCCs of respective health facilities directly, which is not captured in the DiNC system.

### Inbound Calls

The DiNC system received a significant number of inbound calls, with the highest number of calls being recorded in the year 2021-22. For the majority of the time, citizens called the DiNC for information requests, followed by counselling support (See Graph 4). This reflects the growing trust and confidence of citizens in DiNC nurses and doctors.

The increase in calls during 2021-22 can be attributed to the growing demand for virtual care due to the COVID-19 pandemic. Additionally, there was an increase in virtual counselling sessions and calls for bed management support during this period.

For the year 2022-23, about 81.6% of patient calls were for information requests. These typically involve non-clinical inquiries, such as specific government schemes or facility-related doubts, including doctor availability and immunisation schedules. Apart from this, 15.5% of calls were to avail counselling services from DiNC personnel.

### Outbound Calls

Outbound calls made by the DiNC staff represent the proactive approach to reaching citizens and are more targeted in nature and specific service related. These calls are made by coordinators or digi-nurses to offer counselling and guidance, follow-ups, treatment adherence, or non-medical queries.

The analysis of outbound calls denotes a strong emphasis on MCH services (See Graph 5). The DiNC care coordinators and digi-nurses make these calls to support pregnant mothers in attending ANC check-ups and provide dietary and lifestyle counselling. Calls for RBSK, mental health, and NCDs are also significant in number in 2022-23. A significant number of outbound calls are non-medical, providing information, resolving inquiries, and arranging hospital appointments.

**Video Consultations**

Another key feature of the DiNC system is its ability to facilitate video consultations in cases of non-availability of doctors at the nearest public health facility, with specialist doctors, and more.

As is evident from Graph 6, video consultations show a steady increase over time, with over 18,000 such consultations occurring in 2022-23 alone. The COVID-19 pandemic resulted in a significant shift towards teleconsultation services, among citizens as well as healthcare providers. The DiNC initiative is no exception to this trend, as it has also witnessed a surge in teleconsultations. Most of these teleconsultations are for Lamaze sessions, followed by general consultations (See Graph 7).

**Trends in Registrations and Virtual Care Service Utilisation**

Graph 1

**Registations (Unique)**

**Yearly Distribution**

Count



| Year | Count |
|------|-------|
| 2017-18 | 3,29,138 |
| 2018-19 | 6,96,999 |
| 2019-20 | 4,30,317 |
| 2020-21 | 3,17,151 |
| 2021-22 | 3,21,144 |
| 2022-23 | 1,86,572 |

Total registrations as on 31st March, 2023
(sum of all years) - **22,81,321**

**Graph 2**

## Registrations Categorised by Gender (Unique)
### Yearly Distribution

| Year | Male | Female | Others |
|------|------|--------|--------|
| 2017-18 | 1,61,693 | 1,67,445 | 0 |
| 2018-19 | 3,49,574 | 3,47,407 | 18 |
| 2019-20 | 2,37,313 | 1,92,992 | 12 |
| 2020-21 | 1,86,396 | 1,30,745 | 10 |
| 2021-22 | 1,67,083 | 1,54,052 | 9 |
| 2022-23 | 86,465 | 1,00,091 | 16 |

**Graph 3**

## Outbound vs Inbound Calls
### Yearly Distribution

Out-bound
In-bound

1,46,372
1,13,282
99,584
27,601
54,016
37,152

2020-2021    2021-2022    2022-2023

Nature of Call/ Year
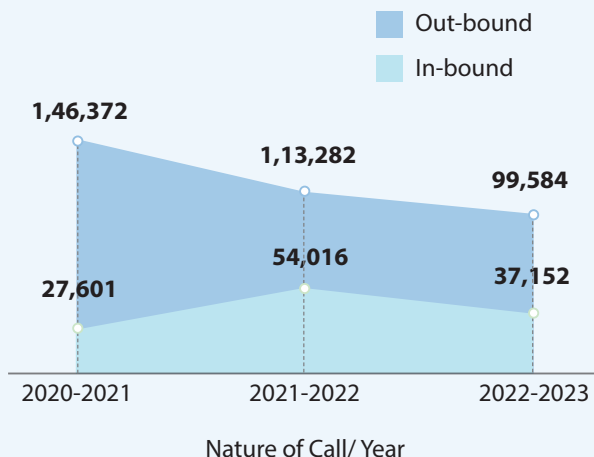
**Graph 4**

## Inbound Calls by Type
### Yearly Distribution

Count

35k
30k
25k
20k
15k
10k
5k

2020-2021: 18,861 — 7,505 — 56 — 1,179
2021-2022: 23,289 — 8,747 — 17,353 — 4,627
2022-2023: 30,323 — 5,766 — 605 — 458

Nature of Call/ Year

■ Information Requests    ■ Counseling support    ■ COVID Care    ■ Others
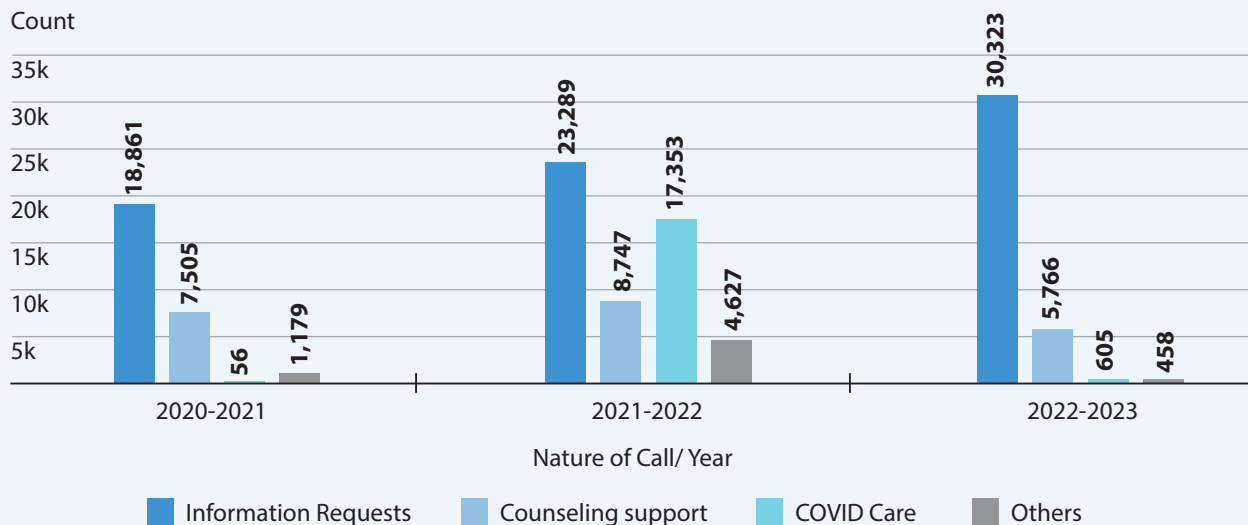
**Graph 5**

## Outbound Calls by Type
### Yearly Distribution
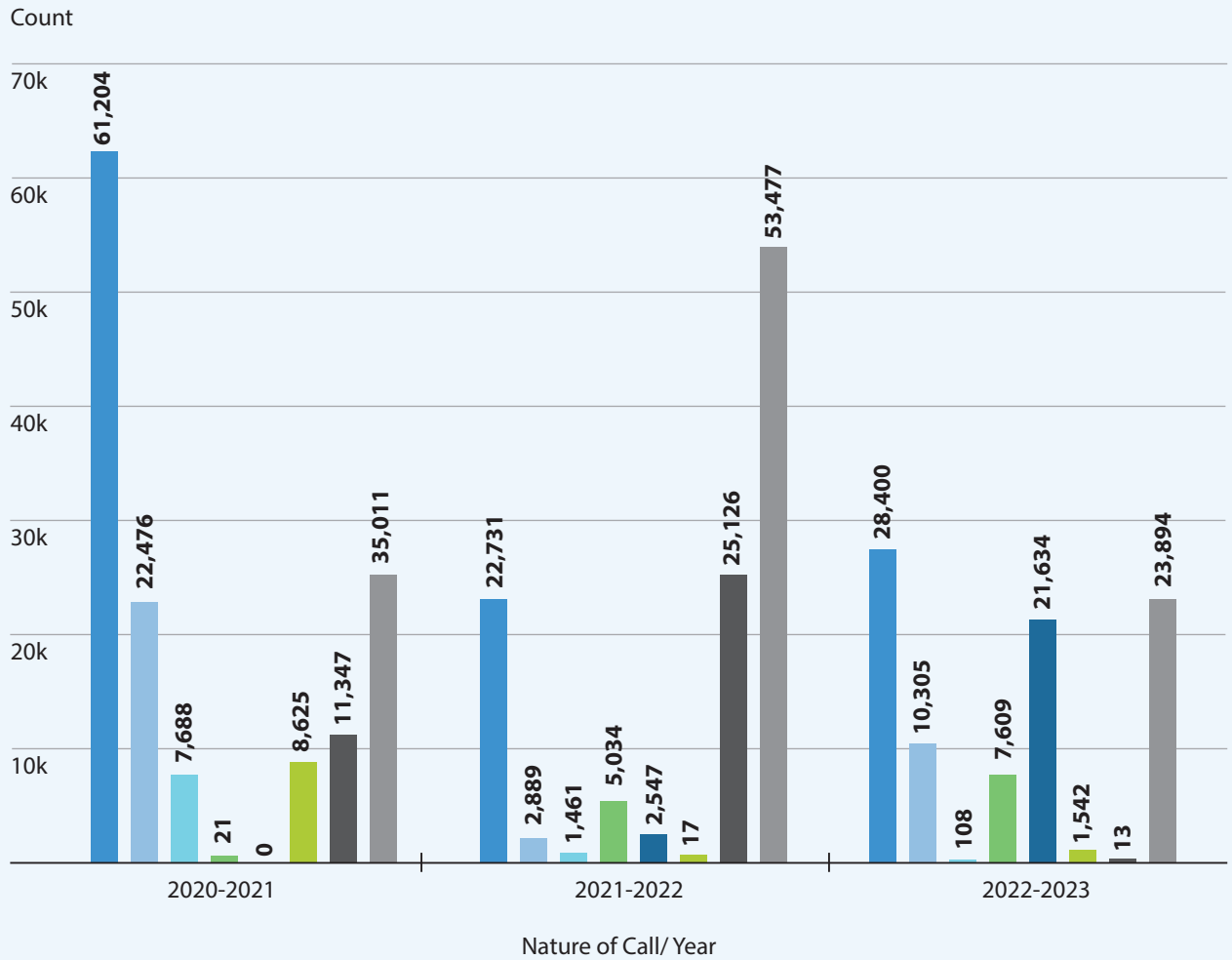
**Trends in Video Consultations and In-Person (OPD) Consultations**

## Graph 6

### Video Consultations
**Yearly Distribution**

Count

20k — Total number of virtual consultations scheduled for patients — 18,910

10k — 6,205

2,224

2020-2021   2021-2022   2022-2023
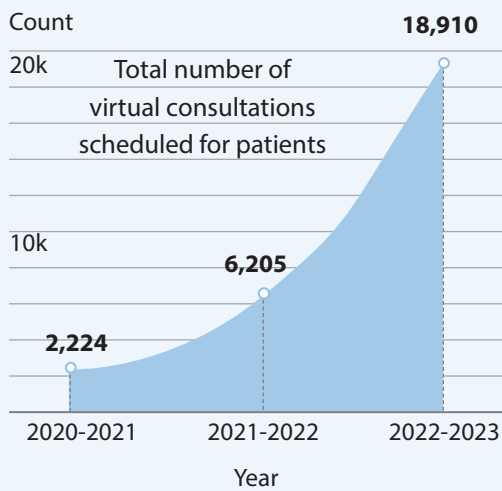
Year

## Graph 7

### Video Consultations by Type
**Yearly Distribution**

| Year | 2020-2021 | 2021-2022 | 2022-2023 |
|---|---|---|---|
| Lamaze | 1,064 | 3,615 | 10,554 |
| General | 946 | 2,320 | 5,926 |
| NCD | 196 | 167 | 56 |
| Mental health | 0 | 81 | 150 |
| Pediatrics | 0 | 9 | 49 |
| Obstetrics and Gynaecology | 9 | 5 | 1 |

## Graph 8

### OPD Consultations by Gender
**Yearly Distribution**

Count

250k

200k

150k

100k

50k

**2020-2021**: 85,054 (Male), 1,04,738 (Female), 3 (Other) — 1,89,795*

**2021-2022**: 1,43,424 (Male), 1,65,495 (Female), 12 (Other) — 3,08,931*

**2022-2023**: 1,78,187 (Male), 2,24,844 (Female), 13 (Other) — 4,03,044*

Gender/Year
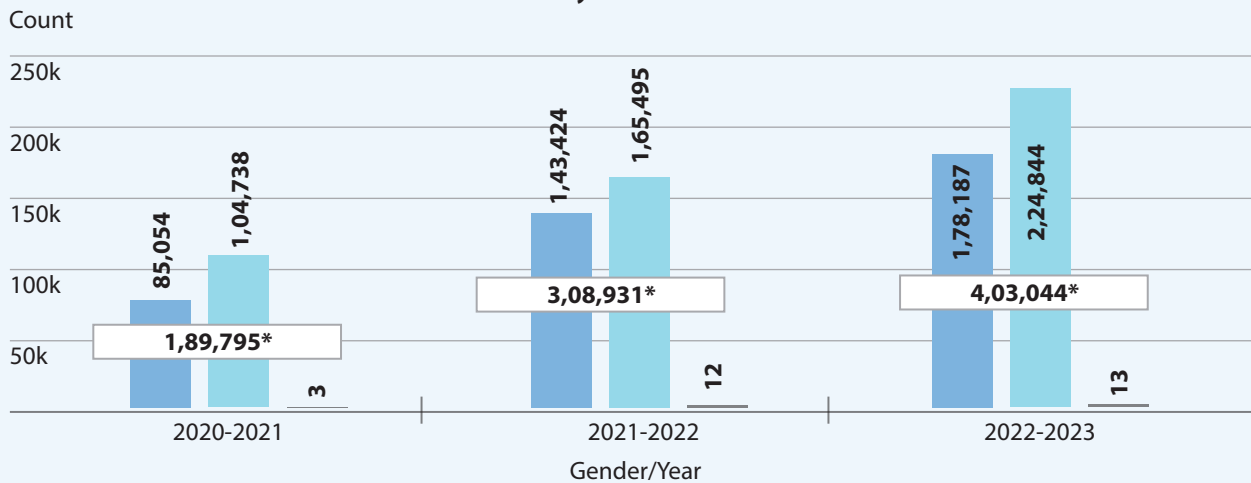
■ Male   ■ Female   ■ Other

*Total number of OPD consultation (in-person) faciliated by DiNC

### In-Person Care (OPD Consultations)

Apart from the virtual form of service utilisation, physical appointments for outpatient care in public health facilities have also consistently risen during this period (see Graph 8), as can be seen in the graph above. More women than men are seen visiting public facilities for OPD, likely to have a positive impact on outcomes of women's health.

## Services Targeted and New Components Added Over the Years

### Maternal and Child Health

The earliest service area targeted by the DiNC initiative was Maternal and Child Health (MCH), which remains their prime focus area. Utilising digital technology, it aimed to enhance MCH by assisting mothers and children throughout their interactions with the public health care system and complementing government efforts in the following ways.

### Maternal Health

i.  **Linking with Primary Care Providers:** Upon pregnancy confirmation, a line list of pregnant mothers is shared by the primary health care team with the DiNC. Through DiNC-enabled health facilities across the district, pregnant women are registered and informed about the Thayi Card (Thayi, translating to mother) benefits. Their ANC visits, diagnostics, ultrasounds, vitals, and outcomes are recorded by using a tagging system.

ii. **Setting Appointments and Reminders for ANC Visits:** The digital system enables PCCs to schedule appointments and send timely reminders to pregnant mothers, saving them from long hospital queues.

iii. **Assured Consultation:** DiNC staff helps pregnant women book fast-track appointments, which in turn promotes PHC visits. If no doctor is available nearby, the pregnant mother can consult via DiNC's video calling feature. Appointments can be scheduled up to 30 days in advance.

iv. **Continuous Follow-up and Counselling Support:** Besides appointment booking, DiNC nurses stay in touch with mothers throughout pregnancy. For high-risk cases, they urge visits to higher facilities. At six months, DiNC requests primary contact details for delivery preparation. Mothers are advised to consult their local ASHA for micro-birthing plans. During counselling, DiNC offers family planning information, educates on contraceptives, and supports mothers in coping with mental distress and anxiety pre- and post-childbirth.

v.  **Coordination Support During Hospital Visits:** Expectant mothers benefit from the presence of PCCs at DiNC arenas in every PHC, CHC, TH, and DH. The PCCs help in hospital processes, ensure understanding of diagnoses, and encourage follow-ups. They also provide vital information on supplements, dietary needs, delivery education, and breastfeeding counselling.

*Service Utilisation*

In key aspects related to maternal care services i.e., unique number of mothers registered and in-person care, both showed an increase recently. However, this number was low in the COVID-19 pandemic years i.e., 2019-20, and 2020-21 (See Graph 9), which can be explained by a lower number of ANCs and deliveries happening in government facilities during the pandemic and associated lockdowns.

In-person care for maternal health services has increased steadily since 2019-20 (See Graph 9), while virtual care peaked during the pandemic, i.e., 2019-20 and 2020-21 (See Graph 10), clearly indicating positive usage of the DiNC virtual care features to meet the maternal health needs and queries during a time when access to health facilities had reduced.

Another unique feature of the DiNC's virtual care services is Lamaze sessions, conducted each Wednesday for women in their second and third trimesters. When a woman visits her nearby PHC for an ANC check-up, the PCC takes the mother to the V-POD room and connects virtually with a DiNC doctor or nurse who conducts group Lamaze sessions for all mothers visiting the facility on the given day. The Lamaze sessions usually include basic exercises comprising of stretching, relaxation and breathing exercises, rotating and wiggling of toes, etc. Graph 11 shows that since 2018, Lamaze sessions have risen significantly over the years. The provision of such innovative classes reflects DiNC's ability to use its existing virtual care infrastructure for multiple purposes.

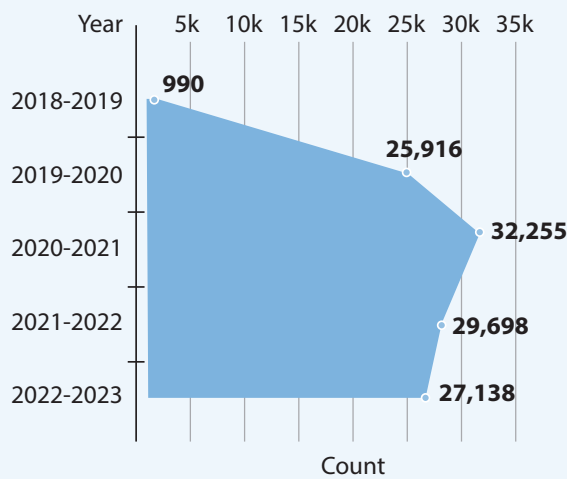**Trends in Service Utilisation for Maternal Care Services**

**Graph 9**

### Registrations (Unique) Compared to In-Person Care - Maternal Health
**Yearly Distribution**



**Count**
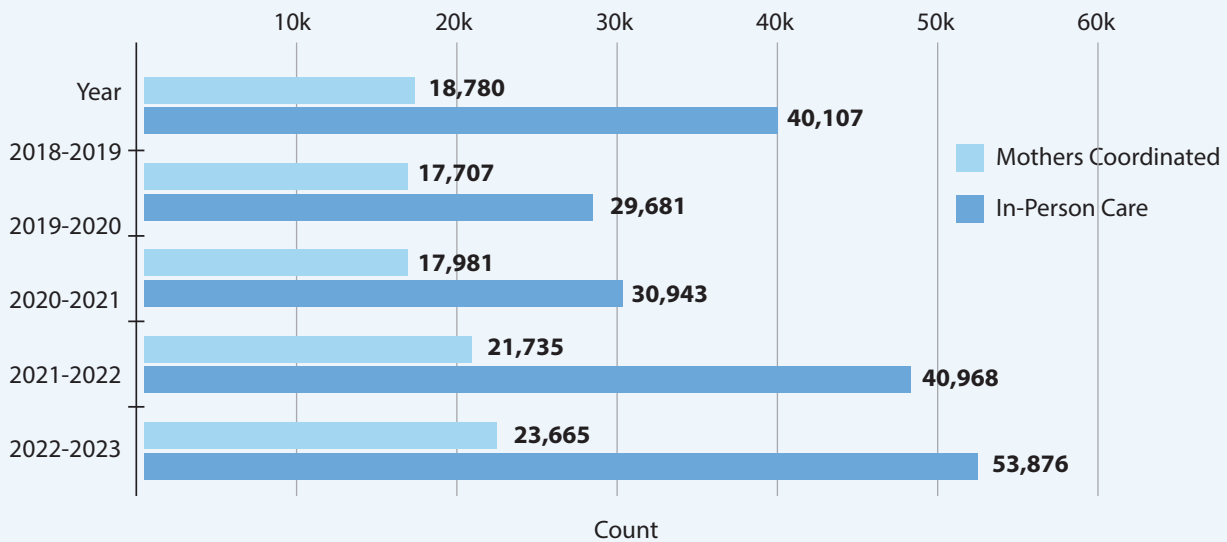
**Graph 10**

## Virtual Care (Inbound + Outbound) - Maternal Health
### Yearly Distribution



| Year | Count |
|------|-------|
| 2018-2019 | 990 |
| 2019-2020 | 25,916 |
| 2020-2021 | 32,255 |
| 2021-2022 | 29,698 |
| 2022-2023 | 27,138 |

**Graph 11**

## Lamaze Sessions Conducted - Maternal Health
### Yearly Distribution



| Year | Count |
|------|-------|
| 2018-2019 | 760 |
| 2019-2020 | 620 |
| 2020-2021 | 1,064 |
| 2021-2022 | 3,615 |
| 2022-2023 | 10,551 |
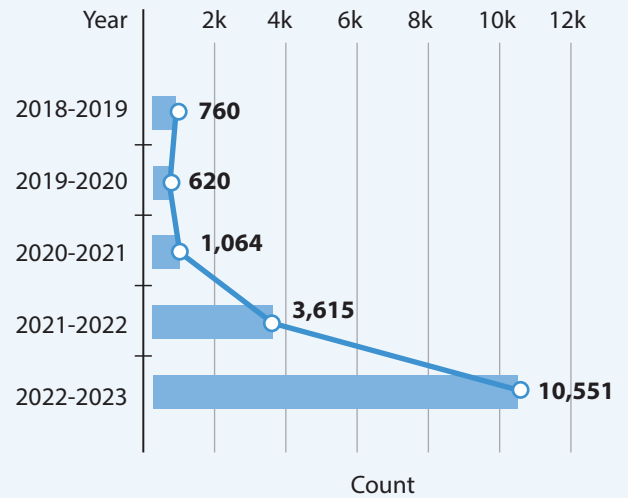
**Table 4. 1**   **Outcomes Indicators for Maternal Health Services (2023-24)**

| Maternity Care | Total (%) |
|----------------|-----------|
| Mothers who had an antenatal check-up in the first trimester | 96.3 |
| Mothers who had at least 4 antenatal care visits | 99.8 |
| Mothers who consumed iron folic acid for 100 days or more when they were pregnant | 99.8 |
| Mothers who consumed iron folic acid for 180 days or more when they were pregnant | 99.1 |
| Protected against TD Vaccination | 100 |
| **Delivery Care** | **Total (%)** |
| Institutional births in public facility | 73.5 |
| Births attended by skilled health personnel | 99.8 |
| Births delivered by caesarean section | 53.9 |

### Survey Conducted by Tata Medical and Diagnostics

In the context of maternal health outcomes, a relevant and related reference is a survey carried out by Tata MD throughout 2023-24. Table 4.1 summarises the findings of their survey. During this survey, 6,763 mothers were approached to understand the effectiveness of maternal care services being provided under the DiNC initiative. The mothers were selected from the HealthX database, and a filter was used to obtain a random sample of 7,000 mothers who had delivered within the last year. Each mother was surveyed employing telephonic calls in which close-ended questions were asked aligned to a specific set of indicators, such as the number of ANC check-ups, duration of Iron Folic Acid (IFA) consumption, delivery type, and more.

The survey measured eight maternal health service indicators. Out of the eight indicators, six recorded a higher mean percentage. However, the lesser institutional deliveries in public health facilities and a higher percentage of births by caesarean section require further exploration.

### Child Health

The following services are offered under Child Health Services by DiNC:

i)   **Health Records and Caregiver Support:** A new record is created for each newborn, digitally linked to their mother. The tagging system tracks updates on immunisations and DiNC care coordinators educate mothers on newborn health, stressing exclusive breastfeeding for six months, complementary feeding, early screening, and more.

ii)  **Rashtriya Bal Swasthya Karyakram (RBSK):** A vital aspect of DiNC's Maternal and Child Care Coordination (MC3) service is providing support for the RBSK programme. The RBSK data is shared with DiNC, where digi-nurses coordinate appointments, referrals, and follow-ups, address clinical and non-clinical queries, and raise awareness about immunisations.

Vitals and hospital visits captured on the digital software allow the DiNC coordinators to monitor compliance and treatment. The personnel also guide patients with dietary and nutritional needs, exercise, and physical therapy, amongst other things.

### Service Utilisation

The DiNC offers childcare coordination services from the birth of a child up to 18 years of age. Services include support for the immunisation of children through counselling, fixing appointments, and sending reminders periodically to mothers and families. Then, DiNC PCCs help in navigating patients at health facilities and ensuring vaccination of the children. Guidance on micro-nutrients and supplements such as Oral Rehydration Solution (ORS), zinc, and deworming tablets is provided over telephonic calls. Finally, video consultations and in-person consultations are arranged with paediatricians.

Graph 12 depicts the in-person care facilitated by DiNC through appointment fixing, reminders to patients, and navigation of patients in the facility by PCCs. The number of in-person care offered remains almost consistent over the years with a slight increase in 2021-22 and 2022-23. However, the number was low in the pandemic year of 2020-21, possibly due to the impact of the COVID-19 situation and associated lockdowns.

Total virtual care (inbound and outbound calls) provided under childcare seems to be inconsistent across the years (See Graph 13). However, they

were highest during COVID-19, i.e., 2020-21. In general, in-person care facilitated by DiNC is higher than the virtual care offered, except during 2020-21, due to the COVID-19 situation and lockdowns.

The DiNC coordinated efforts towards ensuring immunisation through reminders and follow-up has increased over the years as seen in Graph 14. The DiNC has facilitated the immunisation of more than 50,000 children in 2022-23, which is a remarkable achievement.

Beginning in 2021, a similar effort of coordination and counselling has also been made under another priority programme of RBSK. Within a year of extending its services to RBSK beneficiaries, the

DiNC registered more than 5,000 patients (See Graph 15). The RBSK programme, which is related to health conditions of the four Ds, i.e., Deficiencies, Delays, Defects, and Diseases, mandating frequent follow-ups, counselling, and coordination, has immensely benefitted from the virtual care features of the DiNC initiative.

The distribution of 4 Ds during 2022-23 (See Figure 4.1), consisted of deficiencies (47%), followed by childhood diseases (24%), and developmental delays and disabilities (18%). In terms of recovery, during the year 2022-23, as can be seen in Figure 4.2, it was observed that the maximum patients were those who were suffering from diseases of childhood (34%), followed by developmental delays and disabilities (23%) and deficiencies (20%).

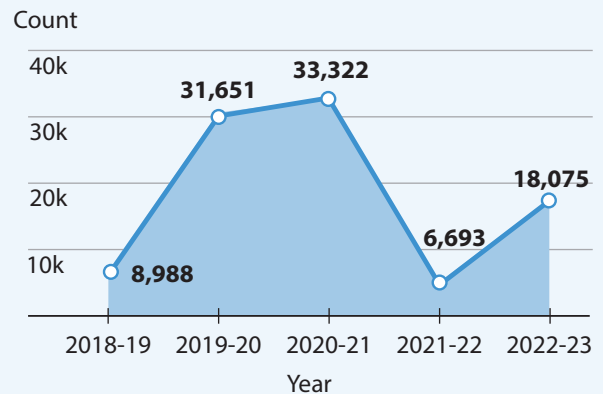**Trends in Service Utilisation for Child Care Services and RBSK**

**Graph 12**

### In-Person Consultations - Child Care
**Yearly Distribution**
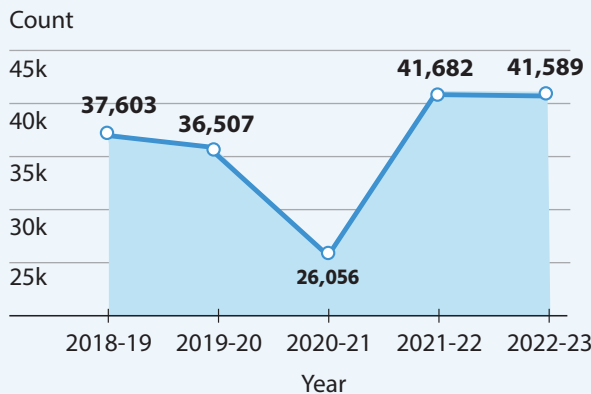


**Graph 13**

### Virtual Care - Child Care
**Yearly Distribution**

## Graph 14

### Immunisations (Unique) - Child Care
**Yearly Distribution**

Count

| | |
|---|---|
| 60k | 56,969 |
| 50k | |
| 40k | |
| 30k | |
| 20k | |
| 10k | 8,355 |
| | 1,571 |
| 96 | |

2019-20    2020-21    2021-22    2022-23
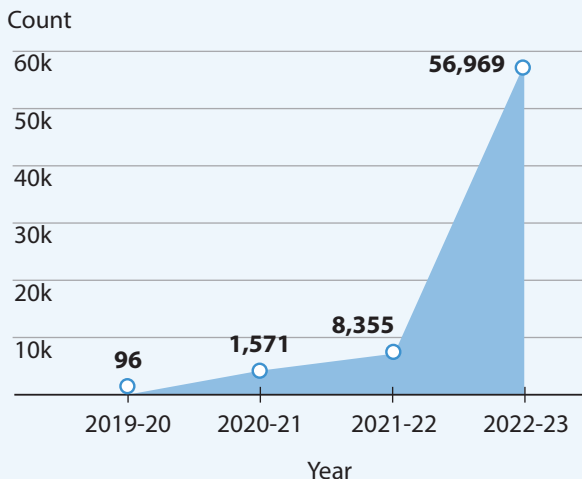
Year

## Graph 15

### Patients Contacted (Unique) vs Counselling Sessions - RBSK
**Yearly Distribution**

Count

■ Patients Contacted (Unique)
■ Virtual Counselling Held

| | |
|---|---|
| 25000 | 21,633 |
| 20000 | |
| 15000 | |
| 10000 | |
| 5000 | 5,486 |
| | 2,547 |
| 1,335 | |

2021-22              2022-23

Year
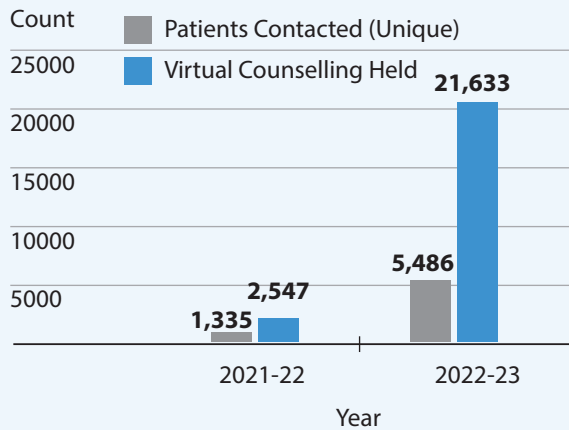
**Figure 4.1** Patients Contacted (Unique) by Type of Condition - RBSK

81
400
165
1,320
Total
5,486
5,486
963

For the Year 2022-23
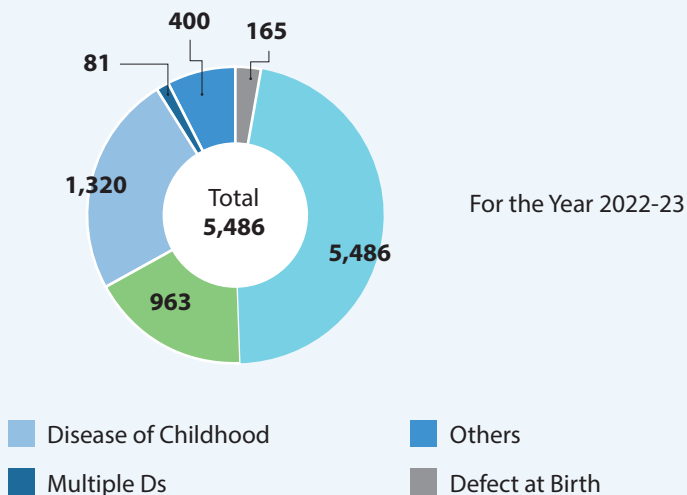
**Figure 4.2** Individuals Recovered (Unique) by Type of Condition - RBSK

342
56
10
368
622
Total
1,810
412

■ Disease of Childhood     ■ Others            ■ Deficiency
■ Multiple Ds              ■ Defect at Birth   ■ Developmental Delays and Disabilities
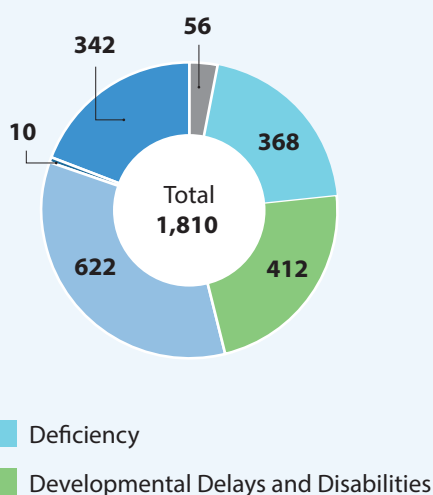
## Non-Communicable Diseases

Under the non-communicable diseases (NCD) programme, many state governments with technical and financial support from the central government have commenced several efforts to prevent and tackle the burden. Out of the common NCDs, the DiNC currently caters to diabetes, and cardiovascular diseases (heart attack and stroke).

The national programme for NCDs aims to ensure all individuals above the age of 30 are screened and encouraged to visit referred health facilities. As per the Census of 2011, the targeted adult population (above 30 years of age) in Kolar is approximately 5.76 lakhs, which is a tall order. The DiNC supplements the government's efforts in the following ways.

i) **Call-based Mobilisation for Screening:** Citizens of 30-plus age are contacted by the digi-nurses at DiNC who encourage them to visit the nearest health facility.

ii) **Counselling:** The DiNC staff also counsel patients and caregivers for two common NCDs; hypertension and type II-diabetes mellitus, and provides information on healthy lifestyle and dietary practices.

iii) **Follow-up and Treatment Adherence Support:** The DiNC staff ensures patients comply with visits and treatment process by regularly following up through calls and messages. Patients with complications are urged to visit a higher health facility and when needed, DiNC makes provisions for tele-/video consultations with specialists.

## Mental Health Care

A recently added service of immense importance within the DiNC setup is the provision of mental health care support. Catering to a mighty

population of 16 lakhs, there are a total of two psychiatrists in the public health system of Kolar. While one of them is stationed at the district hospital, the other travels across various taluk-level hospitals to deliver care. Currently, there are more than 4,000 active mental health patients registered in the DiNC system.

i) **Psychiatric Consultation:** The process of mental health care provision begins when an existing mental health patient visits a health facility and meets the PCC who then guides him or her to an in-person psychiatric consultation. Alternatively, when a psychiatrist is not present, a virtual consultation is arranged by the PCC.

ii) **Maintaining Records:** The appointments of active patients are need-based and depend on the discretion of the doctor/psychiatrist. The PCC also uploads scanned copies of prescriptions and diagnostics results into the HealthX. Care coordinators at the DiNC track visits and ensure that patients regularly visit the preferred health centres, and care coordinators follow up on cases of non-compliance.

iii) **Counselling Support:** The initiative aims to move away from medication-induced symptom reduction to recovery and rehabilitation counselling. The DiNC doctors and nurses make an extra effort to connect with active patients to provide counselling services and arrange need-based virtual consultations.

iv) **Caregiver Engagement:** In addition to counselling the patient, DiNC aims to enhance communication with the family members and primary caretakers to foster a healthy environment at the household level, create awareness about health concerns and reduce the stigma attached to mental health conditions.

As part of DiNC-led virtual calls, counselling is provided to family members of the patient by the DiNC nurses on how to take care of the patient, management of medication, seek follow-up care periodically, and more.

*Service Utilisation*

The DiNC is making several efforts to increase access to mental health services through various measures. This is illustrated through the consistent increase in unique registrations and rise in in-person as well as virtual care (See Graph 16 and 18).

While doctor-led consultations are facilitated by both, a government psychiatrist and a DiNC doctor, the number of virtual OPD consultations by a DiNC doctor for mental health remains significantly low (See Graph 17). A possible explanation could be the social stigmas and discomfort attached to mental health disorders, that limit the scope of online services for mental health care provision and patients feel more comfortable meeting the doctor in person.

**Trends in Service Utilisation for Mental Health Services**

**Graph 16**

**Registrations (Unique) - Mental Health**
**Yearly Distribution**

Count
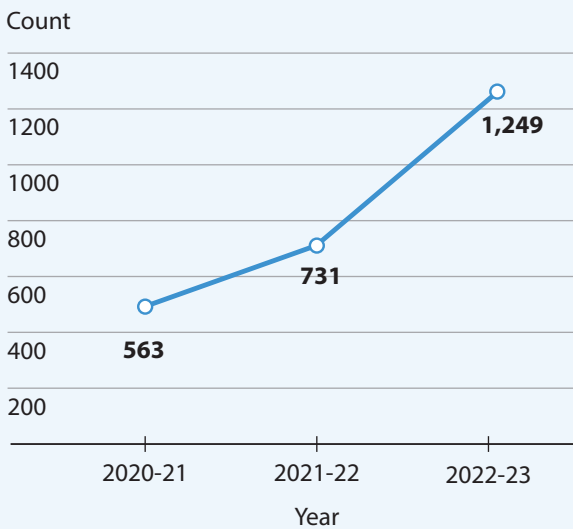


**Graph 17**

**Virtual OPD - Mental Health**
**Yearly Distribution**

Count

**Graph 18**

## In-Person Care vs Virtual Care - Mental Health
### Yearly Distribution

Count

| Year | In-Person Care & Guidance | Virtual Care |
|------|---------------------------|--------------|
| 2018-19 | 516 | 110 |
| 2019-20 | 1,081 | 35 |
| 2020-21 | 1,100 | 21 |
| 2021-22 | 1,491 | 5,257 |
| 2022-23 | 2,819 | 8,255 |

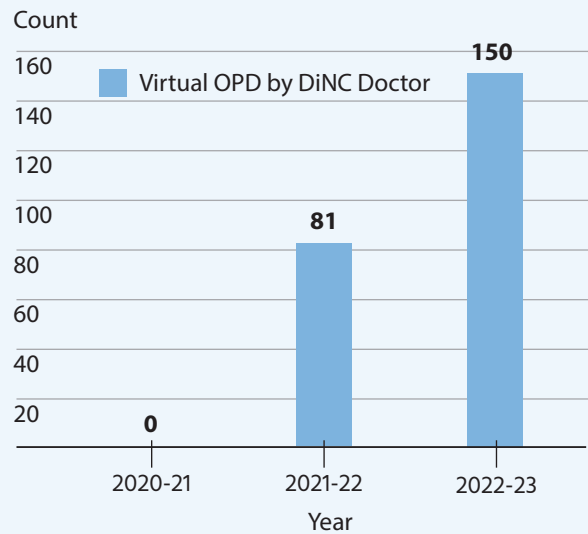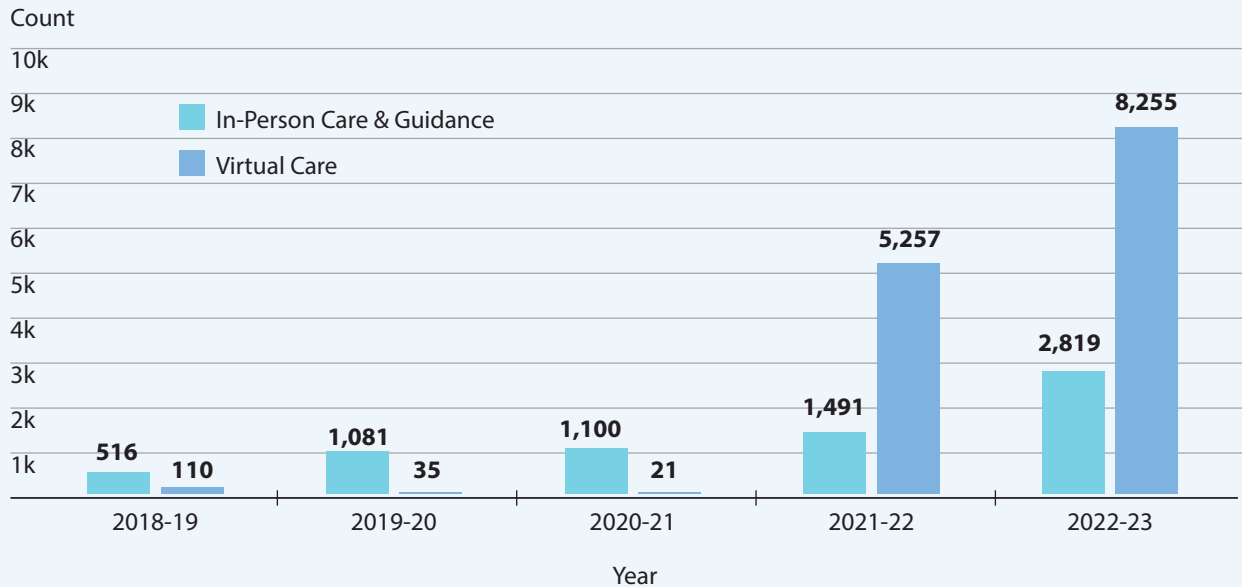### Elderly Care

Elderly care refers to the health care needs of senior citizens, above the age of 60 years. The DiNC aims to complement the National Programme for Health Care for the Elderly (NPHCE) and provides the following services to cater to the elderly.

i) **Scheduling Appointments:** The DiNC's digital services help schedule patient appointments thus reducing wait times and follow-up with patients to ensure compliance with treatment procedures. Those with complications are urged to visit higher health facilities.

ii) **Elderly Sensitive Care in Health Facilities and DiNC:** The counsellors, doctors, and nurses at the DiNC have received special training to provide attentive and sound advice to geriatric patients. Each staff member has been trained to exhibit politeness, kindness, and greater sensitivity while interacting with elderly patients, considering the barriers in communication and comprehensibility that may arise due to old age. The staff is also proficient in the local language and receive thorough training to enhance their communication skills, and their ability to empathise with problems concerning the elderly.

*Service Utilisation*

Individuals under care have steadily risen over the years since the inception of the DiNC, as seen in Graph 19. These individuals were the highest in 2020-21, which coincides with the COVID-19 pandemic. The number has declined in the subsequent years. The virtual care calls have also shown a similar pattern (See Graph 20).

**Trends in Service Utilisation for Elderly Care Services**

**Graph 19**

### Patients Registered (Unique) vs In-Person Care - Elderly Care
**Yearly Distribution**
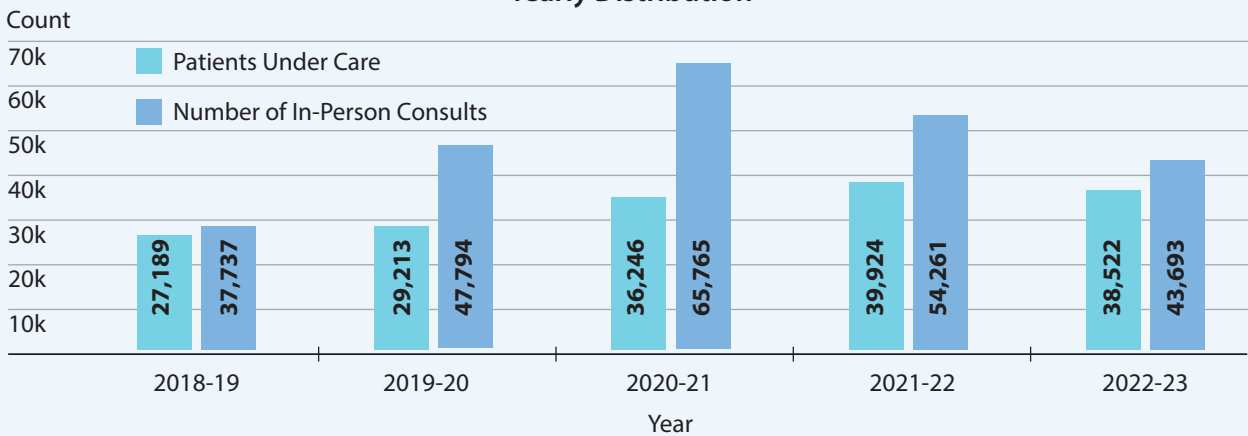


**Graph 20**

### DiNC Initiated Calls vs Patient Initiated Virtual Care - Elderly Care
**Yearly Distribution**
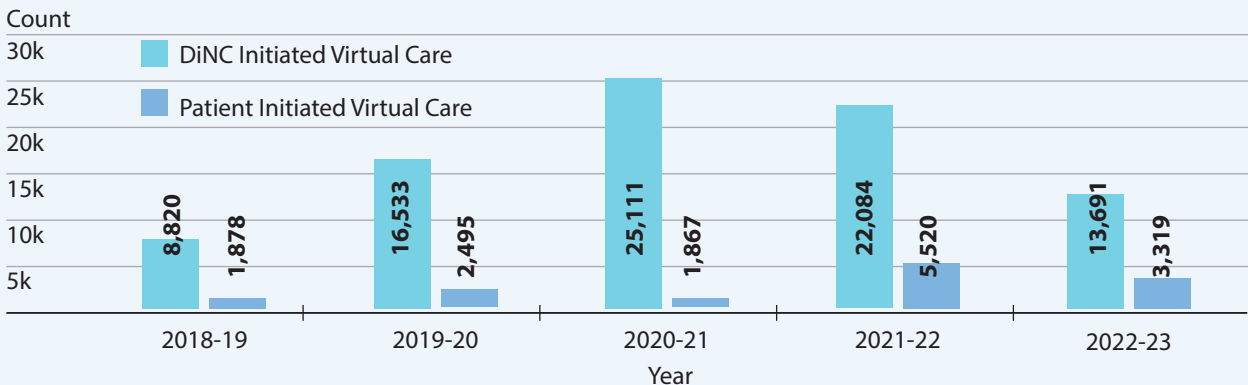
## Communicable Diseases with a Focus on Tuberculosis

DiNC network assists individuals suffering from communicable diseases like malaria, typhoid, and tuberculosis. In the battle against tuberculosis, the following services are offered:

i) **Scheduling Appointments:** DiNC's digital services help schedule patient appointments and patients are guided on the need to consult a doctor. When needed, they facilitate virtual consultations with the doctor. DiNC staff also resolve clinical and non-clinical queries.

ii) **Risk and Complication Assessment:** DiNC staff is actively involved in tracking adverse experiences and regularly monitors the vitals of the patients. Those with complications are urged to visit higher health facilities.

iii) **Counselling for Lifestyle Adaptations:** DiNC staff provides counselling to the patients with regards to healthy lifestyle practices, reduces misinformation in terms of adverse effects of medications, and makes patients aware of relevant government schemes.

iv) **Caregiver Engagement:** Due to the stigma attached to TB, concerning its transmissibility, DiNC staff also engage with other family members to provide sound counselling, and advice, and restore a healthy environment at home.

## Key Takeaways from Trends in DiNC Services and Utilisation

### Strengths

i) **Consistent Increase in the Utilisation of Maternal Health, Immunisation, RBSK**

**Counselling and Mental Health Services:** The in-person outpatient consultations and video consultations, both are showing an increasing trend. DiNC-initiated virtual care calls for follow-ups and counselling are likely to have a positive impact on care continuum practices, which can be exactly measured with studies using probability design.

ii) **High Coverage of Full Antenatal Check-Ups, Iron-Folic Acid (IFA) Supplementation, and Delivery Services:** Tata's internal monitoring survey reflects very high coverage of these key maternal health services. The extent of DiNC's contribution to these positive outcomes will again require further studies and more robust evaluations using probability design.

iii) **Serving as a Key Source of Non-Clinical Information for the Patients:** Although the proportion of inbound calls is lower compared to outbound calls, the data indicates consistent usage of inbound call services for information requests and counselling. To some extent, DiNC complements the functions of 104 toll-free health helpline i.e., Arogyavani-GoK, by serving as a source for medically verified guidance, information on government health schemes, and counselling services.

iv) **Proactive Efforts to Reach the Beneficiaries:** A significant number of outbound calls by DiNC personnel demonstrate proactive engagement offering counselling, follow-ups, treatment support, and addressing various queries. Although gauging the exact outreach in terms of the proportion of beneficiaries contacted remains challenging due to data limitations, nonetheless these efforts still hold significant promise (Houser et al., 2013). With a wider spectrum of CPHC services now being envisaged and each service necessitating

tailored follow-ups and counselling after initial ambulatory care, DiNC outreach can complement the efforts of primary health care teams.

v) **Focus on Health Promotion Along with Curative Care:** DiNC's virtual care is not only limited to curative aspects in contrast to typical teleconsultation interventions. The counselling provided by digi-nurses is comprehensive, following protocols and emphasising nutrition guidance and healthy lifestyle practices. The inclusion of Lamaze sessions introduces a wellness-centric approach to pregnancy. These efforts are essential for mitigating excessive medical intervention in care practices.

vi) **High Uptake and Information Support Through Virtual Care During the COVID-19 Pandemic:** DiNC served as a COVID-19 war room for the district and provided extensive support as a source of authentic information and bed management through inbound and outbound calls during the pandemic. The data suggests that during the pandemic period, virtual care peaked indicating positive usage of the DiNC system to meet the health care needs and queries during a time when access to health facilities had reduced.

**Challenges**

i) **Selective Package of Services and Lack of Data to Support Comprehensive Health Analytics:** Despite DiNC's substantial and significant contribution, the range of services provided does not encompass the full 12 essential package of services as envisaged for CPHC under Ayushman Bharat. Further assessment is required to determine how utilisation of services and

outreach might evolve with the expansion of services, and whether the current level of resources would be adequate to deliver an expanded package of care.

The absence of comprehensive data on the total number of registered beneficiaries limits the possibility of assessing the real-time coverage of these services and tracking patient outcomes.

ii) **Software Inadequacies:** While the system has been designed to capture patient data throughout his/her journey, data captured on HealthX is recorded in an unstructured manner making it difficult for the technical team to retrieve it. This makes it difficult to attribute improvements in health outcomes as per the requirements of standard public health indicators, to specific features of the DiNC initiative.

iii) **Duplicate Registrations:** Albeit with duplication, DiNC has registered the population of Kolar in its database. The one-time known citizen drive activity led by ASHAs was successful and helped in completing the population registry. However, for effective tracking of population coverage and health outcomes, deduplication would be a constant requirement. Registration is an initial stage of a patient's healthcare journey, and the more rigorous and comprehensive the initial patient identification process is, the lower the risk of subsequent duplication or misidentification. Inconsistent and incomplete patient registrations eventually contribute to poor data management and upkeep, a lack of interoperability, and inadequate EHRs.

iv) **Calls Capture Procedure:** From qualitative interviews, it was revealed that many service users contacted PCCs of respective health facilities directly, which is not accounted for in

DiNC's system. This could be the one reason for the fall in inbound and outbound calls. Similarly, citizens also engage with ASHA workers who in turn coordinate with a PCC to ensure smooth navigation through the patient journey. Such calls and coordination have made the lives of citizens easier but circumvent the DiNC's data capture mechanism. The system would need to be redesigned in a way that such calls are captured digitally to assess the complete impact of the DiNC initiative. This is also important from the perspective of quality control of calls.

v) **High C-section Rate:** While many efforts have been made to ensure a healthy lifestyle during pregnancy using regular counselling, follow-ups, and guidance, the C-section rate in the district was still quite high. Although as per NFHS-5, there is an overall trend of increase of the caesarean section in the country, the C-section rate in Kolar (53.14%) remains higher than the country average of 21.5% as well as the Karnataka average of 31.5%.

According to a study published in 2023, factors such as increased access to health systems, better education, higher incomes, perceived notions about the dangers of natural birth, and physician choice have contributed greatly to the rise in caesarean sections in the country. The odds of undergoing this procedure were seen to be higher in private facilities (Mohan et al., 2023).

A PCC assisting a pregnant mother at a health facility

## Chapter 5

# Perspectives from Service Users, Service Providers, and Programme Administrators

This chapter consolidates insights into the Digital Nerve Centre (DiNC) initiative from the perspectives of three primary stakeholders: the beneficiaries of DiNC services, the service providers at government health facilities and the nerve centre, and the programme administrators overseeing the key programmes. A total of 52 stakeholder interviews were conducted, and the invaluable and intricate insights gathered from these stakeholders have served to enrich our understanding of the strengths and challenges of the DiNC initiative.

### Service Users' Perspectives

Interaction with 19 service users, including pregnant mothers, caregivers of children in Rashtriya Bal Swasthya Karyakram (RBSK) services, Non-Communicable Diseases (NCD) patients, elderly individuals, and tuberculosis cases, provided valuable insights highlighting their

perceptions about the nature of the interaction between DiNC and patients, revealed the initiative's benefits and DiNC's role in supporting them throughout their healthcare journey. Each of these beneficiaries belonged to a low-income family and were Below Poverty Line (BPL) card holders.

#### i) A Relationship of Trust Between the PCC and the Service User

Participants were inquired about their knowledge of DiNC services and how they initially learned about them. All the service users are acquainted with DiNC through the Patient Care Coordinators (PCCs) present at the healthcare facility. These PCCs actively approached and helped them understand and access the services available at the hospital.

What stood out in their conversation was addressing

| Service user profile | Number of participants interviewed |
|---|---|
| Pregnant mothers (20-30 years) | 4 |
| Mothers of Rashtriya Bal Swasthya Karyakram (RBSK) beneficiaries | 7 |
| Non-communicable diseases (NCD) patients | 4 |
| Elderly individuals (55-65 years) | 2 |
| Tuberculosis (TB) patients | 2 |

the PCCs by their first names, signifying a strong sense of trust and bond developed with these coordinators. All of them expressed their appreciation for PCCs as someone who helped them seamlessly navigate the government health system. They also served as guides, providing information about the next steps in their healthcare journey.

A service user of DiNC who is receiving treatment for diabetes and hypertension in a nearby PHC said,

> **'For the last two years, I have been suffering from diabetes and hypertension. I was visiting a hospital near the market. For the initial two to three months, I did not recognise any person. Suddenly, Mr. Abdul (Name changed, PCC of DiNC) approached me. I did not know who this person was. He asked me, "What is your difficulty?" "What is your trouble?" I told him that I was suffering from diabetes, had fitness issues, and had been taking tablets for the last four years. He noted down all the problems and took me to the doctor. Through Abdul, I got to know about DiNC.'**

Another pregnant mother from Jayanagar in Kolar mentioned how Salma (PCC name changed) had called her during her early trimester. She appreciated that Salma would call her whenever her appointments were due and that she could easily connect with her to get clarifications about medications, appointments, or even scanning-related information.

### ii) Valuing DiNC's Support in Treatment Adherence

Service users also recognised the significant role played by DiNC coordinators, digi-nurses, and PCCs in promoting treatment adherence, whether it was for TB or for addressing severe anaemia among RBSK beneficiaries.

An old TB survivor (woman) interviewed, mentioned,

> **'Eight months back, I was diagnosed with TB and successfully got cured two months ago. Adhering to the daily medication was not easy... I developed a lot of stomach issues... but support from Salma (PCC) and regular calls from the centre nurses proved very helpful. They emphasised the importance of not skipping the medication and offered tips for maintaining good nutrition and exercise, mainly walking. They also informed us about the ₹500/month benefit for TB patients. I also received a monthly nutrition package containing jaggery, lentils and groundnuts...'**

Service users, particularly NCD patients, deeply rely on PCCs for appointment scheduling and medication needs, highlighting the vital role PCCs play for this group of patients. Regular calls from the DiNC centre reminded them of upcoming consultations and follow-up treatment for NCD.

A patient with hypertension, who retired from a private job three years ago and lives with his spouse, mentioned,

> **'In the middle of a month, I got a call from the coordinator asking me about my well-being, and if my BP was under control. Even my children don't bother to inquire like this...'**

### iii) DiNC – A Primary Source of Information for Migrant Pregnant Mothers

In rural areas, Accredited Social Health Activists (ASHAs) are the first point of contact for all pregnant mothers. Nevertheless, this connection can be disrupted in certain cases like when they migrate to urban areas, and the contact of the pregnant mother

with an urban ASHA does not materialise. In such cases, the calls handled by the DiNC and the care provided by the PCC become the primary means of information and support for them. One such first-time mother, who now has a 3-month-old baby, revealed the following,

> 'No ASHA worker met me during my pregnancy or the postnatal period. One ASHA worker was in my village. Our names as eligible couples were registered in her records. She would call me but was not of great support as we migrated to the town of Bangarapet. So, I relied solely on the calls from the DiNC akka (sister). She guided me on birth planning, nutrition counselling, delivery support, and postnatal care, including exclusive breastfeeding and immunisation for my child. Throughout my pregnancy, I would receive two calls in a month.'

**iv) Support in Accessing Services from Public Health Facilities**

Service users found it easier to navigate health facilities with the assistance of the PCCs who helped patients in doctor consultations, obtain medications, access diagnostic services, etc.  According to a pregnant mother who received care through DiNC,

> 'Without the help of the PCC, it would have been difficult for us to figure out processes at the hospital, like where we need to go, which doctor we must consult, and when we need to come for a follow-up.'

**v) An Essential Support for Caregivers**

The DiNC call centre played a vital role in helping parents of RBSK children understand their children's conditions and navigate hospitals. Despite

getting screened under the programme in schools and high school colleges, the necessary information wasn't adequately communicated to parents in these camps. DiNC got connected with these children and their families through the line list shared by the department, guided them for further treatment, and assisted in navigating health facilities through their PCCs.

A mother of a 6-year-old male child suffering from severe anaemia explained,

> 'Three months back we came to know that my son's HB levels were very low.  This was mainly through the PCC and PCM. They mentioned that my son would need a transfusion. They supported us throughout the process of blood transfusion and since then have been a constant support for me. They call me at least four times a month informing me about how to take care of his nutrition, like including beetroot, green leafy vegetables, meat, etc. in his diet.'

**vi) Wellness, Counselling Support and Follow-up Calls**

Participants noted that they received regular counselling through phone calls from the DiNC nerve centre, on dietary habits and medication usage. This counselling was tailored to everyone's condition and treatment regimen. For instance, parents of RBSK children with deficiencies like anaemia were advised to feed their children iron-rich diets, continue iron tablet intake, and be advised on the frequency of doctor consultations.

A participant studying in 12th standard was screened in her college by the RBSK team. Though the team told her that her Haemoglobin Concentration (Hb) was low, she did not care much. She went to consult the doctor only after receiving calls from DiNC.

'I got a call from Divya Madam (name changed), the coordinator of DiNC asking if I consulted a doctor due to low blood count. I said, no. She told me 5.4 gm is too low, it should be a minimum of 13 gm. She guided me to the hospital and gave me the contact number of Rajeshwari akka (PCC name changed). After coming here, the blood test was done again, and it was 8.5 gm. They counselled me to eat iron-rich foods and take iron tablets regularly. I regularly get calls from Divya Madam and Rajeshwari akka asking about my well-being.'

Participants shared that apart from helping in appointment scheduling, and dietary counselling, they also receive training for exercises.

'When we came to the facility and Tata people helped us in getting the treatment, we were not knowing anything. She took us to the doctor for a consultation. They also told me that, "even after 4 months of pregnancy, you have not made Thayi (Mother) card", and they facilitated the card. We get calls regularly from Tata akka (sister) regarding follow-up. She also asks about what kind of food we eat and tells us what to eat.'

**vii) Effects on OOPE**

Out-of-pocket expenditure (OOPE) in primary health care facilities would largely depend upon the status of free drugs and diagnostics services available in government facilities and on transport costs involved in reaching these facilities. Two patients shared their experiences on availing them.

One NCD patient, who is living in Kolar City and has been treated for his diabetes and hypertension for the last four years, came to know about DiNC two years ago and reported a decrease in OOPE due to the receipt of free medicines from government health facilities,

'Earlier I used to go to a private hospital where I was spending at least ₹200 to ₹300 per consultation and additional expenditure for medications. After I started visiting the government facility, I did not incur any expenditure... I got the medication required for one month free of cost. I get a refill whenever it is over.'

However, another elderly male patient noted that,

'While DiNC effectively manages appointment scheduling and follow-up care, I am spending approximately ₹500 per week on purchasing diabetes medications from private drug stores. Although PCCs did inform me about Jan Aushadhi Stores, I have encountered medicine shortages even at these outlets.'

This underscores the fact that, although initiatives like DiNC may boost the demand and utilisation of public health services, systemic inputs are necessary to guarantee the availability of basic things like drugs and diagnostics to meet this demand.

## Service Providers' Perspectives

A range of service providers, including ASHAs (04), Auxiliary Nursing Midwives (ANM) [2], Community Health Officers (CHOs) [3], staff nurses [2], PHC medical officers [4] and specialist doctors [2] were interviewed to ascertain their perspectives on how DiNC is supporting service delivery, their work, challenges, and potential adaptability solutions they feel are important to optimise the system for more effective health care delivery.

Lamaze session in progress inside a V-POD room at a health facility

### i) Ensuring Service Availability at PHCs in the Absence of Medical Officers

Patient Care Managers (PCMs) regularly update doctor availability across hospitals, from PHCs to district hospitals, via WhatsApp to the DiNC, primary care clinics, and district health administration. Based on this information for health facilities where doctors are not available, virtual consultations are planned to ensure uninterrupted care for patients.

One PHC medical officer said,

'To improve access to patient care, even when the PHC doctor is not available (like when we are here or somewhere outside for meetings or reviews), DiNC doctors conduct online consultations. Like today, the MBBS doctors are on a monthly review meeting. It is helping many people.

Most people come for consultation the next day and inform that they had received care through VC which did not waste their day.'

This was corroborated by the senior health officials who informed that virtual consultations help in addressing human resource challenges in the district and maintaining continuity of care for patients, especially on days when there are no doctors available.

### ii) DiNC is Useful in Follow-up and Tracking of Patients in Villages Without ASHAs

A CHO mentioned that in villages that do not have an ASHA worker, follow-up and treatment adherence for NCD, TB, and pregnant mothers get affected. However, calls and counselling by digi-nurses and coordination by PCCs are helpful in such situations.

### iii) Supports Both 'Forward and Backward' Referral Linkages

A CHO noted how the PCCs coordinate in ensuring treatment adherence. The CHO spoke about her experience upon being referred to a case for alcohol rehabilitation through the PCC network. She mentioned that in addition to referring a case, the PCC also notified her to follow up with the patient and ensure treatment adherence upon discharge from the rehabilitation centre.

### iv) DiNC Reinforces Key Messages and Helps ASHAs in Convincing Beneficiaries

Before DiNC's inception, ASHAs had the sole responsibility to coordinate with all ANC, PNC mothers, children to be immunised, etc. Now, pregnant women are also coordinated by DiNC and PCCs, complementing ASHAs' work and streamlining the process. Two experienced ASHAs expressed the same sentiment by quoting that DiNC has proven highly useful to them as it complements their efforts. Consistent messages about adopting appropriate behaviours, making lifestyle modifications, or seeking care—both from the ASHAs and DiNC—have significantly contributed to persuading patients to a behaviour change.

### v) DiNC is Particularly Valuable in Conditions that Increase the Risk of Social Stigma

For diseases associated with stigma like TB and mental illness, this initiative motivates the patients through phone calls, ensuring compliance with appointments and follow-up treatments. ASHAs also noted that individuals facing conditions susceptible to social stigma, such as mental illness, TB, or HIV/AIDS, feel more comfortable discussing their concerns privately and open up more readily with DiNC nurses. Additionally, in instances where ASHAs visit households without pregnant mothers or newborn,

the neighbouring community perceives that some member of the household is harbouring a serious or infectious disease, thereby increasing the risk of stigma. In such instances too, DiNC calls help in removing such doubts.

### vi) DiNC has Played a Role in Building Trust in the Public Health Care Delivery System

The ANMs interviewed noted that when individuals receive calls from DiNC to track their health status, inform them about appointments, or conduct follow-up calls, they perceive it as a sign of concern from government doctors. This reassurance greatly benefits patients and contributes to building trust in public health facilities.

A CHO from a DiNC-enabled SHC-HWC further confirmed this trust and emphasised that DiNC contributes significantly to enhancing its credibility within the community. She mentioned,

> 'When we refer a newly identified NCD case to the PHC, the PCC assists them, ensuring they receive confirmation of diagnosis and initiation of treatment. They also ensure the patient receives sufficient medication. This enhances people's confidence in our services, as they recognise our ability to efficiently coordinate care to support them in higher-level facilities...'

## Programme Administrators' Perspectives

The research team interviewed programme administrators such as the District Health Officer, District RCH, TB, NCD, surveillance and family welfare officers, and facility in-charges, enriching understanding of the DiNC from a systems perspective.

### i) Multifaceted Support to Health Care Delivery Amid Resource Constraints

Programme administrators appreciated the multifaceted nature of DiNC services ranging from coordinating appointments, intra-facility patient support, counselling, and follow-up care for important national health programmes being prioritised by the government.

Programme officers highlighted DiNC's contribution in multiple ways like an advance notification to parents for adhering to immunisation schedules reduces missed doses. A high uptake of inbound calls to DiNC's toll-free number for seeking information reflects trust and saves time and resources for the patients by confirming doctor availability and preventing unnecessary travel. Digital support streamlines patient navigation and queue management at facilities, reducing consultation and waiting times.

Additionally, DiNC is addressing service delivery gaps due to resource limitations, notably in essential areas like mental health treatment and counselling where specialist providers are limited in number. Virtual consultations with psychiatrists have expanded access to mental health care.

One of the senior district health officials expressed that,

> 'People call DiNC and check the availability of a doctor, get an appointment, and go to the hospital. So, the utilisation of public health facilities has improved. We have only one psychiatrist working at this hospital who is complemented by another psychiatrist at DiNC, who is treating patients through virtual consultations.'

### ii) Helps in Addressing a Key Constraint of Efficient Follow-up Care

Follow-up care is critical for patient well-being which in the opinion of one of the programme officers is the key constraint of the government health system. The programme officer mentioned that there is no way for them (programme officers) to verify if frontline workers and primary care providers carry out adequate follow-up with patients.

DiNC plays a significant role in follow-up care. For instance, it identifies pregnant anaemic mothers and offers them counselling on diet and further treatment, showcasing its proactive patient care approach. Similarly, for NCD and TB patients, DiNC ensures treatment adherence, parents are reminded to vaccinate their children and full immunisation coverage is ensured through programmes like Mission Indradhanush, where DiNC identifies and contacts parents of children who missed vaccinations.

A programme officer of immunisation explained that his team had provided the DiNC with a list of 14,000 immunisation dropouts for follow-up as part of Mission Indradhanush. He commended the DiNC's efforts which successfully brought back 7,800 children for the vaccinations they had missed.

### iii) Potential to Enhance Health Systems' Resilience Through Support for Infectious Disease Surveillance and Responding to Health Emergencies

Every programme officer interviewed, appreciated DiNC's contribution during the COVID-19 pandemic, showcasing a compelling example of the role of digital health initiatives in bolstering system resilience and aiding in responding to health emergencies and disease outbreaks.

During the pandemic, the DiNC was transformed into a central war room, effectively managing the crisis by coordinating counselling, overseeing bed allocations, and generating vaccination awareness, and documentation. With its toll-free number and comprehensive system, DiNC became the hub for all pandemic-related inquiries, awareness campaigns, and mental health counselling. It optimised bed management to allocate hospital resources efficiently and played a vital role in raising awareness for COVID-19 vaccination and ensuring appointment reminders, thus contributing to high COVID-19 vaccination rates. Additionally, its EHR system maintained accurate COVID-19 case records, crucial for tracking virus transmission and providing appropriate patient care. This showcases DiNC's adaptability and efficacy in handling healthcare emergencies.

A programme officer mentioned,

> 'During the COVID-19 pandemic, the centre worked 24 hours a day like a call centre. We used to get calls from all over. So, this is a adaptable intervention that can be adapted as circumstances change. If any health emergency occurs in the future, we can use the system for monitoring, surveillance, and care coordination.'

Another senior district health official appreciated the benefits of DiNC-led counselling efforts during COVID-19. The official mentioned the DiNC's usefulness in allotting beds and later in creating vaccination awareness. The DiNC also made reminder calls to vaccine-due beneficiaries.

One programme officer highlighted how she was leveraging DiNC data for surveillance activities,

> 'The data stored in the DiNC system is more trustworthy and accurate.

> For instance, when identifying individuals at high risk, such as those with NCDs like hypertension and diabetes, or for prioritising vaccination or COVID care, we relied on DiNC data instead of another government-supported application, which faces various accuracy issues.'

She highlighted the role of DiNC for the Integrated Disease Surveillance Programme (IDSP), in gathering data from private health facilities that normally do not report presumptive and laboratory-confirmed cases of reportable diseases as envisaged under IDSP.

### iv) Additional Benefits and Perspectives on Scaling the Initiative

Programme officers highlighted a significant advantage and benefit of DiNC of being a single portal for comprehensive health care management. They noted that currently the public health system is challenged by maintaining multiple, non-integrated government health portals for various programmes and services.

DiNC's patient health records module has been effectively deployed, for enhancing data management and follow-up services. Conversely, government portals lack integration, necessitating multiple logins for data entry.

The e-hospital OPD and clinical modules are underutilised due to time constraints and require additional human resources for operation. DiNC's focus on clinical aspects stands out compared to government applications, which include programme-based fields. Additionally, while the RCH portal provides detailed information from eligible couples to delivery, DiNC focuses primarily on consultation data.

A senior district health official noted,

> 'DiNC has a single portal where all activities can be seen. DiNC has a comprehensive module for each of the services provided. Our government portals are not compatible with one another, and we have multiple portals under various programmes.'

This was corroborated by another senior district health official, who said that the DiNC has been successful in the creation and management of PHRs. These health records aid in follow-up services.

Simultaneously, a medical officer appreciated the DiNC application for clubbing all services into one application. The medical officer mentioned that the presence of multiple government applications requires repeated log-ins in order to upload data.

One programme officer explained the advantage of DiNC over the eSanjeevani teleconsultation application,

> 'You see, in the eSanjeevani application, a token is generated when the CHO or a health provider enters the patient's chief complaint. The application then connects the health provider with a specialist or a doctor anywhere in Karnataka. There is no flexibility to opt for consulting with the doctor that they prefer or from the same district. This disrupts the continuity of care. In DiNC, patients have the option of speaking to the same counsellor and doctor they were connected to earlier, and video/teleconsultations are enabled with doctors and specialists within the same district, who are more familiar with the local health systems context. Each patient is tagged to a health facility close to their residing area. I feel this is a big advantage…'

All stakeholders consulted or interviewed during this study, endorsed scaling up this initiative due to its numerous highlighted benefits.

On exploring its cost-effectiveness, considering investments in human resources such as PCCs and PCMs, and establishing the DiNC hub, a district programme officer with six years of experience noted,

> 'The data stored in the DiNC system is more trustworthy and accurate. For instance, when identifying individuals at high risk, such as those with NCDs like hypertension and diabetes, or for prioritising vaccination or COVID care, we relied on DiNC data instead of another government-supported application, which faces various accuracy issues.'

### v) Challenges and Ideas for Adapting the DiNC System

Finally, those who were interviewed also shared certain challenges and ideas for increasing the adaptability of the DiNC initiative, which are as follows:

a) **Turnover of PCCs:** PCCs are at the fulcrum of this digital initiative however the turnover of PCCs or PCCs handling multiple PHCs leads to disruptions in services and breakage of rapport with citizens. After examining this issue through interviews with DiNC staff, it was found that PCCs who leave the organisation frequently find better prospects elsewhere because of the enhanced abilities they have acquired from DiNC training. Medical officers emphasised that the sudden change of the PCC causes inconvenience, as the previous coordinator would have developed a good rapport with citizens. The incumbent coordinator may take time to establish a similar rapport.

Patient Care Coordinator assisting patients as a health facility

b)  **Need for Integration with Other Health System Applications:** There is a need for better integration with other digital systems, which can help to improve compliance and streamline processes, especially in hospitals. For example, the information on children screened under the RBSK programme is shared with DiNC over Microsoft Excel periodically, which is then uploaded to the worklist of DiNC for further counselling and follow-up.

c)  **Improve Communication Between the DiNC Team and the Programme Officers:** A senior programme officer emphasised the need to enhance communication between the DiNC management and programme officers, to facilitate better activity planning and identification of areas where DiNC can more effectively support key national health programmes. DiNC currently does not collect population-level data crucial for monitoring and tracking the progress of national health programmes. Typically, the health department and specific programme officers provide an updated list of beneficiaries to DiNC to enable counselling and follow-up care. She said,

'There are no reports shared by DiNC with us that can help in understanding the proportion of beneficiaries that have been reached by the DiNC system and what has been the progress on outcomes for these beneficiaries.'

d)  **Patient Self-registration Application:** Currently, patients have access to DiNC information only while visiting a government hospital and not from the convenience of their home. With a self-registration app, the patients would be able to avail services themselves and access their records at home.

e)  **Expand DiNC to SHC Level:** All primary care providers highlighted the need to expand DiNC to the level of SHC- HWCs.

f)  **Module to Cover Emergency Care:** Service providers mentioned that DiNC can play a greater role in managing emergency cases and injuries, which is currently not the case. CHOs and ASHAs we interviewed mentioned that prompt care and additional support are necessary for patients requiring emergency care.

## Summary of Themes from Stakeholder Interviews

Interviews with the three key stakeholder types provided valuable insights about the strengths, challenges, and potential options to consider for the scale-up and strengthening of the DiNC system.

First, for the patients and service users, the initiative helps in several ways by providing information, scheduling appointments, ensuring treatment adherence, counselling, and most importantly support through follow-up care. PCCs personal rapport with the service users is clear and points towards a responsive delivery of services. DiNC also adds value through its immense support to caregivers, especially those at high risk, through more intense and continued counselling support.

Second, DiNC presents numerous benefits to health providers. It serves as valuable complementary support to frontline workers in health promotion, particularly in counselling for illnesses associated with stigma. Moreover, it helps in enhancing follow-up and coordination to improve service accessibility. It enhances their credibility by ensuring assured care when patients are referred to higher facilities. Within health facilities, PCCs offer two-way support to both health providers and patients through well-coordinated communication, improved documentation, and navigating care.

Thirdly, on a systems level, DiNC emerges as a valuable initiative and a crucial add-on for delivering care amid manpower limitations. It serves as the main source of information, providing counselling, follow-up, and facilitating care access for migrant pregnant mothers who do not have access to an ASHA. Similarly, it ensures continuity of care even in the absence of doctors at PHCs and broadens access to care options through virtual consultations for patients. It has also been appreciated as a single unified platform offering multiple services of MCH, NCD, TB, and mental illnesses, which is an advantage over several other fragmented and vertical programme-oriented applications. DiNC also emerges as a useful initiative for building health systems resilience during emergencies and support in surveillance activities.

Finally, the suggestions from programme officers about enhanced communications with district programme teams, phased scale-up, and options for replicability and integration with other digital applications are all useful and can be considered for adoption by the DiNC team.

ASHA workers carrying out door-to-door visits and creating citizen records on HealthX application

# Chapter 6

# Effects of DiNC in Kolar

The Digital Nerve Centre (DiNC) initiative in Kolar represents a pioneering approach to health care delivery, leveraging technology, human resources, and seamless integration of physical and digital infrastructures. This chapter summarises the positive impact created by DiNC in Kolar, providing a holistic view of the strengths illustrated by the initiative.

i. **Increased Access to Care and Increased Service Utilisation:** By redefining roles, services, and task delivery, DiNC significantly increases access to healthcare for clients. Innovative infrastructure like Virtual Pod (V-POD) rooms enables remote care access in the absence of doctors or for specialist consultations. Patient Care Coordinators (PCCs) at health facilities provide support to patients by helping them schedule appointments and follow-ups and navigate complex procedures at health facilities leading to minimised waiting times and prompt doctor consultations. Digitally empowered under the DiNC, PCCs help doctors with many of the administrative tasks, enabling doctors to see more patients in a day. Facilitating timely and hassle-free consultations at health facilities has increased service utilisation and re-instilled citizens' faith in the public health system.

ii. **Seamless Integration of Physical and Digital Elements:** Several features of DiNC enable seamless integration into the public health system from Primary Health Centres (PHCs) to tertiary care facilities of the government. This ensures a care continuum, facilitating efficient care coordination and follow-up. A common gap frequently witnessed in the public health system is the absence of efficient follow-up care. Virtual care features, including video consultations and outbound calls for follow-ups, lifestyle modification adherence, treatment plan compliance, counselling support, and appointment reminders, have strengthened the connection between healthcare providers and patients.

iii. **Streamlined Processes for Healthcare Providers:** HealthX captures, analyses, and manages medical information, providing features such as appointment reminders, basic screenings, virtual consultations, and instant messaging providing real-time insights to patients, doctors, and PCCs. Additionally, the Concentric Data Repository (CDR), consolidates data from multiple healthcare units, providing a comprehensive view of patient's medical records for robust clinical assessments. It efficiently integrates information from various sources without disrupting previous aggregations, handling large data volumes while ensuring transformation and standardisation. Compliance with the Ayushman Bharat Digital Mission (ABDM) standards underscores DiNC's commitment to maintaining high standards of patient information security and privacy.

iv. **Enhanced Quality of Care and Health Promotion Activities:** PCC-enabled processes of care coordination and navigation have been instrumental in enhancing public health care utilisation. PCCs at health facilities help patients through multiple complex procedures including assistance with doctor consultations, obtaining medicines, accessing diagnostic services, etc. The initiative ensures high-quality virtual healthcare through adherence to standard clinical protocols personalised to individual patient needs. The counselling provided by digi-nurses emphasises nutritional guidance and healthy dietary choices, thereby encouraging health promotion along with curative care. DiNC's inbound call feature has often been used by citizens for informational requests showcasing its role as a key source of non-clinical information.

v. **Potential advantages of the DiNC:** The DiNC is a unified platform accommodating diverse services and programmes with the ability to add new modules. DiNC covers different national health programmes like Reproductive and Child Health (RCH), Non-Communicable Diseases (NCDs), mental health, tuberculosis (TB), etc, and integrates functions of eSanjeevani and e-Hospital. This helps the initiative minimise costs associated with the provision of newer services with time. The centralised data management application and virtual care consultations by DiNC enable care coordination, demonstrating the potential to lower out-of-pocket expenses (OOPE) for patients by minimising the need for multiple visits to health facilities and reducing travel costs.

vi. **Augmentation of National Public Health Schemes and Efforts:** DiNC has consistently increased the utilisation of maternal health, immunisation, RBSK counselling, and mental health services. Both in-person outpatient consultations and video consultations show an increasing trend, with virtual care calls for



A PCC advising a citizen post consultation

follow-ups and counselling positively impacting care continuum practices. The Tata MD internal monitoring survey reflects high coverage of key maternal health services, including full antenatal check-up, Iron-Folic Acid (IFA) supplementation, and delivery services. The proactive efforts by DiNC personnel through outbound calls offering counselling, follow-ups, treatment support, and addressing queries ensure comprehensive patient engagement and support various public health programmes.

The above features highlight the myriad ways in which the DiNC has reformed and strengthened Kolar's public health system. Its ability to increase accessibility, affordability, and service utilisation, provide timely and responsive services, ensure a continuum of care through regular counselling, and enhance the acceptability of national health programmes, are all noteworthy attributes showcasing the potential impact of scaling up and expanding the initiative. Additional manpower costs at health facilities seem relatively modest and affordable, considering the range of services provided by them. Simultaneously, the DiNC's contributions to the district's COVID-19 response activities demonstrate its capacity to establish robust health systems for the future, especially during a health crisis. These accomplishments illustrate how the initiative is positioned to make substantial contributions to the broader health landscape of the country.

DiNC doctor speaking to a citizen using the virtual call feature

# Chapter 7

# Recommendations

Based on the opportunities identified in the preceding chapters, below are specific recommendations that could enhance the existing Digital Nerve Centre (DiNC) initiative and build on its strengths.

## i) Physical/digital Infrastructure and Technology Stack

a) **Expand the physical and digital infrastructure to Sub Health Centre-Health and Wellness Centres (SHC-HWCs)** to allow end-to-end coordination between health facilities, ensuring a continuum of care and a time-to-care approach. This will allow Comprehensive Primary Health Care (CPHC) access within 30 minutes for citizens. SHC-HWC connect would also facilitate improved citizen registration and a seamless patient handover for follow-up by primary care teams.

b) **Enhance software capabilities** to provide comprehensive and robust health analytics for various services targeted by the DiNC initiative.

c) **Develop service modules based on facility types** from SHC-HWCs to tertiary care facilities to capture structured data on services and standard indicators monitored by the government for the several national health programmes: Reproductive and Child Health (RCH), Tuberculosis (TB), Non-Communicable Diseases (NCDs), National Mental Health Programme, etc.

d) **Streamline the call capture procedure** to ensure that all inbound and outbound calls to and from the nerve centre are recorded accurately within the digital application. Implement a system to account for calls received directly by Patient Care Coordinators (PCCs) from citizens or Accredited Social Health Activists (ASHAs) to ensure they are captured by the DiNC.

e) **Increase collaboration between the Department of Health and Family Welfare, Government of Karnataka (DoHFW, GoK)** and the Tata Medical and Diagnostics (Tata MD) team to integrate and reduce duplication with other digital applications used by the government, such as the RCH portal, CPHC application, and eSanjeevani platform.

## ii) DiNC Services

a) **The Tata MD team can consider gradually expanding the current package of services** being covered by DiNC to include the 12 essential services mandated under Ayushman Bharat. This expansion can be carefully planned with an assessment of the resources required to fulfil the outreach, health prevention, and promotion needs for comprehensive care.

b) **DiNC can play a pivotal role in emergency response:** During the pandemic, DiNC effectively managed the crisis as a COVID-19 war room and maintained accurate case

records. This showcases DiNC's adaptability and efficacy in managing emergencies and injuries, reinforcing its potential for expanded roles.

## iii) Citizen's Welfare

a) **Prioritise patient rights and safety in health records:** While the DiNC initiative is Ayushman Bharat Health Account (ABHA) compliant, further enhancements can ensure citizens have access to their electronic health records. Service providers, including doctors, PCCs, and DiNC personnel, should always obtain patient consent before accessing personal health records. Additionally, patients should be able to self-register on the platform.

b) **Enhance continuity of care:** DiNC should make suitable arrangements in the absence of PCCs and increase the frequency of outbound calls from DiNC in periods of disruption. Additionally, DiNC must fill vacant positions with backup PCCs and train existing PHC-level staff to handle PCC roles temporarily. For PCCs handling multiple PHCs, DiNC should evaluate their workload and deploy additional resources as necessary.

## iv) Stakeholder Management

a) **Encourage health service providers to utilise HealthX:** Change management workshops should focus on integrating medical officers and specialists into the digital framework, encouraging them to use HealthX during consultations to update patient records and review health history.

b) **Strengthen communication with programme officers:** Enhance coordination and communication between DiNC management and programme officers to facilitate better activity planning and identify areas where DiNC can more effectively support key national health programmes.

## v) Monitoring, Learning, and Evaluation

a) **Establish a dedicated monitoring, evaluation, and learning (MEL) team:** The MEL team should focus on continuous learning and adaptation to enhance the system. They should help set clear objectives, collect requisite data, and develop monitoring plans. Key focus areas for the team should include:

- Regularly update population registrations to minimise duplications.

- Adjust the digital software to provide better health analytics and assess health service utilisation and coverage.

- Generate standard public health reports in line with HMIS or other national programmes.

b) **Conducting effectiveness evaluation:** The current study used a descriptive design to understand whether DiNC is enabling the expected changes. Further, to establish the impact of the DiNC initiative on health outcomes, effectiveness evaluations are required. This will provide insights into how the observed changes compare with those that would have occurred without DiNC.

c) **Implementation research study:** Planning for a scale-up of DiNC would benefit from a robust implementation research study that can help understand the behaviour of practitioners, programme staff, service users, and policymakers. The study should evaluate the context and factors that

affect implementation, describe how the initiative was operationalised across different health facility levels, and analyse factors impacting its performance, sustainability, and learning outcomes.

d) **Perform replication and sustainability analysis:** This analysis will provide insights into scalability by detailing various digital health models in India's health care ecosystem, their advantages, and potential overlaps with other initiatives. Studying ground-level barriers to implementation will ensure that challenges relating to sustainability are addressed.

e) **Conduct a cost-effectiveness study:** A detailed cost-effectiveness analysis will help understand the feasibility of replicating and scaling up the DiNC initiative.

# The Way Forward

Digital health is a blessing for India, envisioning a future where citizens can access basic health services from the comforts of their homes through smartphones and other digital devices, thus revolutionising health care delivery. India is one of the few countries where the potential of digital technologies has been successfully explored in the provision of key public services.

The Ayushman Bharat Digital Mission (ABDM), is a foundation for India's digital health ecosystem. Its aim to create an integrated digital health system is guiding the country's journey towards improved accessibility and efficiency in the healthcare sector. Digital innovations have enabled remote populations to access advanced care, streamline administrative processes, and enhance care coordination through real-time health analytics and data management.

India's national telemedicine service, eSanjeevani, has shown immense potential by delivering virtual care to rural areas through Sub Health Centre-Health Wellness Centres (SHC-HWCs), enabling over 18.9 crore consultations as of December 2023 (PIB, 2023). The COVID-19 pandemic has accelerated the adoption of digital health technologies, underscoring their role in reaching inaccessible regions. With a growing focus on ABDM and digital health integration, India must ensure equitable adoption across regions to address emerging health issues, with a focus on reaching remote and marginalised populations like tribal communities, who bear a disproportionate burden of communicable diseases

like malaria and tuberculosis. India faces a dual burden of communicable and non-communicable diseases, necessitating a robust digital infrastructure that can provide real-time insights into citizens' health concerns and ensure timely responses to health crises. Such interventions are crucial to build sustainable and resilient health systems.

To speed up the progress in building the necessary digital health infrastructure, many public-private partnerships have sprouted in parts of India, which illustrate the benefits of digital technologies in health care. The National Health Authority (NHA) can serve as an anchor, guiding private IT and health care players in developing unified health interfaces (UHIs), to ensure integration, interoperability, and standardisation of data storage and management practices.

This report has highlighted one such public-private initiative in the digital health care space. Tata Medical and Diagnostic's novel initiative, namely the Digital Nerve Centre, has been operational in the Kolar district, Karnataka since 2017. The initiative, through its various virtual care features, has led to reduced waiting times, increased utilisation of public health facilities, improved care coordination through a network of digital, physical and human resources, and promoted preventive health behaviour amongst citizens of Kolar through regular counselling, follow-up, and lifestyle-related guidance. It is through partnerships like these that the government can expand the adoption of ABDM,

and make a nationwide integrated digital health system a reality.

Apart from innovation and roll-out of modern health technologies, relevant stakeholders must keep in mind related domains that would require focussed attention. Digital technology can be a means to make access to healthcare more inclusive, equitable, and gender-friendly. One of the foremost concerns should be to reduce the digital divide between the rich and the poor, men and women, as well as the youth and the elderly. By embracing the growing reliance on smartphones and inducing smartphone usage among vulnerable communities like women and the elderly, India can empower these individuals to take charge of their health decisions.

By optimising the benefits of technology, India can accelerate its journey towards universal health coverage (UHC). Telemedicine initiatives like eSajeevani can play a pivotal role in reaching rural, remote, and marginalised populations at lower costs while reducing the need for physical travel. The widespread adoption of Electronic Health Records (EHR) can streamline patient management and facilitate better coordination across healthcare providers and facilities. Technology enhances monitoring and surveillance, allowing more efficient resource allocation and decision-making. With a vast amount of health data available digitally, both providers and citizens can make more informed decisions, thereby creating a more citizen-centric health system. The ABDM is crucial in this context, as it envisions a completely digital health ecosystem aimed at providing accessible, affordable, and high-quality care to all.

To boost the adoption of ABDM and other digital schemes, efforts are needed to raise awareness among citizens that addresses their concerns and reservations effectively. Strict implementation of data privacy laws and regulations, considering the sensitive nature of patient data, can ease citizens into the digital framework. This entails specifying the forms and the extent to which the patient health records are accessible to healthcare professionals. Campaigns and workshops for citizens can help increase awareness about user authorisation and consent management practices.

By addressing these challenges, India can advance towards a fully digitised health sector, enhancing accessibility and affordability. Digital technology can empower individuals to engage more actively in making their healthcare choices, improving overall well-being. Real-time national health indicators will enable targeted policymaking to address system gaps and emerging health issues, crucial amid global pandemics and climate impacts. Digitally transformed health systems can propel India towards SDG achievement, setting a global benchmark.

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# Appendices

## Appendix - A

## Ethical Clearance Certificate

The study was approved by the ACE Independent Ethics Committee, Bengaluru, on 12 January 2024. The committee is registered under the Drugs Controller General, India (DGCI)- Registration Number- Validity: ECR/141/Indt/KA/2013/RR-19 valid till 19 December 2024. Department of Health Research Certification No.: EC/NEW/IND/2021/KA/0005

A snapshot of a section of the approval letter is attached below, entailing details of the study, documents submitted, and date of approval.

### ACE Independent Ethics Committee

DCGI Reg. No. ECR/141/Indt/KA/2013/RR-19

To

Sankala Foundation,
201, 2nd Floor, Block B,
Somdutt Chambers 1,
Bhikaji Cama Place,
New Delhi-110066

**Subject:** Ethics Committee approval letter.

**Study Code.:** SF001

**Protocol Title:** Rapid Assessment of the Digital Nerve Centre (DiNC) in Kolar District of Karnataka.

**Dear**

The ACE Independent Ethics Committee, Bangalore reviewed and approved above mentioned study on 12-Jan-2024.

The following documents were reviewed and approved during the meeting:

1. Research Protocol
2. UNDERTAKING BY THE INVESTIGATOR; [Signed: 8-Jan-2024]
3. CV of Investigators with qualifications and experience
4. GCP Certificate of Team members
5. GCP_
6. Questionnaire
7. Inform consent document (English)
8. Inform consent document (Kannada)

# In-depth-interview Guides for Different Stakeholders

## Consent Form

Greetings! Thank you for taking the time to speak with me today. My Name is _____, and I am a researcher working for Sankala Foundation on a research study to assess and comprehend the DiNC initiative's functionality, utility, and the value it adds to both service users and health systems. Today, we request 45-to-60 minutes of your time to understand your perspectives about the DiNC and gather findings related to your experience with the initiative.

Before starting the interview, note the characteristics of the interviewee and the date/time of discussion below.

| | |
|---|---|
| Name: | Date ___/___/_____ |
| Institution Name: | Time of Interview: |
| Designation: | Contact Number |

Please be aware that participation in this study is entirely voluntary. If you decide to participate, you may stop participating at any time and decide not to answer any specific question. We will maintain strict confidentiality of the information collected and your identity will not be revealed to any member outside the research team. We will remove all identifying information prior onward sharing of the interview details.

Do we have your verbal consent to ask our questions:   Yes ☐     ☐ No

The research team would like to record the interview to ensure the comprehensibility of the data collected. Please be advised that only the research team will listen to the recording, which will be stored in a secure platform and destroyed once analysed.

Do we have your verbal consent to record this interview:   Yes ☐     ☐ No

If you have questions regarding the study or your rights as a participant, please do not hesitate to contact ------------------------------------------------------------------------------------------

**Signature**

# Interview Guide for DiNC Technology Experts
**(Product Development Team, Delivery Managers, Software Team)**

## Background Information

1. Please introduce yourself and briefly describe your roles and responsibilities in the development and deployment of the DiNC product. (Probes: years of experience, current position, etc.)

## Features of DiNC

2. Please describe in detail the DiNC initiative. (Probes: need for development, key health issues it addresses; platform of the initiative, user interphase, etc.)

3. What are the key features of DiNC initiative? (Probes: different services it caters to, reliability, dependability, robustness, security, interoperability, and usability)

4. Can you walk us through the patient workflow?

   - Patient initiation process (entry point to DiNC system)

   - Care-seeking processes and follow-up services.

   - Referral pathways

   - Ensuring treatment adherence

   - Patient feedback system

5. What is your approach to quality assurance?  (Probes: handling patient flow, handling patient data, consultations, prescriptions, follow-up care, etc.)

6. Can you describe the strengths and weaknesses of the DiNC initiative? (benefits for users and health system, economic aspects, etc.)

7. What are the major challenges that you have faced if any during the implementation of the DiNC system and how did you overcome these challenges?

## Resources Required

8. Can you briefly describe the resources (IT infrastructure, human resources, other infrastructure, internet connectivity, etc.)  required for rolling out DiNC at various levels?

## Transition and Sustainability Plans

9. What are your plans or suggestions for transitioning the initiative to the local health systems and sustainability? (Probe: Experience with transition planning, sustainability dialogues, and foreseen sustainability concerns)

## Concluding Thoughts

10. Is there anything else you would like to add or any additional insights you would like to share regarding DiNC specifically?

**Thanks for participating in this interview today. We appreciate your time.**

# Interview Guide for DiNC Implementation Team
**(Care Coordinators, Service Providers running the DiNC centre, ANM/ASHAs)**

## Background Information

1.  Please introduce yourself and briefly describe your roles and responsibilities in implementing DiNC initiative. (Probes: years of experience, current position, etc.)

2.  Can you describe the process and your experience in delivering services using the Digital Nerve Centre initiative's system?

## Benefits of the Digital Nerve Centre Initiative

3.  In your opinion, what are the main advantages of the Digital Nerve Centre in terms of patient care?

4.  Has the system improved the quality of care provided to patients? If yes/no Can you briefly describe with an example(s)?

5.  Have you noticed any improvements in the delivery of health services?

## Challenges and Concerns

6.  What are the challenges that you have encountered in providing services through the Digital Nerve Centre?

7.  How do you think these challenges can be mitigated or resolved?

## Potential Initiative Adaptations

8.  Based on your experience, are there any modifications or additions you would recommend to optimising the system for health care delivery?

## Concluding Thoughts

9.  Is there anything else you would like to add or any additional insights you would like to share regarding DiNC specifically?

**Thanks for participating in this interview today. We appreciate your time.**

# Interview Guide for DiNC District Health Systems Administrators

**(District Health Officer, District Programme Officer, District RCH/NCD/TB Officers, Health Facility in-charges from PHC/CHC/TLGH/DH)**

## Background Information

1. Please introduce yourself and briefly describe your roles and responsibilities in implementing DiNC initiative? (Probes: years of experience, current position, etc.)

2. What motivated the implementation of the Digital Nerve Centre initiative in the district/facility?

3. Can you describe the resources required for the implementation of this initiative at the facility/district level? (HR, IT equipment, other facilities, etc)

## Benefits of the Digital Nerve Centre Initiative

4. From your perspective, what are the broader benefits of the Digital Nerve Centre for the health system in Kolar?

5. How has the initiative influenced the health care delivery in the region/facility?

6. Have there been any notable improvements in health outcomes, cost savings, or resource efficiencies because of the system?

## Challenges and Concerns

7. Can you identify any systemic challenges or concerns that have emerged since the implementation of the Digital Nerve Centre initiative?

8. How are these challenges being addressed at the administrative level?

## Potential Initiative Adaptations

9. What are the potential adaptations or enhancements to the Digital Nerve Centre initiative you envision for better integration into the broader health system in Kolar?

## Concluding Thoughts

10. Is there anything else you would like to add or any additional insights you would like to share regarding DiNC specifically?

**Thanks for participating in this interview today. We appreciate your time.**

# Interview Guide for DiNC for Beneficiaries
**(Patients/Service Users/Caregivers)**

## Background Information

1. Please introduce yourself and can you briefly describe the health condition for which you have sought care recently from the DiNC?

2. Can you describe your experience in receiving care through the DiNC platform?

3. Has the system helped to improve the health care-seeking experience? If yes/no, can you briefly describe it with an example?

## Benefits of the Digital Nerve Centre Initiative

4. Can you share specific instances where the system has positively affected your health outcomes?

5. How has the system improved your access to health care services? (probe: OPD consultation, waiting time, easy referral, follow-up, etc)

## Challenges and Concerns

6. Have you faced any difficulties or concerns while accessing care through the DiNC initiative?

7. How would you suggest addressing any challenges you have encountered?

## Potential Initiative Adaptations

8. Are there any features or improvements you would like to see in the DiNC to enhance your experience?

## Concluding Thoughts

9. Is there anything else you would like to add or any additional insights you would like to share regarding DiNC specifically?

**Thanks for participating in this interview today. We appreciate your time.**

## Appendix - C

### User Roles and Access under the DiNC System by Levels of Care

| Level of Care | Personnel | DiNC Access and Role | | |
|---|---|---|---|---|
| | | User Level | Access | Roles |
| Community | ASHA/ANM | ASHA | Android Tablet/Mobile | • Citizen drive<br>• Update case details/scan health records/upload audio<br>• Request hospital/virtual appointment/submit assessment |
| Facility (PHC, TH, DH) | DiNC Coordinators<br>Patient Care Coordinator<br>Patient Care Manager | Remote Health Care Admin (RHC) | Web Portal | • Register patient<br>• Create/update case details<br>• Upload health record<br>• Link family members<br>• Request DiNC Service for MC3, FTAS, VC, NCD, MH) |
| DiNC | Assigner | Nerve Centre Assigner | Web Portal | • Assign cases to respective Nerve Centre Doctor |
| DiNC | Nerve Centre Doctor<br>Nurse | Nerve Centre Doctor | Web Portal | • Prepare case, tag comments<br>• Close/reject case<br>• Add care member<br>• Instant<br>• Book hospital/virtual appointment |
| DiNC | Specialist/General Practitioner | Specialist | Android Tablet/Mobile and web portal | • Prepare case. Tag comments<br>• View/upload documents<br>• Conduct virtual consultation<br>• Add care members<br>• Cancel/close case |
| Facility level | Patient Care Coordinator | Patient Care Coordinator | Kiosk/Web Portal | • KIOSK-based appointment booking and confirmation.<br>• Other features as in the ASHA app |

## Appendix - D

### Additional Tables and Figures from Cost Analysis

**Table 1:** Facility-wise costs - A disaggregated view of annual costs at the facility level

| Health facility | Capital costs (IT infrastructure)* | Capital costs (Physical infrastructure)* | Operational costs (Salaries only)[3] |
|---|---|---|---|
| PHC | 12% | 4% | 84% (1 PCC) |
| CHC & TH | 6% | 2% | 92% (1 PCC + 1 PCM) |
| DH | 6% | 2% | 92% (2 PCC + 1 PCM) |

**Graph 1**

### Overall Capital Expenditure
**(categorised by Physical and IT infrastructure investments)**

Physical infrastructure

33%

67%

IT infrastructure

---
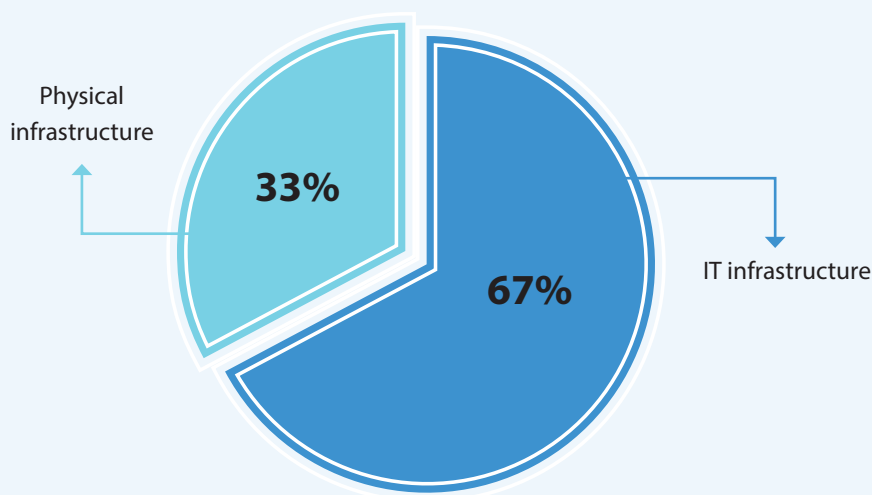
[3] In the above table, we include only salaries in the operational costs at the health facility level as these facilities are run by the government of Karnataka's Health department, who bear the rest of the operational costs.

## Appendix - E

**Layout of the Digital Nerve Centre (DiNC) at the DHO Office Premises**

Main Door

Reception Area

Conference Room

Digital Nerve Centre

VPOD

VPOD

Server Room

Gents Washroom

Ladies Washroom

Store Room

sankala

Voice for a sustainable planet